Walden University

College of Health Sciences

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Jennifer E. Lewis

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Walden University

2020

Abstract

Microvascular Disease and Chronic Kidney Disease in Persons With Diabetes in Grenada

by

Jennifer E. Lewis

MPH, St. George's University, 2011

BA, University of South Florida, 2008

Doctoral Study Submitted in Partial Fulfilment

of the Requirements for the Degree of

Doctor of Public Health

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November2020

Abstract

Chronic kidney disease (CKD) is a set of pathophysiological reactions that impact the functionality of the kidney. The association between microvascular disease (MVD) and CKD as it relates to diabetes is important to the evaluation of organization effectiveness in hospital services planning as well as improving health outcomes. The purpose of this quantitative, cross-sectional study was to determine if there is an association between MVD and CKD severity in persons with diabetes. Using the socioecological model, the association between gender, age group, cigarette smoke, cigarette smoke frequency, alcoholic drink, alcoholic drink frequency, hypertension, albumin-to-creatinine ratio (ACR) severity, cholesterol, sickling (i.e. persons with sickle cell disease),and MVD was examined. Across-sectional data analysis, using secondary data from 2013 to 2017 (N = 775) in the Grenada medical records department, was used to identify associations of CKD status in persons with diabetes over the age of 16 years old. The relationship between the study predictors and the outcome variable was analyzed using chi-square tests and binomial logistic regression. The key findings showed drinking and hypertension were the only significant predictors of CKD severity. The social change implications of this study will not only benefit health care professionals but also the community by assisting in the, enhancement of national guidelines and public health policy, and the implementation of programs aimed to improving risk factors that have been shown to reduce CKD outcomes in Grenada.

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Dedication

This work is dedicated to my heavenly father, God, who has kept and strengthened me during my studies. Without him, it would not have been possible to take on the energy required to complete this program.

This body of work is also dedicated to all public health practitioners within the Caribbean who desire to make a positive impact and devoted to improving the overall health and well-being of the people of Grenada.

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I must first thank God for redirecting my study path to public health, opening the way for finances, encouraging me through the Word of God, and entrusting me with the necessary wisdom to execute the entire process of this program. For without His continued strength it would not be possible for me to finish this program. To Him be all glory and praise to be given.

To my family, friends, and loved ones, who desire see me improve myself and to be truly be happy. To my husband, who has been with me during some the most trying times of my life and encouraging me to keep pushing forward to my dreams placed in my heart by God, despite health or tiredness, to keep moving forward to pass the finish line. For providing the emotional support that is needed to get through such rigorous program, I will forever be thankful. To my parents, I thank you for standing by me with my decision to move to Grenada to conduct this research for my doctoral program and for always pushing me to keep my eyes at the light at the end of the tunnel, the graduation day. Thank you for being there for me and being my biggest cheerleaders.

The medical records staff and hospital administrators of Grenada. I used the assistance of the staff to locate and obtain the data for this study. You all made it possible to obtain the raw data and materials I needed to make this study worthwhile. You also provided platform for which this topic can be discussed and open channels of communication for potentially further studies on policies that can improve health outcomes among my study participants. Thank you very much.

My former chairs, Dr. Amy Thompson and Dr. Amany Refaat, and current chair, Dr. Nancy Rea, went out of her way to ensure that I succeeded in this process. Your guidance was second to none, with the calls and emails. Committee member, Dr. Srikanta K. Banerjee, thank you for your added input, it brought value to the entire process. Your responses were timely, accurate, value adding, and very informative. Thank you so much. I am also grateful to the director of DrPH, Dr. Nancy Rea, and Dr. Michael F. Furukawa whose input in this work made it what it is today.

Finally, I wish to thank all my lecturers in all courses in the DrPH program. You all worked in tandem to help me reach to this point in my public health career. You have helped improve on my understanding of the public health practice and encouraged me to be a social change maker for current and future public health issues. For all these and much more, I am very grateful.

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Section 1: Foundation of the Study and Literature Review

Introduction

Microvascular disease (MVD) results in the narrowing of small vessels within the body, impacting the functionality of the body system (Beckman, J.A., Duncan, M.S., Damraven, S.M., … Freiberg, M.S., 2019). The primary contributing factor of MVD is exposure of the tissues to chronic hyperglycemia (Diabetes.co.uk, 2018). In persons with Type 2 diabetes (T2DM), MVD has been shown to be associated with a higher risk of macrovascular events (Mohammedi et al., 2017). Additionally, persons with T2DM that present with MVD have an increased risk of cardiovascular morbidity and mortality when excluding pre existing risk factors for cardiovascular disease (Brownrigg et al., 2016). According to the Centers for Disease Control and Prevention's (CDC; 2014b) National Diabetes Statistics Report, MVD can be reduced through proper control of blood sugar levels; however, left untreated, MVD can lead to various complications as it relates to diabetes, including diabetic nephropathy, diabetic retinopathy, and diabetic neuropathy. Nephropathy is the damaging or disease of the kidney, and in diabetic nephropathy that damage is due to complications related to a person having diabetes (Gross, J.L., Silveiro, S.P., Canani, L.H., Caramori, M.L., & Zelmanovitz, T.,2005). In severe cases, this can lead to kidney failure and organ transplantation; however, kidney damage does not occur in all cases of diabetic persons (American Diabetes Association, 2015a). Nephropathy can lead to end stage renal disease (ESRD), which in turn can lead to persons needing dialysis and kidney transplantation (Moore et al., 2009). The contributing factors that can lead to ESRD include the development of hypertension and a decrease in glomerular

function (Martínez-Maldonado, M., 1998). According to the National Institute of Diabetes and Digestive and Kidney Diseases (2016), more than 661,000 Americans had kidney failure and compared to Caucasians, ESRD is about 3.7 times more prevalent in African Americans, 1.4 times greater in Native Americans, and 1.5 times higher in Asian Americans. Retinopathy is a condition that affects the retina; decreases vision; and over time, if left uncontrolled, can lead to blindness. In the United States, diabetic retinopathy is one of the leading causes of blindness among 25- to 74-year-olds (CDC, 2014a; Whitaker, 2001). Finally, a complication of MVD is neuropathy, which impacts nerves of the individual. Among diabetic polyneuropathy persons, 20% to 30% suffer from neuropathic pain (Tesfaye et al., 2011). Common symptoms can vary from a reduction in pain sensations to changes in pressure sensations, which can not only lead to lower limb injuries but also an increased risk of lower limb amputations (Hicks, C.W. & Selvin, E., 2019).

This study was designed to look at the association between MVD and chronic kidney disease (CKD) in persons with T2DM within Grenada. In this study, I examined factors that influence health outcomes related to CKD, T2DM, and MVD as well as made recommendations that may assist in improving national chronic health conditions. Implementation of the findings of this study may improve the effectiveness of primary health programs in Grenada because the findings provide evidence for the planning, decision-making, and implementation of health policies. The study may also be used as a resource for further investigation and strategic planning of other chronic disease concerns in Grenada.

In this section of this dissertation, I elaborate on the problem statement and clarify the purpose of the study. This is followed by a presentation of the research questions and hypotheses, theoretical foundations for the study, nature of the study, and literature search strategy. The rest of the section is devoted to an extensive literature review in which major concepts are defined; the assumptions made in the study are itemized; and the scope, limitations, and delimitations of the study are described.

Problem Statement

CKD is a condition that does not occur in isolation(i.e., does not occur due to one particular issue) but instead is a range of pathophysiological reactions linked to changes in the functionality of the kidney as well as a continued decline of its glomerular filtration rate (GFR; Ferguson et al., 2012).According to the Kidney Disease: Improving Global Outcomes Chronic Kidney Disease Workgroup(2012) CKD is defined as when the structure and functionality of the kidney presents this decline for more than 3 months and impedes an individual's health. Abnormal kidney function occurs when the GFR is less than 60 ml/min/1.73m2 (Ferguson et al., 2012). The severity of CKD is determined by the stage at which the disease has progressed. These stages increase in severity from Stage 1 to Stage 5, with Stages 3–5 being considered the most dangerous and leading to ESRD, dialysis, or even death (Thomas, R., Kanso, A., &Sedor, J.R., 2008). It is estimated that the worldwide prevalence of CKD is between 8% and 16% and 11.5% in the United States (Levey & Coresh, 2012). Within the Caribbean, however, the exact prevalence and incidence of CKD and MVD are not fully known due to incomplete or inaccurate data collection within the Organization of Eastern Caribbean States (OECS),

which includes the countries of Grenada, Commonwealth of Dominica, Antigua, St. Lucia, St. Vincent and the Grenadines, and St. Kitts and Nevis.

Among OECS countries, chronic noncommunicable diseases (CNCDs) continue to plague the region (Crews et al., 2017). Non communicable diseases (NCDs), including diabetes, stroke, CKD, heart disease, and hypertension, are among the significant contributors to over half of deaths among members of the OECS (Caribbean Epidemiology Centre, 2000). Per the International Diabetes Federation (IDF), the global prevalence of diabetes mellitus (DM)is 8.3% of the population, with the Caribbean having an overall prevalence of approximately 9%,which is responsible for 13.8% of all adult deaths in the region (Bennett et al., 2015). The Pan American Health Organization (PAHO) says that within the Caribbean region, DM affects an estimated 10% to 15% of the adult population and accounts for most premature deaths (PAHO, 2012).

Persons with renal impairments (i.e., CKD Stages 3–5) not only have an increased risk of MVD but also a higher likelihood of aortic, cerebrovascular and peripheral vascular disease (Ooi et al., 2011). Additionally, CKD patients have an increased chance of developing lacunar infarcts, and those over the age of 55 years old make up almost 70% of dialysis patients with varying degrees of cognition impairments that are of microvascular origin (Soyibo, Roberts, & Barton, 2011). Persons from an African-Caribbean background have been found to have not only a higher prevalence of diabetes and renal failure, but also worse overall outcomes as compared to other ethnic groups within the United Kingdom (Brown, Avis, & Hubbard, 2007).

Due to the increasing numbers of persons within the Caribbean having diabetes and developing either CKD or ESRD, it is essential to see if any additional links may be leading to these disproportionate numbers. Another link that could be evaluated, as it relates to CKD and diabetes, is to look at the MVD. MVD is defined as an injury to small blood vessels in the body, including capillaries, resulting in such issues as nephropathy, retinopathy, and neuropathy (CDC, 2014a). However, there have not been studies on the relation of MVD to CKD patients with diabetes in the region (Ezenwaka et al., 2008; Ezenwaka et al., 2016; Graciolli et al., 2017); therefore, I conducted this study to fill the gap in the literature.

Per the Caribbean renal registry, DM and hypertension are the leading causes of CKD and ESRD (Soyibo et al., 2011). Although many have studied diabetes, CKD, ESRD, and their prevalence, there has been little research conducted on MVD and its relationship to CKD severity in individuals with diabetes, specifically in Grenada. The extant literature includes studies specifically related complications of CKD/ESRD (i.e., anemia and mineral bone disease) and its related complications (i.e., obesity, hypertension, and dyslipidemia).

Purpose of the Study

The purpose of this quantitative, exploratory study was to determine the association between MVD and CKD severity in individuals with diabetes in Grenada. In this study, I also sought to look at the organizational factors of the socioecological model (SEM) of health and its impact on CKD outcomes. This was not an intervention study but

rather an exploratory, cross-sectional study to set the groundwork for potential further studies on CKD severity on diabetes patients on the island.

Research Questions and Hypotheses

RQ1: Is there an association between MVD and CKD severity among diabetes patients in Grenada with or without hypertension, when controlling for age, gender, glycated hemoglobin (A1C), body mass index (BMI), alcohol use, and smoking?

$H_0$1: There is no statistically significant association between MVD and CKD severity among diabetes patients in Grenada with or without hypertension when controlling for age, gender, A1C, BMI, alcohol use, and smoking.

H_A1: There is a statistically significant association between MVD and CKD severity among diabetes patients in Grenada with or without hypertension when controlling for age, gender, A1C, BMI, alcohol use, and smoking.

RQ2: What is the significance between prevalence of MVD and CKD severity - among patients in Grenada with diabetes with or without hypertension when controlling for age, gender,A1C, BMI, alcohol use, and smoking?

$H_0$2: There is no significance between prevalence of MVD and CKD severity among patients in Grenada with diabetes with or without hypertension when controlling for age, gender, A1C, BMI, alcohol use, and smoking.

H_A2: The prevalence of MVD is ≥ 50% of CKD patients in Grenada with diabetes with or without hypertension when controlling for age, gender, A1C, BMI, alcohol use, and smoking.

Theoretical Foundation for the Study

I used SEM as the theoretical framework of this study to explore the environmental risk factors that may increase a person's possible development of MVD as it relates to CKD severity in persons with diabetes within Grenada. The SEM is a health promotion approach that looks at some broad variables that influence health, whether for the good or bad (Robinson, 2008). The SEM is made up of five factors: individual, interpersonal, community, organizations, and or policy/enabling environmental factors (Green, Richard,& Potvin, 1996; Stokols, 1996;see Figure 1). The United Nations Children's Fund (UNICEF) identifies these factors include individual, interpersonal, community, organizations, and policy /enabling environmental factors. Individual factors are an individual's knowledge, attitudes, and behaviors that impact their health, including but not limited to age, gender, ethnicity, and sexual orientation (UNICEF, 2009). Interpersonal factors are the social networks and social support systems that may influence a person's behaviors (UNICEF, 2009). Community factors are the association among the organizations and informational networks within a specific location, including the local environment, villages, community leaders, and businesses (UNICEF, 2009). Organizational factors are those that impact the effectiveness of services provided and may hinder the health of a group or individual (UNICEF, 2009). Finally, policy/enabling

environmental factors are local, state, national, and international laws and policies that impact the health of an individual or a group of persons (CDC, n.d.; UNICEF, 2009).

*Figure 1.*Social ecological model diagram. Source: http://www.cdc.gov/violenceprevention/overview/social-ecologicalmodel.html

In this dissertation, I focused on the organizational factors of the SEM. The organizational factors (i.e., the rules, regulations, policies, and informal structures) can either promote or constrain health behaviors (Robinson, 2008). By understanding the current health situation related to MVD, CKD, and diabetes among the Grenadian population, along with the health organizational structure within the country, the groundwork for improving the healthcare system can be better laid. Using this factor of the SEM in this study, helped me better understand any potential organizational barriers to the treatment and life expectancy variation between persons in Grenada with this

disease as compared to the Western world. I conducted this study through the collection of secondary data, mainly mortality and morbidity rates of persons living with CKD and diabetes and compared these rates to those with MVD along with CKD and diabetes. Collecting and comparing this information as well as information related to the cost of services, cost of living, and the availability of specialists related to this disease provided the groundwork for future work in developing policies and educational assistance for healthcare professionals to decrease the mortality and morbidity rates as it relates to this disease. The findings of this study also have the potential to provide much-needed information on health promotion initiatives as well as for the continued education of medical staff and the procurement of any needed specialists for this field.

Nature of the Study

I used a quantitative, cross-sectional design to MVD to CKD severity in individuals with diabetes among Grenadians. The secondary data used in this analysis came from the sampling of 2016 medical records. In-depth interviews, questionnaires, and focused groups were not used in this study because the primary focus was on the potential severity of this CNCD in Grenada. The independent variables in the study were MVD and diabetes, the dependent variable was CKD severity, and the controls were age, gender, smoking, and weight.

Literature Search Strategy

I used the following databases to locate literature for this study: Walden University Library and Walden Library Books, PubMed, CINAHL Plus with Full Text, MEDLINE with Full Text, Dissertations & Theses, and Dissertations& Theses at Walden

University, ProQuest Central, Science Journals, and Science Direct. Good Scholar, Google, Walden Library Search, World Health Organization (WHO), UNICEF, PubMed, and ProQuest search engines were also used. The following keyword search terms were used: *Type 2 diabetes, diabetes mellitus, CKD, chronic kidney disease, microvascular disease, risks for microvascular disease, Caribbean, risks for CKD, diabetes in Grenada, CKD in the Caribbean, social ecological model, IDF, UNICEF report, WHO report, NDHS, SEM,* and *CDC reports*.

Although I had an open-ended search for literature, emphasis was placed on publications spanning a period of 5 years (i.e., 2013–2018) for this study. I also placed emphasis on peer-reviewed primary publications within the period under review. In addition, national documents, WHO, CDC, and UNICEF periodicals and reports were used to augment the literature review. Some seminal literature like that on the SEM as well as some critical publications on prevalence of CKD, diabetes, and its related risk factors within the Caribbean region was used. Finally, a few doctoral studies and dissertations from the Walden University Library were also reviewed.

Literature Review Related to Key Variables and/or Concepts

Population

According to the Index Muni (2018), as of 2017, it is estimated the population of Grenada to be about 111,724, with 24% being less than 15 years of age, just 10% over the age of 65, and a median age of 31.5 years. Of this, 35.7% lived in urban communities; the total sex ratio of male to females is 1.03, and as of 2016, a birth rate of 15.5 per 1,000 population and 9.7 deaths per 1,000 live births per year (Index Muni, 2018). With a gross

national income per capita of $14,700, Grenada spends about 6.1% of the gross domestic product on health (Central Intelligence Agency, 2017; WHO, 2015). Grenadians have a life expectancy at birth for males and females of 71 and 76 years old, respectively (WHO, 2015).

Grenada has about five different ethnic groups who speak roughly five different languages and dialect; however, English is the official language with French Patois, Spanish, Mandarin, and Indian Hindi being the dominant local languages (Central Intelligence Agency, 2017). Christianity is the predominant religious belief, with some being Roman Catholic and the majority being Protestant (The World Factbook, 2018).

According to Health Grove (2013b), the annual mortality rate per 100,000 persons related to DM increased by 57.5% in Grenada since 1990. From 2005 to 2016, the incidence of diabetes dropped by 2.7% from 2005 to 2016; however, it not only remains the third leading cause of death in the country but also the third leading cause of premature deaths with an increase of 0.4% during the same period (Institute for Health Metrics and Evaluation, 2016). However, CKD is the leading cause of disability-adjusted life years and the fifth leading cause of death in 2016 (Institute for Health Metrics and Evaluation, 2016).

Physiology of Chronic Kidney Disease

CKD is characterized as a condition that damages the kidneys and decreases its functionality (National Kidney Foundation, 2017). CKD can be quantified by a high measure of the GFR for more than 3 months (Thomas, Kanso, &Sedor, 2008). According to the U.S. National Kidney Foundation, Kidney Disease Outcomes Quality Initiative,

CKD is defined as damage to the kidney or GFR lower than 60 ml/min per 1.73 m^2 for 3 months or longer (Jha et al., 2013). The main contributors to CKD in individuals are diabetes and hypertension; however, any health condition that damages the kidneys can lead to CKD (CKD, 2019). Within the Caribbean, as of 2013, the significant risk factors for CKD include low GFRs, high systolic blood pressure, high fasting plasma glucose, high body mass index, and dietary risks (Health Grove, 2013a). This CNCD is a global issue impacting persons from all income levels and various income countries; however, the incidence, prevalence, and progression of CKD vary per country (Webster, Nagler, Morton, & Masson, 2016). Per Health Grove (2013a), the annual mortality rate for CKD within the Caribbean is 18.39 per 100,000 people, which is an 87.1% increase from 1990.

The kidney is a vital organ within the body. Some of the functions of the kidney include: "excretion of waste, acid-base regulation, body water and electrolytes, detoxify/metabolize drugs/hormones, regulate blood pressure and endocrine system" (Gattone, 2007, A-2). Due to the gradual progression of kidney deterioration, many persons are asymptomatic until kidney damage irreversible (Pradeep, A.M., 2020).As the kidney begins to decline in functionality; complications can lead from CKD to ESRD (Thomas et al., 2008). When this begins to occur, it is classified by way of the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative from Stage 1 to Stage 5. The premise of Kidney Disease Outcomes Quality Initiative is to establish guidelines for establishing universal best practices for clinical kidney disease, including (a) defining CKD and classify its stages despite its underlying cause, (b) evaluating laboratory measurements of assessing clinical kidney disease, (c) associating kidney function levels

with CKD complications, and (d) determining risk of kidney loss of function and the development of cardiovascular disease (Levey et al., 2003). These stages are clinically defined by laboratory evaluations as follows: Stage 1-normal eGFR ≥90 mL/min per 1.73m^2; Stage 2- eGFR between 60 to 89 mL/min per 1.73m^2; Stage 3- eGFR between 30 to 59 mL/min per 1.73 m^2; Stage 4- EGFR between 15 to 29 mL/min per 1.73 m^2; and Stage 5- EGFR of <15 mL/min per 1.73m^2 or ESRD (Chapter 1: Definition and classification of CKD,2013).

Physiology of Diabetes

DM orT2DMis a metabolic disorder characterized by the ineffective distribution of insulin within the body, also known as hyperglycemia (American Diabetes Association, 2013). Insulin, the energy vehicle within the body that moves sugar into the cells, is produced in the pancreas (Cologne, Germany: Institute for Quality and efficiency in health care, 2018).When the pancreas begins to have difficulty accurately producing insulin, it can lead to Type 1 diabetes, or juvenile diabetes, which is more commonly found in children (Fonseca, 2006). In contrast, in T2DM, the body has sufficient insulin in the body but is not able to utilize it efficiently to lower the blood glucose levels (Fonseca, 2006).Where T2DM deals with the utilization of insulin in the body, Type 1 diabetes deals with the lack ofa deficiency of insulin, usually occurring within children (American Diabetes Association, 2009). Another form of diabetes can occur during pregnancy, which can increase a woman's chances of developing T2DM later in life (Kim, Newton, &Knopp, 2002). In this study, I focused on T2DM.

Persons that are diagnosed with diabetes are usually of increased age, overweight/obese, and with decreased physical activity; genetics also can play a significant role in the development of diabetes (Pulgaron, E.R. & Delamater, A.M., 2014). The bodies' inability to efficiently utilize insulin within the cells is known as insulin resistance (Wilcox, G., 2005). Insulin resistance has been said to be responsible for health concerns, including obesity, hypertension, triglyceride and cholesterol abnormalities, polycystic ovarian syndrome, and increased heart disease risk (Whitaker, 2001). T2DM left untreated or managed can lead to hyperglycemia, resulting in the most diabetic-related physical complications (Ramteke, P., Deb, A., Shepal, V., & Bhat, M.K., 2019). This increased level of glucose within the body leads to a build-up of sorbitol, which has been shown to be linked to nerve and eye damage (Whitaker, 2001). Unfortunately, this form of diabetes is many times left untreated for years, and when discovered, the person has extremely high blood glucose levels; nerve, eye, and kidney damage, and other organs may have been compromised (Department of Health and Human Services, 2015). All of this damage could be mitigated through either a fasting blood glucose test, which looks at the amount of glucose in an individual's body when fasting for 8 hour or an A1C test, which looks glucose average within a 3-month period (Sherwani, S.I., Khan, H.A., Ekhzaimy, A., Masood, A., & Sakharkar, M.K., 2016). A diagnostic fasting blood glucose reading of 70–110 mg/dl is within reasonable limits, and values great than 126 mg/dl can suggest a person has diabetes, which would be followed up with an A1C test for confirmation(American Diabetes Association, 2016). Gaining a better understanding of the physiology of diabetes and its contributing factors will not

only reduce the risk of developing diabetes but also decrease its prevalence within the region and around the world.

Prevalence of Type 2 Diabetes

As of 2015, 30.3 million or 9.4% of people in the United States are diagnosed with diabetes, and of these, 7.2 million are undiagnosed or unaware they have diabetes (ADA, 2015b). Globally, there has been an increase in diabetes from 108 million or 4.7% in 1980 to 422 million or 8.5% as of 2014, indicating that diabetes has become an increasing global threat both to individuals as well as health systems (WHO, 2017). It is estimated that by 2030, the world prevalence of diabetes will increase from 6.4% of the population or 285 million adults from 2010 to 7.7% or 439 million by 2030 (Shaw, J.E., Sicree, R.A., &Zimmet, P.Z., 2010). Fonseca (2006) estimated that by 2050, the number of people in the United States diagnosed with diabetes will be 39 million (a 225% increase) and prevalence between 4.4% to 9.7% (a 120% increase from previous estimates). The diabetes prevalence increase has affected 69% of developing countries and 20% of developed countries (Shaw, Sicree, &Zimmet, 2010).It is also estimated that over 70% of cases in the next 20 years will come from developing countries, with most persons affected being between the ages of 45 and64 years old (Wild, Roglic, Green, Sicree, & King, 2004).According to the Macro Economy Meter (2013),Grenada is ranked 61st as it relates to diabetes and the prevalence of diabetes for populations aged 20 to 79 years is 9.44% as compared to countries such as Bosnia and Herzegovina, Portugal, Sudan, Iraq, Chile, Tunisia, Cyprus, Brazil, South Africa, and the United States.

Some of the major influencers on the increase of diabetes prevalence are an increasingly aging population among seniors 65 years and older, ethnicity, family history, being obese, socioeconomic status, increased age, sedentary lifestyles, place of residence, and having diets rich in fats; these factors have been shown to increase the prevalence of diabetes both in the U.S. and around the world (ADA, 2013; CDC, 2013; Jain & Saraf, 2010). According to the CDC (2012a), an estimated 25.9% or 12 million of seniors in the United States have T2DM. Ethnic groups are the hardest affected by T2DM and seem to have a higher predisposition to the development of this disease. The ethnic groups in the United States most impacted are American Indians/Alaska Natives (15%), Asian Americans (9.0%), non-Hispanic Blacks (13.2%), and Hispanic Americans (12.8%) as compared to Non-Hispanic Whites(7.6%;CDC, 2014a). Within the Caribbean, it has been found that there is a higher prevalence of diabetes among adult Black populations, affecting about 1 in 5 persons, and increasing morbidity and mortality rates (Hennis et al., 2002).

Prevalence of Chronic Kidney Disease

As industrialization has changed the face of the known world, there has been a shift in the focus of the health field from infectious diseases to CNCDs. One such change includes the leading causes of morality. Diseases of the kidney, overtime, have not only become a leading contributor of mortality rates but also are steadily reaching epidemic magnitudes within first-world countries (Eknoyan et al., 2004). It is estimated that 8%–16% of persons in the world are affected by CKD (Jha et al., 2013).According to the 2010 Global Burden Disease study, in 1990 CKD was ranked 27thon the list of causes for

the total number of global deaths; however, its ranking had increased to 18th in 2010 with an annual death rate of 16.3 per 100,000 (Lozano et al., 2013). Kidney disease is attributed to more deaths than prostate or breast cancer, and in 2013, it was reported that more than 47,000 Americans died from it (Xu, Murphy, Kochanek, &Bastain, 2013). Within the United States, CKD occurs in 14% of the general population (NIDDK, 2016). The NIDDK (2016) found that more than 661,000 Americans currently have kidney failure, of which 468,000 are on dialysis, and an estimated 193,000 are living with operational kidney transplants.

Though within the United States CKD can affect anyone, it does not impact each race equally. The CDC (2012b) found that African Americans (17.01%) and Mexican Americans (15.29%) were more likely to have CKD than European Americans (13.99%). Not only is there a variation in prevalence among races but also by gender. Women are more likely to be diagnosed with CKD Stages 1–4 then men, 15.93% and 13.52%, respectively (CDC, 2012b).

Additional factors that may influence the prevalence of CKD are the following four main risk factors: susceptibility, initiation, progression, and end-stage (Taal, M.W. & Brenner, B.M., 2006). Susceptibility factors are those factors that increase a person's chances of developing kidney damage; this includes older age, family history, reduction of kidney mass, low birth weight, low income or education, and ethnicity (Levey et al., 2003). The second factor, initiation factors, are those that directly start the process of kidney damage, would include diabetes, high blood pressure (BP), autoimmune diseases, systemic infections, urinary tract infections, urinary stones, lower urinary tract

obstruction, or drug toxicity (Levey et al., 2003). The third contributing factor is a progression of the disease; these are causes that worsen the kidney damage and factors that decrease the functionality of the kidney after the commencement of kidney damage, some examples include high BP, poor glycemic control in diabetes, smoking, and elevated protein urea (Levey et al., 2003). Finally, end-stage factors are those that increase persons' morbidity and mortality rate within kidney failure; this would include low dialysis dose, late referral to care, low serum albumin levels, anemia, or temporary vascular access (Levey et al., 2003). However, little is known about the actual prevalence of CKD within the Caribbean.

Risk Factors for Type 2 Diabetes

The prevalence of T2DM in North America and the Caribbean is estimated at 12.9% (IDF, 2015). Within Grenada, the national prevalence of diabetes among adults is 10.3% of persons age 20-79, which is 6.9 in every 1,000 persons (IDF, 2015). There is a multitude of various factors that have been found to contribute to the development of T2DM. Per the CDC (2012a) persons having a low socio-economic status (SES) have a higher risk of developing T2DM than those of higher economic status. A major contributing risk factor to its development is family history (Cheng et al., 2012). Studies have shown that even when factoring in socioeconomic and behavioral factors, Blacks were twice as more likely to develop T2DM than their White counterparts (Brancati et al., 2000). As the level of education decreases, as well as income and SES, there was found to be an increased risk of T2DM, according to the prospective Black Women's Health Study (Krishnan et al., 2010). Studies have also shown that there is a link between

low SES and increased T2DM. The potential reasons for this link include lack of resources, diminished accesses to healthcare, lower levels of income, education and physical inactivity, and postponement of medical care and inadequate dietary options within available income (Robbins, Vaccarino, Zhang, &Kasl, 2005; Williams & Jackson, 2005).Alternatively, as education and income increased the same study found no difference in the development of T2DM among women (Conen et al., 2011). Another contributing risk factor would obesity and weight of the individual. These findings were challenged by a study by Lee et al. (2011), which found that low SES was not responding to the increased rate of T2DM among the African American community. In short, a person's increase of education and income did not prevent their development of diabetes. These risk factors may have been found to contribute to the risk of development of T2DM, but it is not always quite that simple.

According to a study by the United States Agency for International Development (USAID) in collaboration with Johns Hopkins School of Public Health, within the Latin American and Caribbean (LAC) region about half of all years lost to life are attributed to NCDs (Anderson et al., 2009). Among Black Barbados Caribbean nationals, there is a noticeably high prevalence of diabetes as compared to other ethnic groups within the country, affecting an estimated 1 in 5 people and increasing mortality and morbidity rates (Henniset al., 2002). The issues of diabetes and its related factors, as it relates to the prevalence of diabetes, vary by ethnic group. Of those who knew their status, 17.5% impacted were Black, 12.5% mixed race, and 6.0% White (Hennis et al., 2002). Adult Black populations are disproportionately negatively affected by diabetes than other ethnic

Caribbean groups. An estimated 1 in 5 Black adults are at risk for diabetes and have increased levels morbidity and mortality (Hennis et al., 2002). Additional risk factors include age, diabetes history, hypertension, high BMI and weight to height ratios, increased education and the level of alcohol consumption.

Caribbean Blacks and Chronic Kidney Disease

NCDs account for sixty-six percent (66%) of the health burden within Latin America and the Caribbean (LAC), this includes diabetes, CKD, cardiovascular disease, respiratory and digestive diseases (Anderson et al., 2009). Among the LAC, the top eight countries that have the highest percentages of years of life lost due to NCDs as compared to the percentages associated with communicable disease are Netherlands Antilles (85%), Cuba (73%), Uruguay (72%), Antigua (69%), Dominica (68%), Antigua and Barbuda (66%), Grenada (66%), and Jamaica (66%), (Anderson et al., 2009).Globally, as well as within the Caribbean, the major contributor to CKD and ESRD are chronic lifestyle-related disease, i.e., DM and hypertension (Soyibo, Roberts, & Barton, 2011; Moeller, Gioberge, & Brown, 2001; Soyibo& Barton, 2007). Worldwide, treatment for ESRD continues to grow at 5times the population growth rate of 1.3% (Moeller, Gioberge, & Brown, 2002). CKD is a significant concern within the Caribbean due to many financial challenges. Renal replacement therapy (RRT), currently is not available in all Caribbean countries and cases they are available, the leading form of modality is hemodialysis (Soyibo et al., 2011). Within the Black American community contributing factors that lead to T2DM and CKD include low SES, race, poverty, obesity, inappropriate diet, low levels of physical activity, decreased income levels and lowered educations (Krishnan et

al., 2010). Soyibo et al. (2011) found however that within the Caribbean some CKD contributing factors include not only these factors but also lack of BP management, uncontrolled glucose, married with lifestyle modifications, and nutrition, if controlled, could reduce the increasing burden of renal failure in the region.

It is these risks factors that contribute to the increase of CKD and diabetes complications within the Caribbean. Persons with CKD have not only high healthcare utilization rates but also mortality and morbidity rates as well (Thorp, Eastman, Smith, &Johnson, 2006). The prevalence and incidence of CKD through the entire Caribbean is currently unknown, but information is known for some more substantial islands such as Jamaica and St. Kitts. In a study by Ferguson et al. (2015), it was found that among persons attending a specialist diabetes clinic within Jamaica of the 132 participants of the study, 86.3% had not only diabetes but also CKD. Additionally, it was found that the longer a person had diabetes was associated with CKD (Ferguson et al., 2015).

Current literature has been minimal in providing a clear and detailed look at the extent of CKD within the region. However minimal the information is there continuing to be a growing understanding and accesses to services for treatment has continued to improve over the years. Some countries have been more successful in providing necessary care and treatment within the country to their citizens, such as Grenada, Jamaica, Trinidad, and Barbados, but there remains continued effort to improve the standard of conditions and services as it relates to CNCDs within the region. Additionally, as prevention education increases and improves and the focus of encouraging persons to improve lifestyle choices, the number of CKD related deaths will

begin to improve. To achieve such goals, there needs to be a reduction in the incidence of CKD, slow ESRD progression which leads to the need for RRT and provide more efficient financial options for RRT (Soyibo et al., 2011).

Microvascular Complications

Diabetes-related complications include retinopathy, neuropathy, and nephropathy, which can lead to various adverse outcomes, including blindness, amputations of the lower limb and kidney failure (Moore, Gregory, Kumah-Crystal, & Simmons, 2009). Retinopathy occurs due to small vessels of the retina becoming damage due to uncontrolled blood sugar levels, leading to impaired vision and blindness in many cases. According to PAHOs Strategic Framework Visions 2020: The Right to Sight, within the Caribbean Region, more than 75% of persons diagnosed with DM for over 20 years will develop some form of diabetic related retinopathy, 10% will develop severe visual impairments, and about 2% will become blind. Additional contributors to retinopathy include high blood pressure and cholesterol. Nephropathy, when left untreated or poorly managed, can lead to ESRD, thus requiring either dialysis and organ transplant (Moore et al., 2009). The exact global impact of ESRD within the region is unknown. However, the WHO estimates the death burden to more than 400, 000 per year, as compared to 300,000 in the 1995 Global Burden of Disease report (King, Roglic, Lozano, &Boshi-Pinto, 2001; Murray & Lopez, 2000).

The complications related to microvascular disease, as it relates to diabetes, include nephropathy which leads to renal failure, retinopathy – which can lead to blindness, and neuropathy – which can lead to lower limb amputations (Moore et al.,

2009). The best way to reduce a person's risk of developing microvascular disease complications is to have blood sugar under control (CDC, 2014b). Nephropathy is a disease affecting the kidneys which can lead to CKD or ESRD thus requiring dialysis or organ transplant (Moor et al., 2009). As patients become hypertensive and kidney function decrease the risk of developing renal failure increases.

In 2014, diabetes was described as the primary cause of 52,000 people developing ESRD (CDC, 2017). Unfortunately, due to health disparities, some ethnic groups are more impacted by this disease than other. Within the United States, non-Hispanic Blacks (9.0 per 1,000 persons) and Hispanics (8.4 per 1,000 persons) have a higher age-adjusted incidence of diabetes than their non-Hispanic White counterparts (5.7 per 1,000) (CDC, 2017). Furthermore, persons within the Caribbean, the mortality rate due to CKD, was higher in 2013 for the region as compared to the world average, i.e., 18.4 and 13.3 per 100,000 people, respectively (Health Grove, 2013). Retinopathy is a destruction of the retina and nerve endings impacting ones' vision that can lead to blindness. The leading cause of blindness among 25 to 74-year olds in America is due to diabetic retinopathy (CDC, 2014b; Whitaker, 2001). According to PAHO and WHO strategic Framework vision 2020: The right to Sight report, diabetic eye disease is extensive in the Caribbean. With more than 75% of diabetic persons who have had the disease for more than 20 years develop some form of diabetic retinopathy.

Operational Definitions

Acute renal failure: traditionally defined as the rapid fall of the which clinically manifests as the abrupt and continued increase in the serum levels of urea and creatinine in association with disruption of salt and water homeostasis.

Anemia: is the reduction of one or more primary red blood cell measurements, i.e., hemoglobin concentration, red blood cell count or hematocrit (Thomas, Kanso & Sedor, 2008).

Body-Mass-Index (BMI): is determined by dividing a person's weight (in kilograms) by the square of their height in meters. (WHO, 2018).

Chronic kidney disease (CKD): abnormalities of kidney structure or function, present for >3 months, with implications for health (N.D., 2013). Compilation of diseases related to the decline of the kidney and its functions. A slow and progressive loss of kidney function over a period of years resulting in the need for dialysis or kidney transplant to maintain life (Tonelli, 2006).

Chronic noncommunicable disease (CNCD): These are diseases of long duration and slow in progressions that are results of not only genetic but also physiological, environmental and behavioral factors (WHO, 2017). Examples of CNCDs include, but not limited to, cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes.

Diabetes mellitus (DM; i.e., Type 2 diabetes, T2DM): A condition where the cells no longer can efficiently use blood sugar (glucose) for energy. T2DM occurs when the body's cells become insensitive to insulin and blood sugar (Oberg, Balentine, Cunha,

&Shiel Jr., 2017). Insulin sensitivity results in consistently chronic high blood glucose number above average range (ADA, 2013).

Dialysis: the process of removing blood from an artery, purifying it, adding vital substances and returning it to a vein (Dialysis, n.d.)

Dyslipidemia: is a metabolic abnormality leading to a persistent increase in the plasmatic concentration of cholesterol and triglycerides (Moor et al., 2017).

End stage renal disease ESRD: Is the last stage of chronic kidney disease (stage 5), this results in the need for either dialysis or a kidney transplant (Thomas, Kanso, &Sedor, 2008).

Hyperglycemia: Another name for high blood sugar, is clinically defined as blood glucose levels greater than 7.0 mmol/L (126 mg/dl) when fasting or a blood glucose level higher than 11.0 mmol/L (200 mg/dl) 2 hours after meals (Diabetes CO.UK, 2018).

Hypertension: When the systolic blood pressure readings are higher than 140, and diastolic blood pressure is higher than 90 due to thickening of arteries (CDC, 2014). Hypertension is a long-term medical condition in which the blood pressure ithe arteries remains elevated for an extended amount of time.

Incidence: measures the rate of occurrence of a new case of condition or disease (Roe & Doll, 2000)

Insulin: Wilcox (2005) defines insulin as, "a peptide hormone secreted by the β cells of the pancreatic islets of Langerhans and maintains normal blood glucose levels by facilitating cellular glucose uptake, regulating carbohydrate, lipid and protein metabolism and promoting cell division and growth through its mitogenic effects."

Lacunar infarcts: small infarcts (2-20 mm in diameter) located in deep cerebral white matter, basal ganglia or pons; thought to a result of occlusion of a single small perforating artery supplying sub cortical areas of the brain (Wardlaw, 2004).

Macrovascular disease (MVD): the disease of the large blood vessels, this includes the coronary arteries, aorta, and large arteries of the brain and limbs (Macrovascular disease, n.d.).

Microvascular disease (MVD): is the presence of retinopathy and lower extremity numbness and or amputation. Diseases are resulting from poor control of blood sugar (hyperglycemia) resulting in injury to small blood vessels which can lead to such conditions as retinopathy, neuropathy, and nephropathy (CDC, 2014a).

Mineral bone disease: commonly occurring in persons with CKD, occurs when damaged kidneys and abnormal hormone levels cause calcium and phosphorus levels to become out of balanced in the blood (n.d., 2015)

Nephropathy: is defined by macroalbuminuria or a urinary albumin excretion of more than 300 mg in 24 hr. collection. It is often characterized by a progressive increase in protein urea and decline in GFR, hypertension and a high risk of cardiovascular morbidity and mortality (Butt, Hall, &Nurko, 2010).

Obesity: Obesity is the excessive or abnormal build up of fat that presents a risk to a person's health (WHO, 2018). A person with a body-mass-index (BMI) of greater than 30 is considered obese.

Prevalence: The overall number of persons living with a disease. (CDC, 2014a).

Risk factors: Factors that create or contribute to the development of a disease or leads to the increased decline of the disease condition (CDC, 2014a).

Assumptions

The following assumptions were made in this study.

- Medical files documented microvascular disease accurately.
- CKD severity level is clearly identified in all microvascular disease cases.
- Data were entered in efficient and effective manner with minimal errors.
- No bias was introduced in the study due to the random occurrence of missing data.
- The expected dependent and independent variables were contained in the secondary data set identified for this study.
- The manners of the data voluntarily released the data set for this analysis upon request.
- Dataset had enough cases and variable for unbiased study of the variables of interest

Considering these assumptions enhanced the validity of the study.

Limitations

The following limitations of this study are hereby acknowledged:

- This study was a secondary data analysis, thus some variables that may have added value to the study were not be in the dataset.
- Missing data may have affected the inferences drawn from this study and the researcher could not modify the dataset to ensure no missing data

- This dataset was collected more than 2years prior to the study and the current reality on ground in Grenada may have changed markedly.
- The quality of the data set is dependent on the researchers and field workers who collected the primary data, the statisticians and data clerks who inputted the data, and the capacity of the staff who oversee the data set at the records department in Grenada.
- The quality of the data set may have been affected by the level of data collection standards and regulations set by the Ministry of Health in Grenada the various manipulations of the data set over the past 2 years.

Scope and Delimitations

This study is based on 2016 Grenada General Hospital medical records of CKD patients and the socioecological factors that influence associations of MVD among CKD patients with T2DM in Grenada. There was no contact with study participants or primary data collected. There was a difference in time from when the information was collected and when the secondary data analysis was taken place.

The delimitations of this study include:

- This study was delimited to quantitative cross-sectional descriptive study.
- It was use entirely secondary data no primary data will be gathered.
- The study was delimited to the variables present in the dataset selected for this study.
- The study was also delimited to the information collected by the data collectors.

- The study was delimited by time of data collection during patient clinical visits to the general hospital from 01/01/2016 to 12/31/2017.

Significance of the Study and Potential for Social Change

The purpose of this study was to determine if there is an association between microvascular disease and CKD severity in persons with diabetes evaluate the prevalence of MVD and how it relates to CKD severity in individuals with diabetes, in Grenada, West Indies. This project will be unique in that it will be the first of its kind within the region to look at diabetes from a pathophysiological level as well as its potential relationship to CKD about such matters of diabetic neuropathy and diabetic lower-extremity amputations. The results of this study will provide much-needed insight into the impact of MVD not only among the CKD and diabetic community but also on the healthcare system overall.

This study will provide the potential for valuable insights into the overall knowledge of microvascular disease as it relates to CKD and T2DM, especially in this population. This study aims to close the gap in the literature about the understanding of the potential link between microvascular disease and CKD among Grenadian. Within the last 5years, that has only a few studies on CKD and diabetes within the Caribbean, including St. Lucia. This study adds to these findings and could provide the basis for innovations, and strategic planning for interventions for the improved management of CKD, and prevention initiatives. Several studies have shown the prevalence of CKD and diabetes within the Caribbean and Grenada. However, no quantitative study was found that explores the potential relationship between MVD and these diseases within Grenada.

It also has the potential to improve how medical reports are documented as it relates to documentation of critical medical conditions.

This study has three potential implications for social change. (a) knowledge of CKD complications as it relates to diabetic patients. This finding has the potential to identify the extent of this health issue within the country. Currently, within the Caribbean, there is much knowledge about diabetes and growing community knowledge about kidney disease, but the extent to which CKD impacts communities is still unknown (b). Determine the relationship between MVD and CKD in persons with diabetes. These findings have the potential for the development of policy changes in how reporting is done as it relates to microvascular disease and CKD in diabetic patients. (c) Lifestyle modification recommendations are another potential social change that can set the groundwork for reducing the impact of these diseases on the country. No research is currently available as it relates to the overall cost of MVD within Grenada. However, it serves as a potential topic of study through grant funding.

Summary and Conclusions

This section I elaborately described the problems related to exploring the link between MVD and CKD severity among T2DM patients and provided some background into the topic of MVD and its various contributing factors. Additionally, the purpose of the study, the nature of the study, the research questions and hypothesis, a detailed literature review with emphasis on limitations, delimitations and assumptions were given. The section ended with a description of the social change impact of the study. Section 2 focused on the methodology to be used for this investigation. This section will include a

description of the population to be studied, the dataset used, an elaboration of the data management processes, and the potential ethical issues and threats to validity for this study.

Section 2: Research Design and Data Collection

Introduction

The purpose of this quantitative, cross-sectional study was to determine if there is an association between MVD and CKD severity in persons with diabetes and to evaluate the prevalence of MVD. In the previous section, I provided background on the topic, described the problems related to exploring the link between MVD and CKD severity among T2DM patients, the research questions, a detailed literature review, and the study implications to social change. In this section, the study design, methodology, the nature of the study, the operational variables, ethical considerations, and data management processes are described.

Research Design and Rationale

In this study, after reviewing various study designs by Creswell (2009), I decided to use the descriptive, retrospective, cross-sectional study design. The data were collected from the medical records department from 2013 to 2017. Using secondary data not only saved time but was also more cost effective than doing primary data collection. Although, many datasets require an access fee, the data were already collected which reduced the time of collecting data as compared to primary data collection and analysis, reducing duplication (Cheng & Phillips, 2014). Additionally, using secondary data minimizes potential ethical issues that are more commonly associated with primary data collection, increasing confidentiality of patient information (Yiannakoulias, 2011).

Methodology

In this subsection, I provide a description of how the study was carried out. The subsection includes a discussion of the study area/population, secondary data management processes, sampling techniques, and sample size.

Study Area

Grenada is a tri-island country (i.e., Grenada, Carriacou, and Petite Martinique) made up of seven parishes and has population of over 100,000 and a median age of 33.3 years old (The World Factbook, 2020). There is one government parliament with the parishes being divided into 15 constituencies that are governed by elected party officials (The World Factbook, 2020). For this study, the data were obtained from the hospital, which serves persons from each constituency. I obtained sample data from the medical record department to capture all persons who may qualify for the study who receive CKD and diabetes treatment.

Secondary Data Set Management

I used the hospital medical records as the secondary data set in this study. Approval for the study was sought from the ministry of health who are the owners and holders of the medical records. Their approval allowed me not only access to the data for study but also potentially the ability to publish findings at the end of the study (see Appendix A). I received official approvals from the Walden University Institutional Review Board (IRB), and the Government of Grenada. Once this was confirmed, a descriptive analysis was run to better confirm its accuracy and identify any missing data

and outliers (see Green &Salkind, 2014). See Figure 1 for the data management processes.

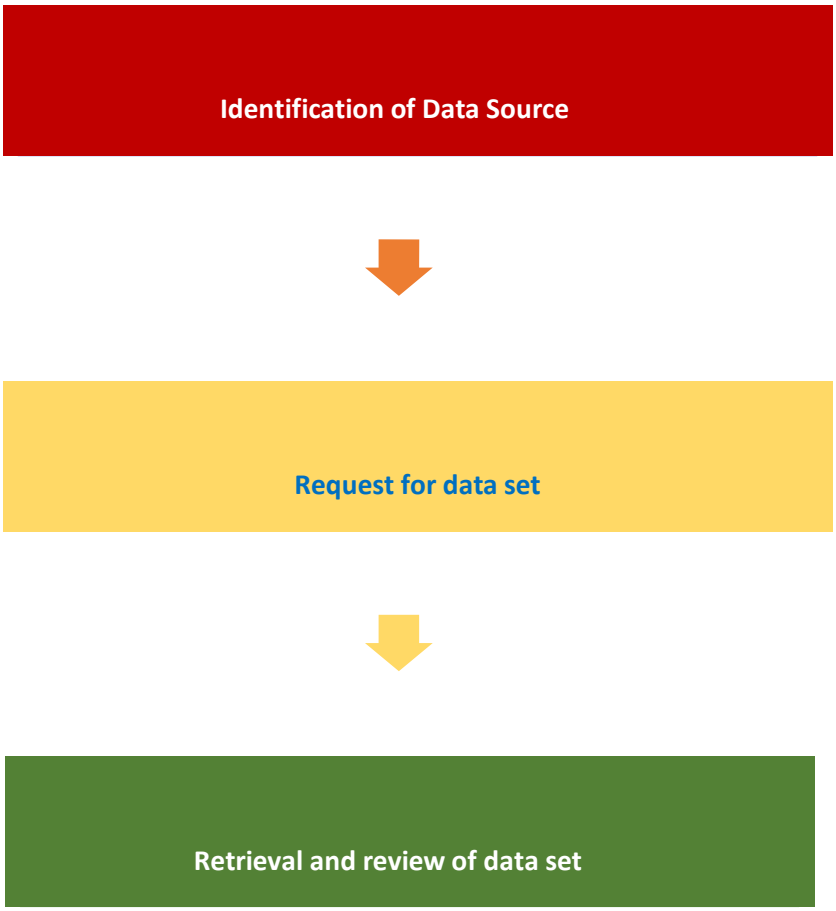

Figure 2. Data management processes.

Sampling and Sampling Procedures

The country of Grenada is a moderately sized country population with many persons using the general hospital. This allowed for ease of conducting a randomized sample of the study participants for the purpose of a statistically appropriate

representation of the population. In this study, I employed a simple random sampling technique. The simple randomization of the cases was appropriate in addressing the research questions and subsequent variables. The benefit of using this sampling technique is that it provides an unbiased representation of the population group studied.

Inclusion and Exclusion Criteria

In this study, the participants included individuals of all sexes above the age of 16 years old, whether visitors, permanent residents, or citizens within the tri-island country. This decision was made to ensure that there was a large enough sample size and to reduce any potential selection bias to the study. Persons that do not have CKD and/or T2DM were excluded from the study. These exclusion criteria were included because the purpose of the study was to determine the association between MVD and CKD in persons with diabetes in Grenada.

Data Collection Tools

I used medical records from the hospital for this study. The dataset holders were asked for access and permission to review the medical record archives. This application for access and permission was requested to the appropriate persons who had the authorization to release the medical records. The data set holders approved my request.

I gathered data on the independent variables of interest, such as age, sex, A1C level, alcohol, and BP at time of study, from the medical chart and BMI was re-coded to establish categories for the use of binomial logistic regression analysis. The dependent variable was CKD Stages3 through 5, so I could establish the severity of the disease in comparison to diabetes and the potential association to MVD.

Quality Assurance and Control

I ensured the quality of the study using the data set analysis tool, Statistical Package for the Social Sciences (SPSS), Version 25 (see IBM Corp, 2012). Outliers, missing data, and errors in the consistency of the data set were established through preliminary descriptive analyses. I carried out continued reviews of the data set to ensure the variables and data collected was within the scope of the study parameters.

Procedures for Gaining Access to the Data Set

I contacted the medical records department at the hospital about the procedures for obtaining access to medical records for research on topic. Next, I spoke to the senior medical officer and the general hospital nephrologist about my interest and intent to do this study. I was instructed on the best way to gain access to data on the variables of interest in the study would be to evaluate the files of those who had kidney disease and then identify diabetes and then look for any associations. Before using the secondary data, particularly medical records, from another country, I obtained IRB approval from Walden University (IRB Approval # 10-12-18-0599663) as well as study approval from the Ministry of Health in Grenada. I waited for approval from the dataset holders, which came a few days to weeks later with specific instructions on where to access the data, what to do with it, and what to do with the report/publications that may result from the analysis.

With the permission in hand, I began accessing the medical records; saved data set variables to my password-protected, portable hard drive; and began analysis. First, I reviewed both the data dictionary and the dataset to ensure that all the required variables

for the study were in the set. Once this was confirmed, I ran a univariate, descriptive analysis to have a better understanding of the data (i.e., the accuracy, skewness, kurtosis, missing data, and even outliners see Green &Salkind, 2014).

Sample Size

In this study, I used a sample size calculator to determine the appropriate sample size for the population. The sample size was determined by setting the confidence level at 95%, a confidence interval of five, and using a population size of 100,000. The resulting sample size recommended for the study was 383 medical records. The numbers of males to females within the study from the sample was determined upon reviewing the data. The total sample size after cleaning the data was 770 cases.

Justification for the Effect Size, Alpha Level, and Power Level Chosen

To improve the validity of the study, I selected an effect size. An alpha level of 0.5 was used to reduce Type 1 error and a power level of 80% was used to reduce Type 2 error. The choice of these figures was made for better external validity and improved outcomes concerning generalization of the study findings.

Instrumentation and Operationalization of Constructs

In this study, I used the medical records of treatment, diagnosis, and demographical information from the hospital as a secondary data set. In the following subsections, the operationalization, target population, and data technique used for this study are discussed.

Operationalization

MVD association was the dependent variable in this study. The key independent variables in this study were the individual and socioeconomic factors of the participants in the hospital medical records from the years of 2013 to 2017. These included age, gender, BMI, alcohol use, smoking, and A1C. I dichotomized the variables for logistic regression analysis (e.g., persons age was reclassified into categories of less than 35 years old and above 35 years old, and marital status was classified into married and single, with single being further broken down to include divorced, widowed, or separated).

Target Population

In this study, the target population was persons who were diagnosed as having CKD and diabetes during 2017. Any persons in the medical records that were over the age of 16 years old and met the preceding criteria were considered for the study because the legal definition of an adult in Grenada is those aged16 or older. Any person that did not fit these basic criteria was not included in the study, including children under the age of 16 years old.

Data Collection Technique

The data set was collected over a period of 12 months by hospital staff, especially the nephrologists from 2013 to 2017. However, the field work was estimated to occur from April 2018 – May 2018.I gathered the data for this study through the reviewing of individual patient files during the determined research period and input the data into Microsoft Excel.

Research Questions and Hypotheses

RQ1: Is there an association between MVD and CKD severity among diabetes patients with or without hypertension, when controlling for age, AIC, BMI, gender, alcohol use, and smoking?

$H_0$1: There is no statistically significant association between MVD and CKD severity among diabetes patients in Grenada with or without hypertension when controlling for age, AIC, BMI, gender, alcohol use, and cigarette smoking.

H_A1: There is a statistically significant association between MVD and CKD severity among diabetes patients in Grenada with or without hypertension when controlling for age, A1C, BMI, gender, alcohol use, and cigarette smoking.

RQ2: What is the significance between the prevalence of MVD and CKD severity - among patients in Grenada with diabetes with or without hypertension when controlling for age, A1C, BMI, gender, alcohol use, and smoking?

$H_0$2: There is no significance between prevalence of MVD and CKD severity among patients in Grenada with diabetes with or without hypertension when controlling for age, A1C, BMI, gender, alcohol use, and smoking.

H_A2: The prevalence of MVD is ≥ 50%of CKD patients in Grenada with diabetes with or without hypertension when controlling for age, BMI, A1C, gender, alcohol use, and smoking.

Data Analysis Plan

The analysis was in line with Figure 3.

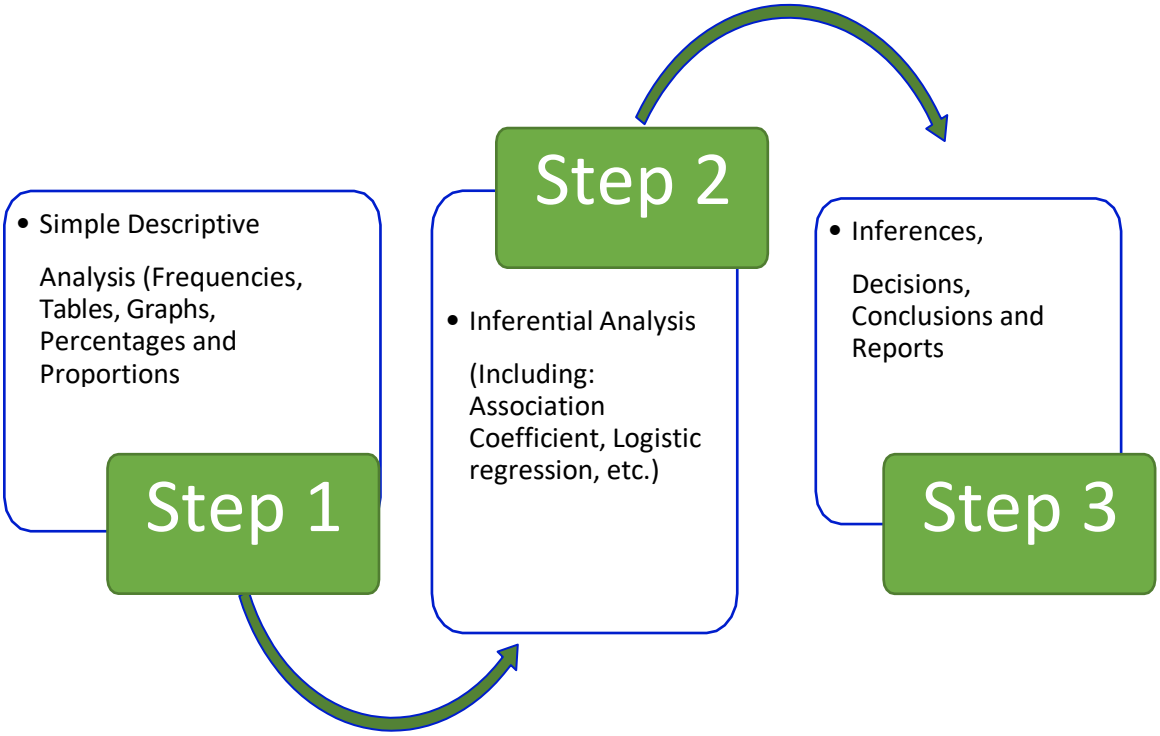

Figure 3. Data analysis process.

SPSS version25was used to analyze the data (IBM Corp, 2012). The data set was validated using built in validation functions in SPSS. Then a simple descriptive analysis was conducted. Identified variables were categorized and manipulated in accordance to the research questions for effective data analysis. Charts, tables and graphs will be created for visual description of the dataset. The first research question of if there is an association between MVD and CKD severity among diabetes patients with or without hypertension, when controlling for age, height, AIC, BMI, gender, smoking, and weight, the statistical tests used to test this hypothesis will be the chi-square test and the binomial

logistic regression due to the dependent variable being nominal and having more than two categories.

The second research question, what is the significance between the prevalence of MVD and CKD among patients with diabetes with or without hypertension when controlling for age, A1C, BMI, gender, alcohol, and smoking in Grenada, according to an organizational variables arising from the foundation of the SEM was statistically evaluated by using the binomial logistic regression due to the dependent variable being nominal and having more than two categories.

Threats to Validity

Since it is unclear if the medical records have been validated in the past, there is a potential of several threats to the studies validity. Being a secondary data analysis, there may have limitations to construct validity, limited number of variables available for analysis with absence of some essential variables, inherent bias, missing data and unaccounted errors in data collection. In addition, as this data were collected from 2013 to 2017, there could be significant changes to data storage and access to data archived medical data in Grenada. To minimize these threats, the data were validated using the SPSS preloaded rules.

Limited work hours, lack of clearance to enter some data on a regular basis, and lack of access to power outlet in available data area may affect coverage and limited internal validity of the project. Also, there may have inconsistent documentation of patients as having MVD. This may result in a non random missing data scenario.

Ethical Procedures

This study involved indirect research with human subjects as it entailed analysis of secondary data looking at key variables collected in the 2013 to 2017 medical records. The proposal has been approved by the primary data collector and data were collected (The DHS Program, n.d.), because ethical approvals have been approved by the Walden University IRB prior to proceeding to data retrieval, analysis and report development. Relevant additional approvals for the form the data holders – Grenada Ministry of Health Research Committee was obtained. These approvals enabled me to enter the data, analyze and develop result report. The approvals gave me the permission to publish the findings of the study in peer reviewed journals. As the dataset still belonged to the Government of Grenada, all saved data sets were deleted from my portable hard drive after analysis and report development. The product of this secondary data analysis was shared with the Grenada Ministry of Health – if they request for it. Individual identifying information was removed, and data anonymized to protect the participants before the analysis.

Dataset Treatment Post Analysis

Data set was deleted from the system upon completion of analysis and study.

Summary

In Section 2 of this inquiry, I elaborated on the research design (cross-sectional quantitative approach of inquiry), rationale and methodology of the study. In describing the methodology, the study population (Grenada), study area using the 2013 - 2017 medical records from the hospital, national population census, secondary data set management technique, sampling and sampling procedure, and instrumentation and

operationalization of constructs were described. In describing the instrumentation and operationalization of constructs, the section operationalized the variables by explaining the dependent and independent variables and their means of measurement, data collection and management techniques and data analysis plan. In addition, the section also discussed threats to validity and ethical considerations and procedures. In Section 3, we investigated analyzing the results, and interpreting its finds as it relates to the research questions.

Section 3: Presentation of Results and Findings

Introduction

The purpose for this quantitative, cross-sectional study was to determine if there is an association between MVD and CKD severity in persons with diabetes in Grenada among persons who visited the hospital between 2013 and 2017as well as to evaluate the prevalence of MVD. The research questions and hypotheses that guided this study were:

RQ1: Is there an association between MVD and CKD severity among diabetes patients with or without hypertension, when controlling for age, AIC, BMI, gender, alcohol use, and smoking?

$H_0$1: There is no statistically significant association between MVD and CKD severity among diabetes patients in Grenada with or without hypertension when controlling for age, AIC, BMI, gender, alcohol use, and smoking.

H_A1: There is a statistically significant association between MVD and CKD severity among diabetes patients in Grenada with or without hypertension when controlling for ageA1C, BMI, gender, alcohol use, and smoking.

RQ2: What is the significance between the prevalence of MVD and CKD severity among patients in Grenada with diabetes with or without hypertension when controlling for age, A1C, BMI, gender, alcohol use, and cigarette smoking?

$H_0$2: There is no significance between prevalence of MVD and CKD severity among patients in Grenada with diabetes with or without

hypertension when controlling for age, A1C, BMI, gender, alcohol use, and cigarette smoking.

H_A2: The prevalence of MVD is ≥ 50%and CKD patients in Grenada with diabetes with or without hypertension when controlling for age, BMI, A1C, gender, alcohol use, and cigarette smoking.

In this section, I present the data collection, the results, and a summary. I analyzed the hospital medical records of patients with diabetes and CKD for the for mentioned year range using SPSS Version 25. The data were validated using SPSS validation functions. Descriptive analyses of both the recoded, when necessary, and coded variables were conducted to align with the research questions. Data were then cleaned to spot and rectify data errors, mitigating its potential negative impact on study results. Next, I reviewed the analyzed data to ensure validity and conducted further analytical tests using SPSS.

Data Collection of Secondary Data Set

For this study, I used the medical records from a hospital in Grenada, West Indies. Patient medical files were obtained through the medical records department of the hospital, and medical records department staff was guided by the proposal for data collection from 2013 to 2017. The General Hospital is the main hospital for the tri-islands of Grenada, Carriacou, and Petite Martinique. Patient files used for analysis were gathered by the medical records department of the hospital based on the research criteria of the person's initial hospital interactions (i.e., diabetes, CKD, and hypertension),which was approved by IRB committee, and were presented to me as they were available. Due

to limited staffing, files only became available when the staffing was available to gather the data between their other duties to the hospital. Patient files contained a minimum primary diagnosis of diabetes, and many contained not only secondary diagnoses but also various procedural codes.

The use of medical records is essential to the determination of the effectiveness of not only the healthcare system but also for the evaluation of patient care. Though there are other medical facilities on the islands, all major medical procedures and specialists are located at the hospital. The 2013 to 2017 medical records contain data that represents the population of Grenada, Carriacou, and Petite Martinique. It is through evaluation of these records that I determined if the study null hypotheses could be accepted or rejected.

Limitations

There were a few discrepancies related to the secondary data collection for analysis. I originally proposed to use only data from 2016; however, due to the small sample size, this was updated to use all patient files from 2013 to 2017, thus making the study a retrospective analysis. The change in data set study range resulted in a longer time for data collection timeframe than intended. Additionally, many basic fields were missing in the intake portion of the patient's files. For example, height, weight and BP were either incorrectly noted (e.g., obese for weight, A1C, or instead of a number the words HI for BP) or not noted at all. This caused difficulty in determining BMI for many for the patient files, and therefore, the data were not controlled for this variable along with weight, A1C, height, and BMI.

The data screened for patients aged 16–100 years old with a diagnosis of diabetes resulted in 998 records. However, due to many files missing data for the specific study period or having no laboratory report or medical notation of laboratory procedures done, the final sample included 770medical records. Female participants made up the largest demographic group (57.9%). Most participants (58.8%) were between, equal, to or over the age of 60 years old, with many participants (76.7%) being diagnosed with having hypertension and 35.6% of persons found to have Stage 2 CKD. Table 1 shows the frequency of participants by population characteristics. Additionally, most of the participants were reported as not smoking (92.1%) or drinking (77%), with many participants reporting their frequency of drinking or smoking as never (78.3%, 89.7%, respectively). As it relates to CKD severity and being categorized as either less severe (i.e., CKD Stage 1 or 2) or severe (i.e., CKD Stage 3A, 3B, 4, or 5) determined by eGFR, most cases was defined as less severe CKD (57.6%). See Tables 1 and 2.

Table 1

Frequency Distribution for Study Population Characteristics

Variables	Categories	*N*	Valid%
Gender	Male	324	42.1
	Female	449	57.9
Age group	16–19	4	0.5
	20–24	4	0.5
	25–29	10	1.3
	30–34	5	0.6
	35–39	22	2.9

	40–44	34	4.4
	45–49	58	7.5
	50–54	74	9.6
	55–59	106	13.8
	≥60	453	58.8
Diagnosed with hypertension	Yes	584	76.7
	No	177	23.3
CKD stage	Stage 1	167	21.9
	Stage 2	271	35.6
	Stage 3A	113	14.8
	Stage 3B	92	12.1
	Stage 4	67	8.8
	Stage 5	51	6.7

Table 2

Frequency Distribution for Research Sample

Variables	Categories	*N*	Valid %
Alcohol	Yes	174	23
	No	581	77
Frequency of alcohol use	Daily	2	0.3
	Socially	14	2.1
	Occasionally	79	11.7
	Former	52	7.7
	Never	529	78.3
Smoke	Yes	60	7.9

	No	695	92.1
Frequency of smoking	Daily	1	0.1
	Occasionally	4	0.6
	Former	67	9.6
	Never	629	89.7
CKD severity	Less severe	438	57.6
	Severe	323	42.4

Results

In order to answerRQ1, I first conducted descriptive statistics for the variables of (a) age, (b) A1C, (c) BMI, (d) gender, (e) smoking, (f) hypertension, and (g) CKD severity. Age, BMI, and A1C were continuous variables; however, due to many variable points missing for height, weight, BMI, and A1C, they were not included in the analysis(see Table 3). The ordinal variables of gender, smoking, alcohol use, hypertension, and CKD severity, are represented in Table 3. A chi-square test was conducted to determine association to address RQ1 of this study. This test was used as the primary statistical analysis for evaluating whether there was an association between CKD and its various potential contributing health behavior factors. Finally, a binomial logistic regression was conducted to determine if MVD was predicted by the independent variables of age group, gender, smoking, cholesterol, ACR severity, hypertension, and MVD and the dependent variable of CKD.

Table 3

Variables Removed from the Analysis

Category	# of Possible Cases	# of Missing Data

BMI	770	732
Height	770	706
Weight	770	676
A1C	770	545

Table 4

Binary Logistic Regression Analysis Predicting Likelihood of Chronic Kidney Disease Severity Association without Drinking with p value, OR, and 95% CI

Variables	*B*	*p* value	OPR	95%CI	
				Lower	Upper
Gender (ref = female)	0.207	0.480	1.230	0.692	2.184
Age	0.304	0.009	1.355	1.080	1.702
Smoke (ref = no)	-0.868	0.104	0.420	0.147	1.196
Cholesterol (ref = high)	-0.009	0.976	0.991	0.535	1.836
ACR severity	0.223	0.632	1.250	0.502	3.114
Hypertension (ref = yes)	-0.571	0.130	0.565	0.270	1.182
MVD	0.019	0.968	1.020	0.398	2.614
Constant	-3.279	0.026			

Using the sample size of *N*= 761, I conducted a chi-square test for association to evaluate whether a person's gender is associated with CKD. The two variables were the gender of the participants with two levels (i.e., male and female) and the diagnosis of

CKD with two levels (i.e., less severe and severe). The results in Table 5showed no statistically significant association between a person's gender and CKD diagnosis, X^2 (1) = 0.607, p = 0.436, Cramer's V = 0.028. Therefore, I failed to reject the null hypothesis that there was no association between the gender and CKD. Cramer's V correlation also provides the strength of the relationship. A value of 0 indicates no association or difference, and a value of 1.0 indicates a very strong or perfect association. Cramer's V correlation showed a very weak or no association between the variables.

Table 5

Chi-Square Results for Gender and Chronic Kidney Disease Severity

Variables	Value	*df*	*p* value
Person chi-square (X^2)	0.607	1	0.436
Likelihood ratio	0.608	1	0.436
Cramer's V	0.028		0.436
N of valid cases	761		

The cross-tabulation chi-square test of gender as it relates to CKD severity in Table 6shows that 43.4% (190 out of 438) of male participants was found to have a less severe case diagnosis of CKD severity and 40.6% (131 out of 323) was found to have a severe case diagnosis of CKD severity, while 56.6% (248 out of 438) of female

participants was found to have less severe case diagnosis of CKD severity and 59.4% (192 out of 323) had a severe case diagnosis of CKD severity. The results from the chi-square tests for association, as shown in Table 5 & 6,failed to reject the null hypothesis that there was no statistically significant association between the patients' gender and CKD severity.

Table 6

Chi-Square Results Crosstabulation for the Development of Chronic Kidney Disease Severity and Gender

			Gender		Total
			Male	Female	
CKD	Less severe	Count	190	248	438
		Expected Count	184.8	253.2	438.0
		% within CKD	43.4%	56.6%	100.0%
	Severe	Count	131	192	323
		Expected Count	136.2	186.8	323.0
		% within CKD	40.6%	59.4%	100.0%
Total		Count	321	440	761
		Expected Count	321.0	440.0	761.0
		% within CKD	42.2%	57.8%	100.0%

Utilizing the sample size valid cases *N*= 753, a Chi-square test for association was conducted to assess the association between hypertension and CKD severity. The two variables were hypertension with two levels (Yes and No) and the contraction of CKD with two levels (less severe and severe). Table 8(chi-square cross-tabulation table) shows that 82.2% of the participants diagnosed with hypertension was shown to have severe

CKD levels, while 17.8% of the patients without hypertension tested was found to have had severe CKD levels. Seventy-three percent of patients that did have hypertension had less severe CKD, while 27% without hypertension had less severe CKD. The result in Table 7 reveals a statistically significant association between the presence of hypertension and CKD severity, $X^2(1) = 9.61$, $p<0.05$, Cramer's V = 0.11. As a result, the null hypothesis should be rejected that there was no statistically significant association between hypertension and CKD severity. The observed difference is statistically significant, and therefore is proof to reject the null hypothesis. Cramer's V correlation in Table 7also provides the strength of the relationship. Cramer's V correlation shows a small effect between the variables. The result as shown in Table 7validates the alternative hypothesis that there was an association between hypertension and CKD severity.

Table 7

Chi-Square Results for Hypertension and Chronic Kidney Disease Severity

Variables	Value	*df*	*p* value
Person chi-square (X^2)	9.608[a]	1	0.002
Likelihood ratio	9.809	1	0.002
Cramer's V	0.113		0.002
N of valid cases	753		

Table 8

Chi-Square Results Crosstabulation for the Development of Chronic Kidney Disease Severity and Hypertension

			Hypertension		
			No	Yes	Total
CKD	Less severe	Count	314	119	433
		Expected Count	331.8	101.2	433.0
		% within CKD	72.5%	27.5%	100.0%
	Severe	Count	263	57	320
		Expected Count	245.2	74.8	320.0
		% within CKD	82.2%	17.8%	100.0%
Total		Count	577	176	753
		Expected Count	577.0	176.0	753.0
		% within CKD	76.6%	23.4%	100.0%

Using the sample size of N= 723, a chi-square test for association was conducted to evaluate whether ACR severity is associated with CKD. The three variables were the ACR of the participants with three levels (normal to mildly increase, moderately severe, and severely increased) and the diagnosis of CKD with two levels (less severe and severe). The result in Table 8 shows no statistically significant association between ACR severity and CKD diagnosis, $X^2(2) = 2.194$, $p = .334$, Cramer's V = 0.055. Therefore, the null hypothesis could not be rejected that there was no association between the ACR severity and CKD. Cramer's V correlation shows a very weak or no association between the variables.

Table 9

Chi-Square Results for ACR Severity and Chronic Kidney Disease Severity

Variables	Values	Df	p value
Person chi-square (X^2)	2.194	2	0.334
Likelihood ratio	2.166	1	0.339
Cramer's V	0.055		0.334
Number of valid cases	723		

The cross-tabulation chi-square of gender as it relates to CKD severity in Table 10 show that 3.1% (13 out of 420) of persons with normal to mildly increased ACR levels was found to have less severe case diagnosis of CKD; 92.9% (390 out of 420) of persons with moderately severe ACR levels was found to have less severe case diagnosis of CKD; and 4.0% (17 out of 420) of persons with severe ACR levels was found to have less severe case diagnosis of CKD. In comparison, the same table showed that 4.6% (14 out of 303) of persons with normal to mildly increased ACR levels was found to have severe case diagnosis of CKD; 89.8% (272 out of 303) of persons with moderately severe ACR levels was found to have severe case diagnosis of CKD; and 5.6% (17 out of 303) of persons with severe ACR levels was found to have severe case diagnosis of CKD. The results from the chi-square test for association as shown in Table 8 and9 sustain the null hypothesis that is no statistically significant association between ACR severity and CKD severity. Therefore, the null hypothesis cannot be rejected.

Table 10

Chi-Square Results Crosstabulation for Chronic Kidney Disease Severity and ACR Severity

			ACR Severity			
			Normal to Mildly Increased	Moderately Increased	Severely Increased	Total
CKD	Less severe	Count	13	390	17	420
		Expected Count	15.7	384.6	19.8	420.0
		% within CKD	3.1%	92.9%	4.0%	100.0%
	Severe	Count	14	272	17	303
		Expected Count	11.3	277.4	14.2	303.0
		% within CKD	4.6%	89.8%	5.6%	100.0%
Total		Count	27	662	34	723
		Expected Count	27.0	662.0	34.0	723.0
		% within CKD	3.7%	91.6%	4.7%	100.0%

With the sample size valid cases *N*= 255, a Chi-square test for association was conducted to assess the association between cholesterol and CKD severity. The two variables were cholesterol with two levels (normal and high) and the contraction of CKD with two levels (less severe and severe). Table 12(chi-square cross-tabulation table) shows that 72.7% of the participants with normal cholesterol levels were shown to have severe CKD levels, while 27.3% of the patients with high cholesterol tested were found to have severe CKD levels. Seventy-two percent of patients that had normal cholesterol had less severe CKD, while 28% with high cholesterol had less severe CKD. The result in Table 11 revealed no statistically significant association between the cholesterol and CKD severity, $X^2(1) = 0.034$, $p = 0.847$, Cramer's V = 0.012. As a result, the null hypothesis should be accepted that there is no statistically significant association between cholesterol and CKD severity. The observed difference is not statistically significant, and therefore was proof to accept the null hypothesis. Cramer's V correlation in Table 10 also provides the strength of the relationship. Cramer's V correlation shows a small to no effect between the variables. The result as shown in Table 11validates the null hypothesis that there was no association between cholesterol and CKD severity.

Table 11

Chi-Square Results for Cholesterol and Chronic Kidney Disease Severity

Variables	Value	*df*	*p* value
Person's chi-square (X^2)	0.037	1	0.847
Likelihood ratio	0.003	1	0.847
Cramer's ratio	0.012		0.847
Number of valid cases	255		

Table 12

Chi-Square Crosstabulation for Chronic Kidney Disease Severity and Cholesterol

			Cholesterol		
			Normal	High	Total
CKD	Less severe	Count	96	38	134
		Expected Count	96.7	37.3	134.0
		% within CKD	71.6%	28.4%	100.0%
	Severe	Count	88	33	121
		Expected Count	87.3	33.7	121.0
		% within CKD	72.7%	27.3%	100.0%
Total		Count	184	71	255
		Expected Count	184.0	71.0	255.0
		% within CKD	72.2%	27.8%	100.0%

Observing the sample size of valid cases *N*= 761, a Chi-square test for association was conducted to assess the association between MVD and CKD. The two variables were MVD with two levels (yes and no) and the development of CKD with two levels (less

severe and severe). Table 14(chi-square cross-tabulation table) shows that 12.4% of the participants diagnosed with MVD was shown to have severe CKD levels, while 87.6% of the patients without MVD tested was found to have severe CKD levels. Fifteen percent of patients that did have MVD had less severe CKD, while 85% without MVD had less severe CKD. The result in Table 12 revealed no statistically significance association between the presence of MVD and CKD severity, $X^2(1) = 0.782, p = 0.376$, Cramer's V = 0.032. As a result, the null hypothesis should be accepted that there was no statistically significant association between MVD and CKD severity. The observed difference is not statistically significant, and therefore is proof to accept the null hypothesis. Cramer's V correlation in Table 13also provides the strength of the relationship. Cramer's V correlation shows a small effect between the variables. The result as shown in Table 12 validates the null hypothesis that there was no association between MVD and CKD severity.

Table 13

Chi-Square Results Microvascular Disease and Chronic Kidney Disease Severity

Variables	Value	*df*	*p* value
Person chi-square (X^2)	0.782[a]	1	0.376
Likelihood ratio	0.788	1	0.375
Cramer's V	0.032		0.376
N of valid cases	761		

Table 14

Chi-Square Cross-Tabulation for Chronic Kidney Disease Severity and Microvascular Disease

			MVD _Recode		
			Yes	No	Total
CKD	Less severe	Count	64	374	438
		Expected Count	59.9	378.1	438.0
		% within CKD	14.6%	85.4%	100.0%
	Severe	Count	40	283	323
		Expected Count	44.1	278.9	323.0
		% within CKD	12.4%	87.6%	100.0%
Total		Count	104	657	761
		Expected Count	104.0	657.0	761.0
		% within CKD	13.7%	86.3%	100.0%

The result from the logistic regression analysis in Table 15shows that age group and drinking does significantly predict the odds of CKD severity among the participants while controlling for gender, and smoking(*OR* = 1.320, 95% *CI* [1.191-1.463], $p < 0.05$; *OR* = 1.801, 95% *CI* [1.212-2.676], $p<0.05$, respectively). The result showed that the difference in age and drinking was associated with the development of CKD. As a result, I accepted the alternative hypothesis of statistically significant difference in the odds of developing CKD between age groups, as well as drinking or non-drinking, and reject the null hypothesis of no significant odds of CKD contraction between age groups, plus

drinking or non-drinking, after adjusting for gender, and smoking. In contrast, Table 15shows that gender and smoking status did not significantly predict the odds of developing CKD among the participants while controlling for age group, and drinking (*OR* = 1.012, 95% *CI* [0.737-1.390],*p* = 0.939; *OR* = 1.759, 95% *CI* [0.923-3.353], *p* =0.086, respectively). Therefore, the result shows that the differences in gender and smoking or non smoking were not associated with the development of CKD. As a result, I rejected the alternative hypothesis of statistically significant difference in the odds of developing CKD between male and female and smoking and non smoking, and accept the null hypothesis of no significant odds of CKD contraction between male and female and smoking and non smoking after adjusting for age, and drinking.

Table 15

Binary Logistics Regression Analysis Predicting Likelihood of Chronic Kidney Disease Severity Association with p value, OR, and 95% CI

Variables	*B*	*p value*	*OR*	*95% CI*	
				Lower	Upper
Gender (ref = male)	0.012	0.939	1.012	0.737	1.390
Age	0.278	0.000	1.320	1.191	1.463
Smoke (ref = no)	0.565	0.086	1.759	0.923	3.353
Drink status (ref =no)	0.589	0.004	1.801	1.212	2.676
Constant	-3.802	0.000			

The result from the logistic regression analysis in Table 16 shows that cholesterol, ACR severity and MVD does not significantly predict the odds of developing CKD among the participants while controlling for age, gender, smoking, and drinking (*OR* = 0.904, 95% *CI* [0.509-1.606], *p* = 0.73; *OR* = 1.296, 95% *CI* [0.532-3.157], p = 0.57; *OR* = 1.043, 95% *CI* [0.417-2.607], *p* = 0.93 respectively). The result shows that the difference in cholesterol, ACR severity and MVD are not associated with the development of CKD. As a result, I rejected the alternative hypothesis of statistically significant difference in the odds of developing CKD between person with normal and high cholesterol, normal to severely increase ACR levels, MVD or no MVD diagnosis, and accepted the null hypothesis of no significant odds of CKD contraction between person with normal and high cholesterol, normal to severely increase ACR levels, MVD or no MVD diagnosis. However, Table 16 showed that hypertension did significantly predict the odds of developing CKD among the participants while controlling for age, gender, smoking, and drinking (*OR* = 2.635, 95% *CI* [1.328-5.226], $p < 0.05$). Therefore, the result shows that the differences in hypertension and no hypertension were associated with the development of CKD. Thus, I accepted the alternative hypothesis of statistically significant difference in the odds of developing CKD among persons with and without hypertension and reject the null hypothesis of no significant odds of CKD among persons with and without hypertension after adjusting for age, gender, smoking, and drinking.

Table 16

Summary of Binary Logistic Regression Analysis and Socioecological Model

Variables	*B*	*p value*	*OR*	95% CI	
				Lower	Upper
Cholesterol	-0.101	0.730	0.904	0.509	1.606
ACR severity	0.259	0.569	1.296	0.532	3.157
Hypertension	0.969	0.006	2.635	1.328	5.226
(ref = no)					
MVD	0.042	0.929	1.043	0.417	2.607
(ref = no)					
Constant	-1.281	0.209			

A Pearson correlation coefficient was calculated to assess the relationship between CKD severity and variables that could influence the severity of CKD, i.e. hypertension, drinking, frequency of drinking, smoking, frequency of smoking, gender, cholesterol, MVD and/or sickling. There was a positive correlation found between four variables: hypertension (r=-1.113, N= 753,p= .002), drinking (r = .139, N= 747, p<.001), drink frequency (r = .130, N= 671, p = .001), and smoke (r= .097,n = 747, p = .008). Table 17summarizes the results. Overall, there was a strong, positive correlation between CKD severity, hypertension history, drinking, drink frequencies and cigarette smoking.

Table 17

Correlation

	Variables	Hypertension	Drink	Drink	Smoke

				Frequency	
CKD	Pearson Correlation	-1.113**	0.139**	0.130**	0.097**
	Sig. (2-tailed)	0.002	0.000	0.001	0.008
	Number of cases	753	747	671	747
	Pearson Correlation	-1.113**	0.139**	0.130**	0.097**

**. Correction is significant at the $p<0.01$ level (2-tailed).

Summary

I presented the results for the 2013 to 2017 Grenada medical records, to evaluate the relationship between MVD and CKD severity among diabetes patients with or without hypertension when controlling for age, AIC, BMI, gender, alcohol, and smoking in Grenada. A total of 998 files were reviewed, of which 770 cases were examined. I conducted a binary logistic regression to determine the association between CKD severity, the presence of hypertension, age, gender, alcohol, smoking, ACR severity and MVD. Drinking, age group, and history of hypertension were all significant predicators of CKD severity. Based on the statistical significance I accepted the null hypothesis that there was no association between MVD and CKD severity among diabetes patients with or without hypertension when controlled for AIC, BMI, gender, alcohol, ACR severity, and smoking in Grenada. A chi-square test was used to assess whether there was an association between CKD severity and the variables gender, age group, smoke, smoke

frequency, drinking, ACR severity, cholesterol, and MVD. An association was found between, age group and hypertension; therefore, I rejected the null hypothesis. In Section 4, I discuss the findings of my research, the potential application to the practice of the public health profession, and implications for positive social change.

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

Introduction

The purpose for this quantitative, cross-sectional study was to determine if there is an association between MVD and CKD severity in persons with diabetes in Grenada who visited the Grenada General hospital with diabetes between 2013 and 2017as well as the prevalence of MVD. I also ascertained whether there is significance between the prevalence of MVD and CKD among patients with diabetes with or without hypertension when controlling for age, BMI, A1C, gender, alcohol use, and smoking status in Grenada. The key findings from the study were that smoking, drink frequency, and history of hypertension were significant predictors of CKD severity.

In Section 4, I provide an interpretation of the findings as they relate to existing literature and the SEM. The section also includes the limitations of the study and recommendations for future research. Finally, I discuss the implications of the study for professional practice and positive social change.

Interpretation of the Findings

Age Group and Chronic Kidney Disease Severity

For RQ1, I found an association between age group, hypertension, smoking, drinking, drink frequency, and CKD severity among persons in Grenada with diabetes. In this study, persons over the age of 60 years old and smoking frequency were associated with have a very large effect on CKD severity. These findings add to the literature documenting age being a contributing factor in increased risk for diseases. While age has been shown to impact health outcomes previously, the results from the current study may

be novel with a focus on health outcomes within the Caribbean and from a socioecological standpoint. A higher tendency for persons over the age of 60 years old to be at risk for CKD compared to younger persons suggests age adversely impacts health outcomes more than gender as it relates to CKD severity.

Drinking and Chronic Kidney Disease Severity

In this study, I found that drink frequency was associated with CKD severity. Persons who reported as never having had alcohol comprised of 78% of the study population, and I found a statistically significant relationship between drink frequency and CKD severity among this group. CKD severity was used as the constant for the regression analysis, with less severe patients comprising of 58% of the study population. The results showed that as drink frequency increased from never drinking to daily (β =.06, p = < .005, OR =1.801), the severity of CKD on the person increased by.06. The results of the current study, when compared to existing literature, also indicated that there is a significant association between frequency of drinking and CKD severity. In this study, females who drank more frequently were more likely to have increased CKD severity. This study may be the first to include drink frequency among female participants or a predominantly Black study population, whereas previous studies excluded drink frequency among females as it relates to CKD severity (Funakoshi et al., 2012; Sato et al., 2014).

Microvascular Disease and Complications of Chronic Kidney Disease

Analysis for RQ2 indicates that although age group, smoke frequency, drink frequency, ACR severity, sickling, and MVD had a significant relationship with CKD

severity, they differed in the effect they had on CKD severity. The severity of a person's CKD may be associated with number of risk factor contributors and underlining health conditions (i.e. sickling and/or amputations). The results for RQ2 indicated a statistically significant relationship between MVD, hypertension, age group, and CKD severity, which predicts an increased odd of having more severe CKD outcomes for older women (i.e., mean age of 64 years old). For MVD, there was a statistically significant difference of .94 with a Cohen's *d* effect size of 1.04. History of hypertension was also statistically significant, with a mean square of1.7 and Cohen's *d* effect size of .42 compared to.30 for those having documented cholesterol issues. A person's age group was also statistically significant of $p = 0.00$ and a Cohen's *d* effect size of 5.82, with participants 60 years old or older having a higher risk of more severe levels of CKD. Although vascular complications, prevalence, progression, and pathophysiology differ in men and women, the presence of diabetes among women poses a higher risk of vascular complications (Maric-Bilkan, 2017). Kiberd and Clase (2002) observed that among gender-race groups, during the lifetime of ESRD for a 20-year-old, Black women were 7.8 times more likely to die when compared to breast cancer among Black women.

The results of this study were like those of Maric-Bilkan (2017) in that a statistically significant association was found in which women has an increased risk of MVD complications compared to men and, therefore, more severe forms of CKD. Additionally, this study finding showed the average age for women having more severe forms of CKD was 64 years old. The findings from the present study expound on the

existing literature regarding that age, in addition to gender, can be a predictor of CKD severity.

The Social Ecological Model and Association Between Chronic Kidney Disease

The theoretical framework that guided this study was SEM. This theological construct addresses the association between CKD risk factors, such as hypertension and diabetes, and addresses the complexity of socioenvironmental factors (Levey et al., 2003). At the community level, when strategic social norm changes are facilitated with regards to health behavior, prescribed interventions are more effective (Golden & Earp, 2012). The connection between delay in CKD progression and its proposed cost benefit to the health care system is substantial when managed effectively (Ontario Renal Network, 2016). The results of the study indicated that MVD, age group, and drink frequency were associated with increased risk of development of more severe levels of CKD.

Within the medical system of the public hospital, there are currently two doctors to address the health needs of CKD patients. The study population demographics (N = 775), of which only (N=165)22% of persons are currently receiving treatment within the Grenada, indicated that with only two specialized doctors in neuropathy available for limited service days, there could be a deficiency in the provision of adequate care. Decreased awareness of CKD and delayed referrals to nephrologists are associated with unsatisfactory prognosis, such as increased mortality, longer hospitalizations, and rapid advancement of CKD to ESRD (Smart et al., 2014). According to the theory of the SEM and Schroeder (2007), a key determinant in enacting social environmental change is a

strategic focus on the improvement of the social factors, health care, and the environment in order to curb persistent health inequalities.

I used the SEM in this study to evaluate the risk factors associated with MVD and CKD severity not only from an individual level but for organizational structures handling CKD patients that affect how and how well services are provided to individuals within the hospital (see UNICEF, 2014). The advantage of using the SEM was that theory could be employed to evaluate MVD and CKD severity associations from a community level and could accentuate the fact that a continued dialogue is needed to address the organizational, social, and environmental factors contributing to CKD disparities and further cost-effective policy interventions are needed to shorten the disparity gap (see Nicholas, Kalantar-Zadeh,& Norris, 2015).

Limitations of the Study

I obtained the data for this study from the 2013 to 2017 medical records of the hospital. The study findings may be generalized to the tri-island state of Grenada, Carriacou, and Petite Martinique because the sample was taken from the main hospital that contained data from persons that are from all three islands from 2013 to 2017.The findings could also be used for the development of further studies on chronic diseases in the country.

The sample collected provided a good representation of the health of the population because it included all cases for persons 16 years old and older. Though it does provide a good demonstration of the population, the use of a national database has its limitations. The classification of CKD stages was based on the National Kidney

Foundation's Kidney Disease Outcomes Quality Initiative. These diagnoses may be incomplete due both an absence of a common definition of CKD and misclassification of stage progression (Hogg et al., 2003). A notable limitation of this study was the lack of consistent data collection for the some of the reported fields. Another significant limitation of this study was the ease of accessibility to medical records. Data are only in paper format that required the pulling of individual patient files in order to review them for this study. Additionally, records did not all have the same basic data collected, (i.e., weight, height, blood sugar or BP); therefore, the possibility exists that there could be a correlation between CKD stages and BMI.

Recommendations

The results of this study showed that additional research is needed to identify interventions that can be used to improve overall outcomes of persons with MVD and/or CKD with a focus on improving data collection from all necessary medical staff. Although there have been improvements in the care of persons with kidney disease and MVD, not all persons have access to such care. I recommend further study of the impact of decreasing medical staffing has on the outcomes of persons with CKD and MVD as well as the financial implications to the government in order to provide a more accurate trajectory of these diseases on Grenada. Further studies also are needed to examine the effectiveness of health education in the matters of CKD and MVD to the general population.

Implications for Professional Practice and Social Change

The implications of this study on public health practice include the development of risk assessment of MVD for both men and women. The findings of this study could be used by practitioners to provide age-appropriate and culturally sensitive health education to their patients on the risks of developing MVD and/or CKD. Sue-Hsien et al (2011) found that patients who actively participated in care through education not only improved their relationship with the clinician but also embraced CKD treatment, maximizing positive outcomes. Health educators, such as the health promotion team and nursing staff, could develop literature for the public about the risk factors that contribute to CKD and MVD. By having an evolving CKD education program focused on patient involvement, symptom management, and disability potential while emphasizing CKD risk factor monitoring, like hypertension and drinking habits, then both doctors and patients can work together to minimize or eliminate the long-term effects of CKD not only on the individuals but also on the community and health system. (see Corbin & Strauss, 1991). The results of this study could also result in senior medical officers along with the chief medical officer working to develop protocols for not only efficiently tracking CKD and MVD cases but also conducting further studies on the long-term implications to the community. Finally, the findings of this study could lead to the recruitment of additional specialized medical staff to better assess, educate, and treat patients affected by these diseases. The application of these proposed interventions could lead to long-term reductions in CKD and MVD cases and improvement in patient outcomes.

Along with implications to the public health practice in Grenada, this study also has implications for positive social change. The observed correlations confirm the need for increased efforts to improve community outcomes among drinkers, those with a history of hypertension, and smokers to reduce the burden of CKD within society. The findings of this study could provide evidence for health care professionals, public health providers, and governmental officials to use to enhance national guidelines and change health policy to not only improve but reduce CKD outcomes in all tri-island members. The results of the study may also shed light on questions that help public health experts understand not only why the type of social practices and their frequency puts them at a higher risk of developing CKD-related complications, but also it provides the basis for further study to expand the global impact for the health of Black persons around the world.

Conclusion

In this study, I examined MVD and its relationship to CKD severity among diabetes patients with or without hypertension, when controlling for age, AIC, BMI, gender, and smoking. On average, older females were found to have more severe CKD stages (i.e., Stages 3A– 5) as compared to men. Additionally, an assessment was made to determine if there is a significant difference between MVD and complications of those with or without diabetes among men at various age groups and women at various age groups.

I found a statistically significant relationship with a large effect size between age group, cigarette smoking status, cigarette smoking frequency, alcoholic drink frequency,

ACR severity, sickling, and MVD. As age increased, there was increased risk for the development of more severe levels of CKD among women. An increased level of CKD severity in women 60 years old and older compared to men, suggests that factors associated with gender negatively impact kidney health in women. The results of this study will contribute to further studies on the impact that these risk factors have on CKD patients' long term as well as their impact on the community on a whole. Additionally, the findings of this study lay the groundwork for investment into research on other chronic diseases that directly or indirectly impact the lives of persons living within Grenada.

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