2023

Risk Factors Associated with the Development of Type II Diabetes-Related Complications

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Walden University
2023

Abstract

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by

Jessica D. Lucas Williams

MSPH, Southern New Hampshire University, 2019

BS, East Carolina University, 2014

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

By 2040, it is estimated that 642 million people ages 20 to 79 will have Type II diabetes, thereby making it a heavily studied topic among scholars. As more people are diagnosed with Type II diabetes each year, the literature is slowly shifting to long-term complications. However, the many risk and protective factors that exist have created gaps in the literature. The purpose of this study was to determine the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). The gap in the literature was addressed by assessing these variables in relation to the stated complications. The protection motivation theory was the theoretical framework of this research. This cross-sectional study design used the 2020 Behavioral Risk Factor Surveillance System (BRFSS) dataset (secondary data), and the data were analyzed using binary and multiple logistic regression models. The results revealed a few statistically significant findings. In the binary logistic regression, results indicated individuals in poor physical health have a 4% increase in odds of developing diabetes-related kidney disease [OR = 1.04, 95% CI (1.01, 1.07), $p = 0.01$]. In relation to diabetes-related kidney disease, there is a 51% decrease in odds for individuals who exercise [OR = 0.49, 95% CI (0.25, 0.93), $p = 0.03$]. The other statistically significant values were found among the covariates (race, age, and household income). The significant relationships should support the need for further research with more extensive data samples and targeted data. The opportunities for positive social change include social institutions and cultures, such as the local communities, the healthcare system, and the economic burden of families.

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Dedication

This body of work is dedicated to my son Brandon Jeremiah Williams. Do not let anyone tell you what you cannot do. Anything is possible with God.

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Section 1: Foundation of the Study and Literature Review

Type II diabetes is a metabolic disorder resulting from pancreatic beta cells preventing an individual's ability to use insulin (Padhi et al., 2020). The disease is often characterized by increased fasting blood glucose and glycated hemoglobin (Tao et al., 2020). Type II diabetes is prevalent around the world, making diabetes a global chronic public health issue. The diagnosis of Type II diabetes continues to increase yearly in the United States. The prevalence and incidence of diabetes diagnosis doubled during the 1990s and most of the 2000s (Benoit et al., 2019). In the United States, about 34.3 million adults (18 years and older) (10.5% of the population) were estimated to have diabetes in 2018 (Centers for Disease Control and Prevention, 2020). By 2040, it is estimated that 642 million people ages 20 to 79 will have Type II diabetes (Ruilope et al., 2019).

Type II diabetes can also develop into complications, thus resulting in decreased quality of life and even increased mortality (Shah et al., 2015). Diabetes-related retinopathy and diabetes-related kidney disease are two more prevalent complications of Type II diabetes (Rodriguez-Sanchez et al., 2018). My goal for this study was to assess the association between risk and protective factors of Type II diabetes and diabetes-related retinopathy and kidney disease. The growing prevalence of Type II diabetes increases the prevalence of complications treated within the health system, thereby increasing the economic burden. Determining how risk and protective factors affect diabetes-related kidney disease and diabetes-related retinopathy is critical as time progresses to lessen the burden on the individual, community, and health system. This chapter includes a discussion of the foundation of the study and literature review, research design and data collection, presentation of the results and findings, and lastly, application to professional practice and implications for social change.

Background

After living with Type II diabetes for 20 years, about 60% of patients develop retinopathy to some degree (Venkatesh et al., 2014). Research also shows that diabetes causes end-stage renal disease more than any other disease, representing one-third of all patients on dialysis (Venkatesh et al., 2014). The exact origin of Type II diabetes is complicated. A series of multiple risk factors, such as genetics, age, obesity, and lifestyle, are believed to be the cause of Type II diabetes (Tao et al., 2020). Identifying risk factors for Type II diabetes provides direction for screening and prevention measures (Fletcher et al., 2002). Early detection through screening and prevention measures would also ideally heighten the prevention of diabetes-related complications such as retinopathy and kidney disease (Fletcher et al., 2002).

However, to address each diabetes-related complication, it is vital that each factor (risk or protective) is examined independently. Therefore, I analyzed participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, and exercise independently and collectively in relation to diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). Studies such as this one, in which the researcher assesses each of these factors independently and collectively, are rare in related literature. Research continues to show the growing number of people living with diabetes and how that trajectory alters the profile of Type II diabetes due to the higher rate of complications (Harding et al., 2019). At this rate, some complications, like kidney disease, may become synonymous with Type II diabetes.

Individuals living with diabetes are becoming more concerned about long-term complications such as kidney disease and retinopathy (Kuniss et al., 2019). For patients who have already received a Type II diabetes diagnosis, one of their primary concerns is the maintenance of the disease and the prevention of diabetes-related complications such as retinopathy and kidney disease (Kuniss et al., 2019). One study assessed the fear of diabetes-related complications in people with Type II diabetes (Kuniss et al., 2019). Approximately one-third of participants in that study showed meaningful fear of diabetes-related complications (Kuniss et al., 2019). In addition, health systems and communities share the same concerns as the burden of cost increases with complications like diabetes-related retinopathy and diabetes-related kidney disease (Rodriguez-Sanchez et al., 2018).

Problem Statement

While a significant amount of Type II diabetes research and programming is happening, ethnic minorities are still disproportionately affected. (Zachary et al., 2017). The mean prevalence of individuals living with diabetes is 21.7% among minorities compared to 11.3% non-Hispanic Whites (Schillinger et al., 2018). The disparities continue to increase because of many factors, including social and environmental factors such as poverty, food insecurity, violence, and neighborhood structures (Williams et al., 2010). Low socioeconomic status is often associated with irregular doctor visits, poor eating habits, lack of physical activity, and substandard diabetes management (Siddique et al., 2017). Therefore, lower incomes are a concern for patients trying to prevent diabetes-related complications, as are other factors like age and gender. Some international studies have found that men struggled less with diabetes management than women (Siddique et al., 2017). The difference in outcomes for men and women could be associated with the higher prevalence of chronic conditions and older age among women (Sayadi et al., 2021).

Research has shown a significant increase in retinopathy as individuals with Type II diabetes age, and the increase will continue because of the rapidly aging population (Gibson, 2012). An association between diabetes-related kidney disease and age has also been revealed in research (Wu et al., 2021). Many researchers have focused on the older population and the growing percentage of those affected by diabetes; however, there is an increasing concern about the rising number of young people affected by Type II diabetes (Farnaz et al., 2019).

When diabetes is not well managed, it can lead to grave complications, including kidney failure and retinopathy (Canedo et al., 2018). Forty percent of patients with Type II diabetes are expected to develop kidney disease (Hussain et al., 2021). In addition, diabetes-related kidney disease is the leading cause of chronic kidney disease (Fontana et al., 2021). When comparing diabetes-related kidney disease to nondiabetes-related kidney disease, the renal survival of patients with diabetes-related kidney disease is negatively reduced, yielding shorter renal life (Fontana et al., 2021). In one study, 23.5% of patients with diabetes-related kidney disease reached end-stage renal disease and required dialysis, compared to 5.5% of patients with non-diabetes-related kidney disease (Byun et al., 2013). Approximately 10% of all deaths of Type II diabetes patients can be attributed to diabetes-related kidney complications (Jitraknatee et al., 2020).

Diabetes-related retinopathy is a life-altering complication. Many eye illnesses or issues such as cataracts, corneal blindness, or refractive errors cause obvious visual impairments from the start (Gupta et al., 2022). Individuals with diabetes-related retinopathy maintain their normal vision levels even as the retinopathy progresses (Gupta et al., 2022). Therefore, when an individual realizes something is wrong, extensive measures are required to reverse vision loss, resulting in blindness for many people. Blindness due to diabetes-related retinopathy is a leading cause of adult-onset blindness (Wykoff et al., 2021). Because of the asymptomatic nature of diabetes-related retinopathy, in one study, 32.9% were diagnosed with diabetic retinopathy (Nwanyanwu et al., 2021). 70% of participants diagnosed with diabetic retinopathy in that study were unaware. According to another study's analysis, the number of adults with diabetes-related retinopathy worldwide is expected to increase from 103.12 million in 2020 to 160.50 million in 2045 (Shi et al., 2022). Thus, without proper intervention, the approximate increase places a severe burden on the healthcare system.

Literature Strategy and Search

I used two databases to conduct a comprehensive search of the literature concerning diabetes-related complications (retinopathy and kidney disease), risk factors (BMI, smoking status, participation in exercise, poor mental health, poor physical health), and protective factors (participation in a class to manage diabetes). These databases included the Thoreau Multi-Database Search at Walden University Library and Google

Scholar. The keywords used in the library search were: *diabetes-related complications (diabetes-related retinopathy, diabetes-related kidney disease)* and *risk or protective factors*. The literature search was also limited to peer-reviewed journal articles within the 5 years prior to completion of my study (2017–2022).

Literature Review Related to Key Variables

Diabetes-Related Complications

Researchers are concerned with the growing number of people living with diabetes for a longer time and the altering disease profile because of complications (Harding et al., 2019). Harding et al. (2019) showed that complications of diabetes, such as end-stage renal disease and retinopathy, are less explored complications of Type II diabetes. Kuniss et al. (2019) examined and assessed the expectations and fear of diabetes-related complications in the long term. Kuniss et al. (2019) used a questionnaire to determine the level of fear and personal risk of suffering from diabetes-related complications after ten years of diabetes. Long-term diabetes-related complications such as kidney complications and blindness were the most important worries for individuals with diabetes (Kuniss et al., 2019). The concern presented by Kuniss et al. (2019) would provide a basis for the interest in the topic of individuals with Type II diabetes.

Rodriguez-Sanchez et al. (2019) assessed the impact of diabetes and diabetes-related complications on people in and out of the labor force. The findings showed that diabetes considerably affected the perception of people and their condition to work (increased fear, limiting the ability to work; Rodriguez-Sanchez et al., 2018). These findings can be directly related to employers' concerns because of absenteeism and presenteeism for individuals with Type II diabetes (Rodriguez-Sanchez et al., 2018). In another study, the costs associated with kidney disease (dialysis) were the costliest complication (Ng et al., 2021). Ng et al. (2021) concluded that the prevalence and medical expenditures associated with diabetes-related complications were massive. For example, Ng et al. (2021) showed that individuals on dialysis paid 155% to 315% more in medical expenditures than those without complications. Therefore, this article directly relates to the purpose of my study as health systems and insurance providers look for strategies to lessen the financial burden associated with diabetes-related complications.

Risk or Protective Factors

Type II diabetes is a complex disease. The factors that influence diabetes-related retinopathy and diabetes-related kidney disease can vary. Multiple studies have shown that people with diabetes have a greater prevalence of depression than the non-diabetic population, and depression is associated with poor self-management and glycemic control (Lorig et al., 2009). Owens-Gary et al. (2019) highlighted the need for strategies to address mental health as a risk factor for patients with Type II diabetes. Owens-Gary et al. (2019), however, did not address diabetes-related complications in relation to mental health.

Researchers have also documented diabetes self-management classes as influential (Lorig et al., 2010). Emphasis is on the importance of researching additional strategies to prevent diabetes-related complications. Smoking is also an influential factor, as insulin resistance increases for smokers (Wang et al., 2021). Researchers have stated that modifiable risk factors such as smoking should be a primary concern for individuals diagnosed with Type II diabetes to prevent or delay the development of complications (Campagna et al., 2019). Unfortunately, while tobacco consumption has decreased across the United States, this positive trend has not been seen among individuals with Type II diabetes (Campagna et al., 2019).

Healthcare use coupled with physical activity is critical to the management of diabetes. Researchers have found that sedentary behavior was associated with a greater likelihood of Type II diabetes, cardiovascular disease, and even mortality (Marçal et al., 2020). In addition, healthcare inequities among lower socioeconomic status individuals place a more significant risk of diabetes complications, like many other factors (Tapager et al., 2022).

The goal of public health is to promote and protect the health of individuals and the communities in which they live. In this study, I examined the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). The identified relationships in the study support the structure of tailored programming to prevent or delay the onset of diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). Diabetes-related complications place the burden on the individual with the diagnosis and families and the healthcare system in general. This burden is increased when comorbidities are present (Schmidt-Busby et al., 2018). In 2014, diabetes-related costs represented almost 14% of the healthcare budget for the region (comprising the United

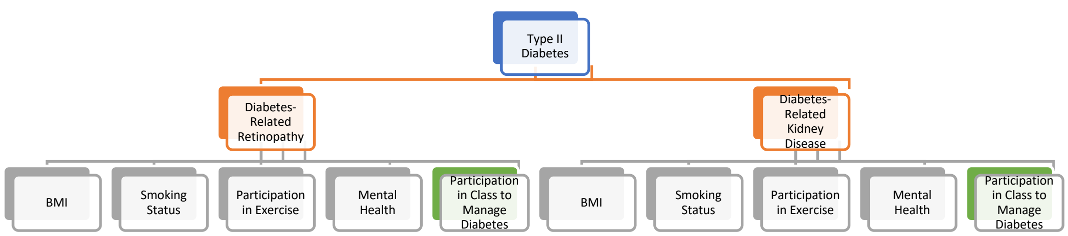
States and the Caribbean; Panton et al., 2018). Moreover, not only are individuals with diabetes concerned with self-management, but communities are also.

Purpose of the Study

The purpose of this quantitative study was to determine the role of risk and protective factors in Type II diabetes-related complications depicted in Figure 1 below.

Figure 1

Study Conceptual Model



I used secondary data (2020 BRFSS dataset) that included risk factors (BMI, smoking status, participation in exercise, poor mental health), protective factors (participation in a class to manage diabetes), and diabetes-related complications (retinopathy and kidney disease) for individuals in the United States. By determining the role of various factors in diabetes-related complications, insight is provided to individuals seeking to control their current diabetes and healthcare systems. Diabetes-related complications place burdens on people, families, and the healthcare system. By 2025, researchers expect diabetes to cost the public and private sectors $17 billion annually, and the rural communities will face the most brutal hit (Luo et al., 2022). Rural communities are especially at a disadvantage because of their limited access to resources (i.e., healthcare facilities, diabetes educators, dieticians/nutritionists) and preventive care, thereby putting individuals in rural communities at a greater risk for diabetes complications (Luo et al., 2022). Some research studies have shown that patients with Type II diabetes have significantly higher annual healthcare costs ($2,689 higher than patients without Type II diabetes) (Cannon et al., 2018).

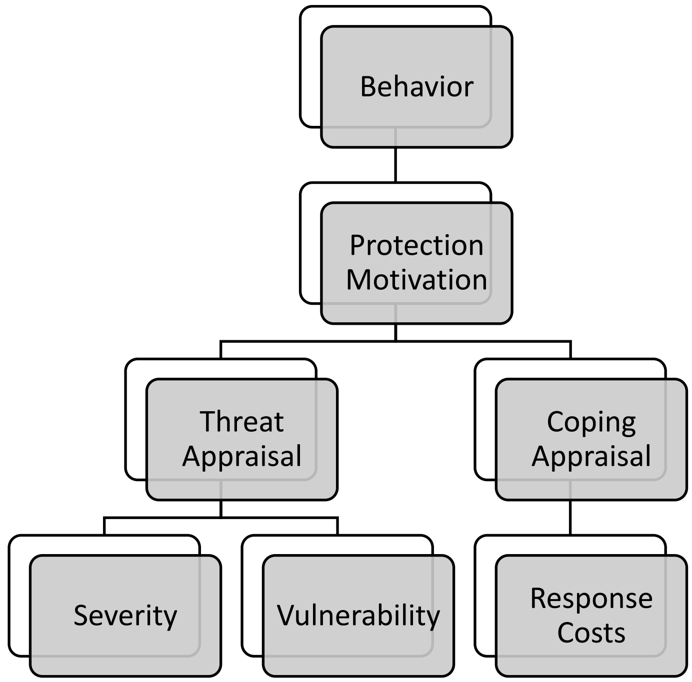
The development of diabetes-related complications such as retinopathy and kidney disease often compromise patients with Type II diabetes' quality of life (Cannon et al., 2018). Diabetes is one of the leading factors in end-stage renal disease and blindness for adults in the United States (Cannon et al., 2018). Extensive research exists on diabetes-related complications, retinopathy, and kidney disease. However, research is limited that included each of these factors (BMI, smoking status, participation in exercise, poor mental health, and participation in diabetes self-management) in relationship with diabetes-related complications (kidney disease and retinopathy) in the same study. The decreased quality of life associated with uncontrolled diabetes and complications increases mortality risks (Cannon et al., 2018). It is imperative that healthcare providers uniquely address the complex needs of patients with Type II diabetes. Otherwise, the risk of increased healthcare costs and rising mortality rates will become a reality.

Framework

The ability of an individual to manage or control their diabetes is critical to preventing or delaying diabetes-related complications (Kavookjian et al., 2005). Therefore, this study was based on the protection motivation theory. R.W. Rogers originally developed the protection motivation theory in 1975 as a framework to understand the impact of fear appeals (Conner & Norman, 2015). The theory was later expanded to cover a broader view of the impact of persuasive communication, emphasizing the cognitive processes that mediate behavior change (Conner & Norman, 2015). The protection motivation theory is based on a fear-drive model, where fear indicates and drives behaviors (Conner, 2009). As depicted in Figure 2, the protection motivation theory proposes that various environmental and intrapersonal sources of information or behaviors can result in two individual appraisal processes: threat and coping (Conner, 2009). I determined the extent of a relationship between identified risk and protective factors (behaviors) and diabetes-related complications (retinopathy and kidney disease). Therefore, I examined the independent variables (participation in a diabetes self-management class, mental health, physical health, BMI, smoking status, and exercise) as behaviors. The dependent variables (diabetes-related retinopathy and kidney disease) or outcomes may or may not happen after an individual selects an appraisal process with Type II diabetes.

Figure 2

Schematic Representation of Protection Motivation Theory



Significance

The study revealed relationships between particular risk or protective factors and diabetes-related kidney disease or retinopathy. The assumption was that the relationship provides reasoning behind tailoring a program to cover more of the complexities of Type II diabetes. The significance of healthcare costs was also noteworthy. Researchers estimated in 2012 that the estimated cost of diabetes in the United States was 245 billion to 176 billion in direct medical costs and $69 million in lost productivity (Cannon et al., 2018). In the United States, in 2017, it was estimated that the overall cost of diabetes was $327 billion (American Diabetes Association, 2018). The overall costs included $237 billion in direct medical costs and at least $90 billion in lost productivity for Americans

(American Diabetes Association, 2018). Comorbidities are the most substantial factor in diabetes-related medical expenses (American Diabetes Association, 2018). The outcome of this study provides clarity on addressing the complexities of diabetes to lessen the burden on the healthcare system.

The indirect costs (absenteeism, presenteeism, inability to work due to disability), estimated to be $89.9 billion, are equally concerning for employers (American Diabetes Association, 2018). Research has shown that individuals with diabetes have higher absenteeism rates, presenteeism, and inability to work than individuals without diabetes (American Diabetes Association, 2018). The burden is only exacerbated when diabetes-related complications are present. It is estimated that if individuals with diabetes were able to work at the same rate individuals without diabetes were able to, there would be two million more adults (ages 18–64) in the workforce (American Diabetes Association, 2018). Therefore, the findings of this study are also significant to employers as they examine their workforce's health and possible sources of indirect costs.

There is also an opportunity for social change. Because of the ever-changing statistics and state of Type II diabetes in the United States, it is critical that social change is considered to transform institutions, cultures, and society in general. By dissecting a few of the complexities around diabetes-related complications (diabetes-related retinopathy and diabetes-related kidney disease) and other diabetes-related risk and protective factors, there is an opportunity for interactions to occur that may influence social institutions and cultures. The social institutions could include the effect it may have on the economy and the economic burden of families as they navigate providing support for family members as they care for someone with Type II diabetes.

The opportunity for permanent social change is also possible through policy change. Policy change is possible for employers as they make changes to allow for better diabetes self-management skills during the workday to decrease indirect costs such as absenteeism and presenteeism. Local government entities may also make policy change possible as the outcomes in this study may provide the evidence needed to begin to change policy to increase the number of sidewalks and grocery stores in neighborhoods. In some instances, the policy could involve making new housing developments and stores mandatory to add a sidewalk to their development plans within the area. Policies around health care access through health insurance may also be supported through this study. The prevalence of diabetes-related complications and certain factors may be extensive enough for health plans to examine further for coverage.

Scope and Delimitations

Type II diabetes-related complications of retinopathy and kidney disease) were issues that I addressed in this study. I selected this area of research because according to Abdulghani et al. (2018), Type II diabetes amplifies health complications long-term. The rising rate of Type II diabetes is the focal concern of many physicians to prevent or delay related complications (Abdulghani et al., 2018). Addressing the risk/protective factors (participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, and exercise) in this study fills a gap in the research. The variables in the study are limited to the 2020 Behavioral Risk Factor Surveillance System (BRFSS), thereby limiting the scope of the study to variables in the secondary dataset. The selected dataset included data from 50 states, the District of Columbia, Guam, and Puerto Rico, in 2020. I maintained generalizability in the study by not excluding any groups. Moreover, I found no issues with the data set.

The health belief model and transtheoretical model were potential frameworks for this study. However, unlike the other theories, the protection motivation theory provides a possible explanation of how an individual can start with a behavior (independent variable) and experience an outcome of diabetes-related retinopathy or kidney disease.

Limitations, Challenges, and/or Barriers

When considering potential limitations of the study, self-report surveys were considered because of the increased likelihood of social desirability bias. Respondents may not feel comfortable providing an answer that does not represent them in the best manner. For example, participants in the survey could report the amount of physical activity they believe they should be getting instead of the accurate amount. Using a cross-sectional design was one of the challenges of this study. One of the main disadvantages of a cross-sectional approach is the inability to imply causation (Taris et al., 2021). Cross-sectional studies are used to analyze all parts of the dataset (independent, dependent variables) from a population simultaneously, making it difficult to establish a temporal association (Wang & Cheng, 2020). A longitudinal study is the only study that can demonstrate causation (Spector, 2019).

Foundation of the Study and Literature Review Summary

The purpose of this quantitative cross-sectional analysis was to examine the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). The study featured a multiple regression analysis of the 2020 BRFSS by the Centers for Disease Control and Prevention (CDC) dataset. The comprehensive literature review featured a segregated display of the diabetes-related complications (kidney disease and retinopathy) and risk/protective factors (participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, and exercise). The literature that studies these factors together in relationship to diabetes-related complications (kidney disease and retinopathy) is minimal. The study's design and data collection were initiated after reviewing the existing literature.

Section 2: Research Design and Data Collection

In this quantitative cross-sectional analysis, I examined the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). In this section, I introduce the research questions as well as the research design of the study. The variables and related questions from the 2020 BRFSS by the CDC survey is presented in detail. In addition, I described, in detail, the data and dataset used in the study, including the data collection method and information on the background of the data collection, leading to the presentation of the results and findings.

Research Questions and Hypotheses

The first research question was used to determine the extent to which there is a relationship between risk factors (mental health, physical health, BMI, smoking status, exercise) and diabetes-related retinopathy. The second question was used to determine the extent to which there is a relationship between protective factors (participation in diabetes self-management classes) and diabetes-related retinopathy. The third research question was used to determine the relationship between risk factors and diabetes-related kidney disease. The final research question was used to determine the relationship between protective factors (participation in diabetes self-management classes) and diabetes-related kidney disease. The independent variables were participation in a diabetes self-management class, mental health, physical health, BMI, smoking status, and exercise. The covariates were race, age, gender, and household income. The dependent variables were diabetes-related retinopathy and diabetes-related kidney disease.

Research Question 1 (RQ1): To what extent is there a relationship between mental health, physical health, BMI, smoking status, exercise, with diabetes-related retinopathy, when controlling for race, age, gender, and household income?

Null Hypothesis ($H_0 1$): There is no relationship between participation in mental health, physical health, BMI, smoking status, and exercise, with diabetes-related retinopathy after controlling for race, age, gender, and household income.

Alternative Hypothesis ($H_a 1$): There is a relationship between participation in mental health, physical health, BMI, smoking status, and exercise, with diabetes-related retinopathy after controlling for race, age, gender, and household income.

RQ2: To what extent is there a relationship between participation in diabetes self-management classes with diabetes-related retinopathy, when controlling for race, age, gender, and household income?

$H_o 2$: There is no relationship between participation in diabetes self-management classes with diabetes-related retinopathy after controlling for race, age, gender, and household income.

$H_a 2$: There is a relationship between participation in diabetes self-management classes, with diabetes-related retinopathy after controlling for race, age, gender, and household income.

RQ3: To what extent is there a relationship between mental health, physical health, BMI, smoking status, and exercise, with diabetes-related kidney disease, when controlling for race, age, gender, and household income?

H_o3: There is no relationship between mental health, physical health, BMI, smoking status, and exercise, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

H_a3: There is a relationship between mental health, physical health, BMI, smoking status, and exercise, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

RQ4: To what extent is there a relationship between participation in diabetes self-management classes, with diabetes-related kidney disease, when controlling for race, age, gender, and household income?

H_o4: There is no relationship between participation in diabetes self-management classes, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

H_a4: There is a relationship between participation in diabetes self-management classes, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

Secondary Data Types and Sources of Information

I accessed the secondary data from the BRFSS by the CDC. The selected data were from 50 states, the District of Columbia, Guam, and Puerto Rico, in 2020. The survey collected the BMI (_RFBMI5), race (_RACE), age (_AGE_G), gender

(BIRTHSEX), and household income (INCOME2) of all 401,958 participants. Participants were asked if they've ever taken a course or class to manage their diabetes to determine participation in self-management classes (DIABEDU). Mental health was determined by asking how many days during the past 30 days was their mental health not good (including stress, depression, and problems with emotions; MENTHLTH).

Similarly, physical health was determined by asking participants in the past 30 days how many days was their physical health not good (including physical illness and injury; PHYSHLTH). To determine participants' smoking status, they were asked if they were an everyday smoker, someday smoker, former smoker, or nonsmoker (_SMOKER3). Exercise status was gathered by asking participants during the past month, other than their regular job, if they participated in any physical activities or exercises (such as running, calisthenics, golf, gardening, or walking for exercise) (EXERANY2). Diabetes-related complications were evaluated in the survey as well. To determine if participants had retinopathy, they were asked if a doctor ever told them that diabetes had affected their eyes or that they had retinopathy (DIABEYE). In addition, they were also asked if they were ever told they had kidney disease (not including kidney stones, bladder infection, or incontinence; CHCKDNY2).

Table 1

Summary of Variables and Analysis

Study variables	Name in codebook	Level of measurement	Categories	Data analysis
BMI (IV)	_RFBMI5	Ordinal	1 = No Note: BMI < 25.00 2 = Yes Note: BMI > 25.00 9 = Don't Know/Refused/Missing	Multiple logistic regression
Household Income (IV)	INCOME2	Ordinal	1 = Less than $15,000 2 = Less than $25,000 ($15,000 to less than $25,000) 3 = Less than $35,000 ($25,000 to less than $35,000) 4 = Less than $50,000 ($35,000 to less than$50,000) 5 = Less than $75,000 ($50,000 to less than$75,000) 6 = $75,000 or more 77 = Don't know/Not sure 99 = Refused	Multiple logistic regression
Taken a course to manage Type II Diabetes (IV)	DIABEDU	Nominal	1 = Yes 2 = No 7 = Don't know/Not sure 9 = Refused	Multiple logistic regression

Study variables	Name in codebook	Level of measurement	Categories	Data analysis
Mental health (IV)	MENTHLTH	Categorical	1-30 = Yes (experienced at least one day) 88 = None 77 = Don't know/Not sure 99 = Refused	Multiple logistic regression
Physical health (IV)	PHYSHLTH	Categorical	1-30 = Yes (at least one day) 88 = None 77 = Don't know/Not sure 99 = Refused	Multiple logistic regression
Smoking status (IV)	_SMOKER3	Nominal	1 = Current smoker -now smokes every day 2= Current smoker -now smokes some days 3 = Former smoker 4 = Never smoked 9 =Don't know/Refused/Missing	Multiple logistic regression
Exercise (IV)	EXERANY2	Nominal	1 = Yes 2 = No 7 = Don't Know/Not Sure 9 = Refused	Multiple logistic regression
Kidney Disease (DV)	DIABEYE	Nominal	1 = Yes 2 = No 7 = Don't Know/Not Sure 9 = Refused	Multiple logistic regression
Retinopathy (DV)	CHCKDNY2	Nominal	1 = Yes 2 = No 7 = Don't know/Not Sure	Multiple logistic regression

Study variables	Name in codebook	Level of measurement	Categories	Data analysis
			9 = Refused	
Race (CV)	_RACE	Nominal	1 = White only, non-Hispanic 2 = Black only, non-Hispanic 3 = American Indian or Alaskan Native only, non-Hispanic 4 = Asian only, non-Hispanic 5 = Native Hawaiian or other Pacific Islander only, non-Hispanic 6 = Other race only, non-Hispanic 7 = Multiracial, non-Hispanic 8 = Hispanic 9 = Don't Know/Not Sure/Refused	Multiple logistic regression
Age (CV)	_AGE_G	Ratio	1 = Age 18 to 24 2 = Age 25 to 34 3 = Age 35 to 44 4 = Age 45 to 54 5 = Age 55 to 64 6 = Age 65 or older	Multiple logistic regression

Study variables	Name in codebook	Level of measurement	Categories	Data analysis
Gender (CV)	BIRTHSEX	Nominal	1 = Male 2 = Female 7 = Don't Know/Not Sure 9 = Refused	Multiple logistic regression

Data Collection

The BRFSS is the leading system of telephone surveys collecting data related to health in the nation (*CDC*, 2019). The annual survey was established in 1984, with only fifteen states participating (*CDC*, 2019). The system has expanded quite a bit since its start in 1984. The system is now collecting in all 50 states, including the District of Columbia and three United States territories; the survey interviews over 400,000 adults (≥ 18 years) every year (*CDC*, 2019).

The BRFSS questionnaire contains three primary sections: core component, optional modules, and state-added questions (CDC, 2021). BRFSS coordinators and the CDC represent the states and must agree on the questionnaire content (CDC, 2021). Some questions are pulled from other credible surveys, such as the National Health Interview or the National Health and Nutrition Examination Survey (CDC, 2021). All new questions from states, federal agencies, or other entities go through field and cognitive testing before they are released into the questionnaire (CDC, 2021). The core component is required in all interviews, and it included health-related perceptions, conditions, and behaviors in addition to demographic information (CDC, 2021). The optional modules included specific topics such as prediabetes, diabetes, and sugar-sweetened beverages (CDC, 2021). The state-added questions are developed and acquired by each state organization individually (CDC, 2021). The CDC does not edit, evaluate, track, or report those questions or responses (CDC, 2021).

The system primarily uses state health departments to transmit a standardized monthly questionnaire over landline and cellular telephones (*CDC - BRFSS - Survey Data & Documentation*, 2021). The questionnaire was used to collect client data concerning risk behaviors and preventive health practices that could affect their health status (*CDC - BRFSS - Survey Data & Documentation*, 2021). In the 2020 BRFSS survey used in this study, data were collected from all 50 states, the District of Columbia, Guam, and Puerto Rico (CDC, 2021). Also, in the 2020 BRFSS survey, the state used seven state health departments to collect data. The remaining data was purchased from Marketing Systems Group, Inc. (MSG) (CDC, 2021).

Computer-Assisted Telephone Interview (CATI) systems were used to conduct the interviews (CDC, 2021). This system also provides questionnaire programming and scripting to conduct interviews providing a standard of 17 to 27 minutes per interview, dependent upon the number of questions used (core questions – 17 minutes) (CDC, 2021). Telephone interviews were conducted seven days a week, during the daytime and evening (CDC, 2021).

Nature of the Study

A cross-sectional analysis was conducted using secondary data. A cross-sectional design is often used to test assumptions about the relationships in research questions (Taris et al., 2021). Another use of cross-sectional studies is to research associations between risk factors and a potential outcome (Levin, 2006). The second use was the design used in this study. The analysis featured a multiple regression analysis. The independent variables or behaviors (in reference to the protection motivation theory) were participation in diabetes self-management classes, state of mental health, physical health, BMI, smoking status, and participation in exercise activity. The covariates were race, age, gender, and household income. Lastly, the dependent variables or outcomes (in reference to the protection motivation theory) were diabetes-related retinopathy and diabetes-related kidney disease. When a behavior (independent variable) is initiated, there are two methods of assessment or appraisal, threat or coping. The protection motivation theory provides a possible explanation of how an individual can start with a behavior (independent variable) and experience an outcome of diabetes-related retinopathy or kidney disease.

Threats to Validity

External and internal threats were assumed to be present due to the nature of the secondary data in the study. The data in the study was collected through telephone surveys, which can include non-response bias as well as oversight of key populations, thereby affecting the randomization of the study. The results of this study should be cautiously used as generalizable due to the complexities of securing the secondary data.

Ethical Procedures

All applicable ethical procedures were applied to the study. BRFSS data were federally produced and are available in the public domain for use without permission. In addition to being publicly available, the data were de-identified. An application for

Walden University's Institutional Review Board was submitted and approved before completing the analysis.

Research Design and Data Collection Summary

The cross-sectional study design allows for the investigation of possible associations between risk factors identified in the research questions (Levin, 2006). Four research questions were addressed in this study. The first research question was used to determine the extent to which there is a relationship between risk factors (mental health, physical health, BMI, smoking status, exercise) and diabetes-related retinopathy. The second question was used to determine the extent to which there is a relationship between protective factors (participation in diabetes self-management classes) and diabetes-related retinopathy. The third research question was used to determine the relationship between risk factors and diabetes-related kidney disease. The final research question was used to determine the relationship between protective factors (participation in diabetes self-management classes) and diabetes-related kidney disease. The data used in the study were from the 2020 BRFSS survey. The telephone interview questionnaire was conducted in all fifty states, the District of Columbia, Guam, and Puerto Rico (CDC, 2021). Using this secondary data source, a cross-sectional design featuring a multiple logistic regression analysis was selected through the IBM Statistical Package for Social Sciences 28.0 (SPSS 28.0) provided by Walden University. The data were filtered to only include participants who have been told they have diabetes (in alignment with the survey questionnaire). The presence (or absence) of diabetes-related kidney disease and diabetes-related retinopathy was compared among these participants.

I used the analysis to examine the risk and protective factors collectively first and then individually. Univariate regression analysis was conducted to determine independent factors associated with outcomes and estimate any confounding factors. A p-value of < 0.05 was considered significant. Then, multiple regression analysis was conducted to determine the protective and risk factors collectively associated with outcomes. A p-value of < 0.05 was considered significant. Multiple methods could have been used for interpreting results when analyzing the data. Results in this study were described as mean ± SD or median unless otherwise noted. The next section presents the results and findings of this analysis.

Section 3: Presentation of the Results and Findings

The purpose of this study was to examine the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). Through the literature review I determined that the covariates, race, age, gender, and household income influence both diabetes complications, diabetes-related retinopathy, and diabetes-related kidney disease. In this section I will describe the data collection, cleaning process, and descriptive statistics as well as summarize the study. The research questions and hypothesis in the study were:

RQ1: To what extent is there a relationship between mental health, physical health, BMI, smoking status, exercise, with diabetes-related retinopathy, when controlling for race, age, gender, and household income?

H_o1: There is no relationship between participation in mental health, physical health, BMI, smoking status, and exercise, with diabetes-related retinopathy after controlling for race, age, gender, and household income.

H_a1: There is a relationship between participation in mental health, physical health, BMI, smoking status, and exercise, with diabetes-related retinopathy after controlling for race, age, gender, and household income.

RQ2: To what extent is there a relationship between participation in diabetes self-management classes with diabetes-related retinopathy, when controlling for race, age, gender, and household income?

H_o2: There is no relationship between participation in diabetes self-management classes with diabetes-related retinopathy after controlling for race, age, gender, and household income.

H_a2: There is a relationship between participation in diabetes self-management classes, with diabetes-related retinopathy after controlling for race, age, gender, and household income.

RQ3: To what extent is there a relationship between mental health, physical health, BMI, smoking status, and exercise, with diabetes-related kidney disease, when controlling for race, age, gender, and household income?

H_o3: There is no relationship between mental health, physical health, BMI, smoking status, and exercise, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

H_a3: There is a relationship between mental health, physical health, BMI, smoking status, and exercise, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

RQ4: To what extent is there a relationship between participation in diabetes self-management classes, with diabetes-related kidney disease, when controlling for race, age, gender, and household income?

H_o4: There is no relationship between participation in diabetes self-management classes, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

H_a4: There is a relationship between participation in diabetes self-management classes, with diabetes-related kidney disease after controlling for race, age, gender, and household income.

Data Collection and Cleaning of Secondary Data

I downloaded the 2020 BRFSS survey data from the CDC website. The data were downloaded in the SAS Transport Format and was imported into SPSS. I cleaned the data by first hiding the variables that were not a part of this study. After additional analysis, I realized the complications variables (kidney disease and retinopathy) included two responses (don't know/not sure and refused) that needed to be excluded. This exclusion reduced the number of cases of individuals that answered the question about diabetes-related kidney disease and diabetes-related retinopathy to 257. I completed the same process for the other variables in the study (race, gender, taken a course to manage Type II diabetes, mental health, physical health, smoking status, exercise, BMI, and household income).

Recoding Variables

I recoded the household income variable in the study to slightly reduce the number of values produced by this variable. The codebook label for this variable was: 1 = *Less than $10,000*, 2 = *Less than $15,000 ($10,000 to less than $15,000)*, 3 = *Less than $20,000 ($15,000 to less than $20,000)*, 4 = *Less than $25,000 ($20,000 to less than $25,000)*, 5 = *Less than $35,000 ($25,000 to less than$35,000)*, 6 = *Less than $50,000 ($35,000 to less than $50,000)*, 7 = *Less than $75,000 ($50,000 to less than $75,000)*, 8 = *$75,000 or more*, 77 = *Don't Know/Not Sure*, and 99 = *Refused*. The variable in this study combined values one and 2 in the original codebook *(Less than $15,000)* and values 3 and 4 *(Less than $25,000)* (and excluded values *77* and *99*). I combined these two levels to have an equal distribution. The other values stayed the same and were renumbered following the previous value.

The study's dependent variables (diabetes-related kidney disease and diabetes-related retinopathy) originally included two categories *(don't know/not sure and refused)* that I removed to allow for a binary logistic regression in SPSS. These variables were also dummy coded *(0 = no, 1 = yes)*.

Results and Findings

Descriptive Statistics

I produced descriptive statistics that included frequencies, minimum, maximum, mean, and standard deviation for non-categorical variables in the study, as depicted in Table 2. A frequency table (Table 3) was produced for all categorical variables in the study, and it included the frequency and percentage of the variable that appeared in the study.

Table 2 includes the total sample size ($N = 257$) for each non-categorical variable in the study, the minimum (1 day) and maximum (30 days) number of days an individual could answer that their physical or mental health was not good. The average number of days in the study that an individual's physical health was not good was about 16 days (16.14), and about 14 days (14.30) for mental health days. In Table 3, the frequency and frequency percentage showed that each categorical variable was represented 100% for the selected cases in this study. The valid percent was also reported (100%) for each categorical variable in the study. For the diabetes self-management class variable, most participants stated they had participated in a class (57.6%). 89.1% of participants had a BMI greater than or equal to 25 and 55.6% of participants smoked at some time in their past (smoking status). The exercise status was a little closer in measurement with 55.6% of individuals in the study stating they exercised in the past 30 days. For both diabetes-related complications (kidney disease and retinopathy) an overwhelming majority of participants in the survey group had not been diagnosed with either complication. In Table 4, the frequency and frequency percentage showed that each demographic or control variable was represented 100% for each case in the study. The demographics in Table 4 showed that most participants in the study were White (59.1%) women (69.1%). The second most represented race in the study was Black at 32.7%. Most of the participants in the study were also above the age of 45. The age category of 45 to 54 years old represented 20.6% of the study and the 55 to 64-year-old age group represented 25.6% of the population. The largest group represented by age was individuals 65 years old or greater (45.9%). As far as the household income of the participants in the study, the majority identified as less than $50,000 (greater than $35,000 and less than $50,000) (23%). No one in the study stated they had a household income greater than $50,000.

Table 2

Descriptive Statistics for Physical Health and Mental Health Variables

	N	Minimum	Maximum	Mean	Std. Deviation
Number of Days Physical Health Not Good	257	1	30	16.14	10.84
Number of Days Mental Health Not Good.	257	1	30	14.30	10.82

Table 3

Frequency Statistics of Independent and Dependent Variables

		Frequency	Percent
Diabetes Self-Management Class	No	109	42.4
	Yes	148	57.6
	Total	257	100.0
BMI	No 12 >=BMI <25	28	10.9
	Yes 25 >= BMI <99	229	89.1
	Total	257	100.0
Smokes Everyday	Does Not Smoke Every Day	215	83.7
	Smokes Every Day	42	16.3
	Total	257	100.0
Smokes Some Days	Does Not Smoke Some Days	239	93.0
	Smokes Some Days	18	7.0
	Total	257	100.0
Former Smoker	Not a Former Smoker	174	67.7
	Former Smoker	83	32.3
	Total	257	100.0
Never Smoked	Has Smoked in the Past	143	55.6
	Never Smoked	114	44.4
	Total	257	100.0
Exercise	No	143	55.6
	Yes	114	44.4
	Total	257	100.0
Kidney Disease	No	205	79.8
	Yes	52	20.2
	Total	257	100.0
Retinopathy	No	205	79.8

Yes	52	20.2
Total	257	100.0

Table 4

Frequency Statistics for Demographic Variables

			Frequency	Percent
	White	Non-White	105	40.9%
		White	152	59.1%
	Black	Non-Black	173	67.3%
		Black	84	32.7%
	American Indian	Non-American Indian	251	97%
		American Indian	6	2.3%
	Asian	Non-Asian	257	100.0%
Race	Native Hawaiian or Pacific Islander	Non-Native Hawaiian/Pacific Islander	257	100.0%
	Other Race	Non-Other Race	255	99.2%
		Other Race	2	0.8%
	Multiracial	Non-Multiracial	250	97.3%
		Multiracial	7	2.7%
	Hispanic	Non-Hispanic	251	97.7%
		Hispanic	6	2.3%
Age	Age 18 to 24	Not 18 to 24	255	99.2%
		Age 18 to 24	2	0.8%
	Age 25 to 34	Not Age 25 to 34	251	97.7%
		Age 25 to 34	6	2.3%
	Age 35 to 44	Not Age 35 to 44	245	95.3%
		Age 35 to 44	12	4.7%
	Age 45 to 54	Not Age 45 to 54	204	79.4%
		Age 45 to 54	53	20.6%
	Age 55 to 64	Not Age 55 to 64	191	74.3%
		Age 55 to 64	66	25.7%
	Age 65 or Older	Not Age 65 or Older	139	54.1%
		Age 65 or Older	118	45.9%

Gender		Male	98	38.1%
		Female	159	61.9%
Household Income	Less than $10,000	Not Less than $10,000	223	86.8%
		Less than $10,000	34	13.2%
	Less than $15,000 ($10,000 to less than $15,000)	Not Less than $15,000	224	87.2%
		Less than $15,000	33	12.8%
	Less than $20,000 ($15,000 to less than $20,000)	Not Less than $20,000	218	84.8%
		Less than $20,000	39	15.2%
	Less than $25,000 ($20,000 to less than $25,000)	Not Less than $25,000	218	84.8%
		Less than $25,000	39	15.2%
	Less than $35,000 ($25,000 to less than $35,000)	Not Less than $35,000	204	79.4%
		Less than $35,000	53	20.6%
	Less than $50,000 ($35,000 to less than $50,000)	Not Less than $50,000	198	77.0%
		Less than $50,000	59	23.0%
	Less than $75,000 ($50,000 to less than $75,000)	Not Less than $75,000	257	100.0%
		Not Greater than or equal to $75,000	257	100.0%

Normality was tested using skewness and kurtosis for physical and mental health variables (Table 5). Both values (skewness and kurtosis) were found to be within the threshold of ± 3.3. Box plots and *z*-scores were also produced for the same two variables (mental health and physical health) to determine if there were any outliers in the dataset. The boxplot for mental health (Figure 3) and the boxplot for physical health (Figure 4) did not feature any outliers.

These tests were only completed for the noncategorical variables (mental health and physical health). The other variables (categorical) in the study were not tested because the same assumptions do not apply.

Table 5

Normality Test Statistics for Physical and Mental Health

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness Statistic	Skewness Std. Error	Kurtosis Statistic	Kurtosis Std. Error
Number of Days Physical Health Not Good	257	1	30	16.14	10.84	0.09	0.15	-1.54	0.30
Number of Days Mental Health Not Good	257	1	30	14.30	10.82	0.35	0.15	-1.42	0.30

Figure 3

Box Plot for Physical Health

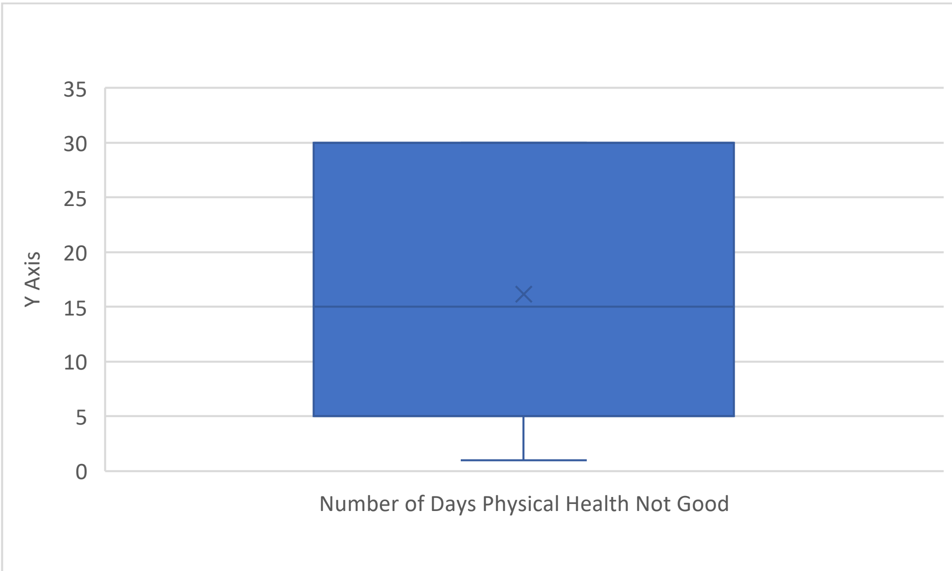
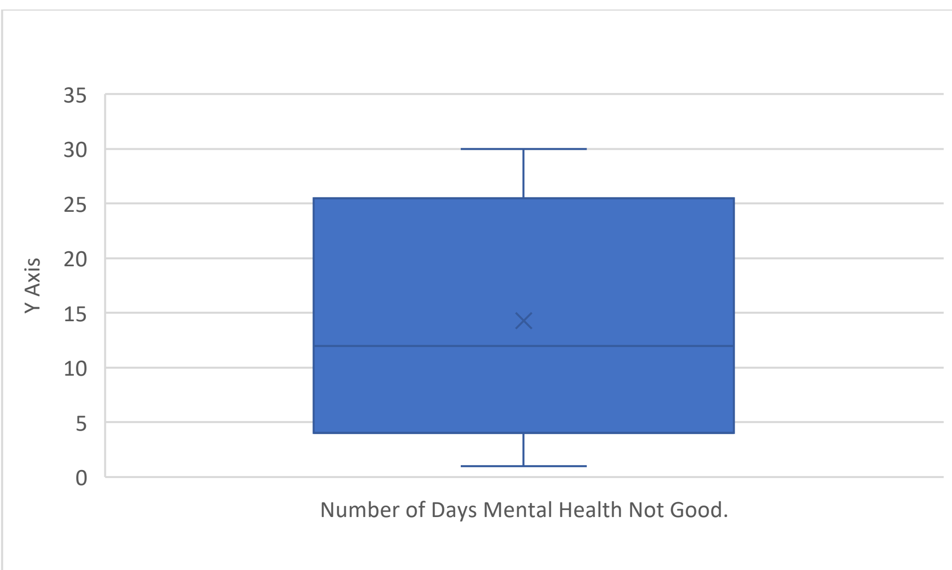


Figure 4

Box Plot for Mental Health



The absence of outliers' results was confirmed with the z-scores of both variables (mental health & physical health) featured in Table 6. Whether positive or negative, Z-scores are used to indicate how many standard deviations the score is above or below the average, respectively (Chikodili et al., 2021). Therefore, outliers are detected based on a z-score value of $\pm$ 3.3 (Chikodili et al., 2021). For each of the z-scores presented in Table 6, the values were within $\pm$ 3.3, indicating no outliers in the dataset. The other variables in the study were not tested for outliers because they are categorical variables, and the same assumptions do not apply.

Table 6

Z-scores for Continuous Variables

	N	Minimum	Maximum	Mean	Std. Deviation
Zscore (PHYSHLTH) Number of Days Physical Health Not Good	257	-1.40	1.28	0.00	1.00
Zscore (MENTHLTH) Number of Days Mental Health Not Good.	257	-1.23	1.45	0.00	1.00

Statistical Analysis

A total of 257 cases were included in the analysis for both dependent variables (diabetes-related kidney disease and diabetes-related retinopathy), which had all study variables and reported having diabetes. The statistical analysis in this section is separated by the applicable research questions. The analysis for each research question begins with an individual variable analysis through a binary logistic model. The individual analysis is followed by a collective analysis through a multiple logistic regression model. The multiple and binary logistic regression tables in this section are separated in the same manner as the analysis.

Research Question 1

Binary Logistic Analysis

Each variable in research question one was analyzed individually in a binary logistic model. None of the independent variables (Table 7-11) were found to be statistically significant with diabetes-related retinopathy.

Table 7

Binary Logistic Regression with Diabetes-Related Retinopathy and Mental Health

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
Number of Days Mental Health Not Good	0.00	0.01	0.07	1	0.79	1.00	0.98	1.03

Table 8

Binary Logistic Regression with Diabetes-Related Retinopathy and Physical Health

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
Number of Days Physical Health Not Good	0.02	0.01	1.46	1	0.23	1.02	0.99	1.05

Table 9

Binary Logistic Regression with Diabetes-Related Retinopathy and BMI

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
BMI	-0.52	0.45	1.33	1	0.25	0.59	0.25	1.44

Table 10

Binary Logistic Regression with Diabetes-Related Retinopathy and Smoking Status

		B	S.E.	Wald	df	p-value	OR	95% C.I.	
								Lower	Upper
Smoking Status	**Smokes Everyday****	0.41	0.39	1.09	1	0.30	1.51	0.70	3.24
	Smokes Some Days	-0.25	0.65	0.15	1	0.70	0.78	0.22	2.79
	Former Smoker	-0.20	0.34	0.35	1	0.55	0.82	0.42	1.59
	Never Smoked	-0.01	0.31	0.00	1	0.98	0.99	0.54	1.83

reference category**

Table 11

Binary Logistic Regression with Diabetes-Related Retinopathy and Exercise

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
Exercise	0.19	0.31	0.36	1.00	0.55	1.21	0.66	2.22

Multiple Logistic Analysis

Multiple logistic regression was used to investigate the extent to which there is a relationship between mental health, physical health, BMI, smoking status, exercise, with diabetes-related retinopathy when controlling for race, age, gender, and household income. The model fitness was assessed using the Chi-square statistic. The logistic regression model was statistically significant using the X^2 value for the Omnibus test of the model ($\chi2(6) = 37.53$, $p = 0.03$). A post-hoc power analysis was performed using G* Power for the significant test result; statistical power was found to be 46%, indicating inadequate power, on an alpha level of 0.05. The low statistical power of the observed effect may be due to the smaller population. The model accounted for 13.6% of the variance (Cox & Snell, $R^2 = 0.136$) and correctly classified 81.7% of cases. When examining the independent variables and covariates individually in the model, individuals ages 45 to 54 were significantly associated with retinopathy ($p = 0.02$). Diabetes-related retinopathy is 71% less likely to occur among individuals ages 45 to 54 (Table 12) [OR = 0.29, 95% CI (0.11, 0.88)]. No other associations were observed.

Table 12

Multiple Logistic Regression with Diabetes-Related Retinopathy and Risk Factors

		B	S.E.	Wald	df	p-value	OR	95% C.I. Lower	95% C.I. Upper
Independent Variables	Number of Days Mental Health Not Good.	0.01	0.02	0.37	1	0.54	1.01	0.98	1.05
	Number of Days Physical Health Not Good	0.03	0.02	2.81	1	0.09	1.03	0.99	1.07
	BMI	-0.37	0.54	0.47	1	0.49	0.69	0.24	1.98
	Smokes Everyday	0.26	0.48	0.30	1	0.58	1.30	0.51	3.32
	Smokes Some Days	-0.30	0.80	0.14	1	0.71	0.74	0.15	3.58
	Former Smoker	-0.36	0.43	0.72	1	0.40	0.70	0.30	1.61
	Exercise	0.54	0.40	1.81	1	0.18	1.72	0.78	3.78
Covariates	**White****	-1.41	1.14	1.53	1	0.22	0.24	0.03	2.28
	Black	0.02	1.14	0.00	1	0.98	1.03	0.11	9.66
	American Indian	0.91	1.42	0.41	1	0.52	2.48	0.15	40.11
	Other Race	-20.39	28384.60	0.00	1	1.00	0.00	0.00	

Multiracial	-0.93	1.58	0.34	1	0.56	0.40	0.02	8.77
Age 18 to 24**	-20.40	28128.29	0.00	1	1.00	0.00	0.00	
Age 25 to 34	1.44	1.01	2.02	1	0.16	4.21	0.58	30.54
Age 35 to 44	-0.72	0.91	0.62	1	0.43	0.49	0.08	2.93
Age 45 to 54	-1.23	0.54	5.14	1	**0.02***	0.29	0.10	.85
Age 55 to 64	-0.41	0.43	0.88	1	0.35	0.67	0.29	1.55
Gender	-0.63	0.36	3.01	1	0.08	0.53	0.26	1.09
Less than $10,000**	0.11	0.60	0.03	1	0.86	1.11	0.34	3.63
Less than $15,000 ($10,000 to less than $15,000)	-0.19	0.64	0.09	1	0.76	0.82	0.24	2.88
Less than $20,000 ($15,000 to less than $20,000)	0.85	0.55	2.43	1	0.12	2.34	0.80	6.82
Less than $25,000 ($20,000 to less than $25,000)	0.15	0.62	0.06	1	0.81	1.16	0.35	3.90
Less than $35,000 ($25,000 to less than $35,000)	-0.03	0.57	0.00	1	0.95	0.97	0.32	2.94

*$p < .05$

**reference category

Research Question 2

Binary Logistic Analysis

The independent variable in research question two was analyzed individually in a bivariate logistic model. The independent variable, diabetes self-management classes, in research question two was not found to be statistically significant.

Table 13

Binary Logistic Regression with Diabetes-Related Retinopathy and Diabetes Self-Management Class

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
Diabetes Self-Management Class	0.41	0.32	1.61	1.00	0.20	1.51	0.80	2.84

Multiple Logistic Analysis

Multiple logistic regression was used to investigate the extent to which there is a relationship between participation in diabetes self-management classes with diabetes-related retinopathy when controlling for race, age, gender, and household income. The logistic regression model was statistically significant using the X^2 value for the Omnibus test of the model ($\chi 2(6) = 31.79$, $p = 0.02$). A post-hoc power analysis was performed using G* Power for the significant test result; statistical power was found to be 46%, indicating inadequate power, on an alpha level of 0.05. The low statistical power of the observed effect may be due to the smaller population. The model accounted for 11.6% of the variance (Cox & Snell, $R^2 = 0.116$) and correctly classified 81.3% of cases.

When examining the independent variables and covariates individually, individuals aged 45 to 54 were significantly associated with kidney disease (p = 0.03). According to the odds ratio for diabetes-related retinopathy, there is a 66% decrease in odds among individuals ages 45 to 54 (Table 14) [OR = 0.34, 95% CI (0.13, 0.93)]. No other associations were observed.

Table 14

Multiple Logistic Regression with Diabetes-Related Retinopathy and Protective Factors

								95% C.I.	
		B	S.E.	Wald	df	p-value	OR	Lower	Upper
Independent Variable	Diabetes Self-Management Class	0.37	0.36	1.04	1	0.31	1.45	0.72	2.93
Covariates	**White****	-1.46	1.06	1.89	1	0.17	0.23	0.03	1.77
	Black	-0.30	1.06	0.08	1	0.78	0.74	0.08	5.45
	American Indian	0.91	1.35	0.45	1	0.50	2.48	0.16	31.50
	Other Race	-20.41	28207.61	0.00	1	1.00	0.00	0.00	
	Multiracial	-1.15	1.50	0.59	1	0.44	0.32	0.02	5.76
	Age 18 to 24**	-20.46	27158.19	0.00	1	1.00	0.00	0.00	
	Age 25 to 34	1.43	0.95	2.28	1	0.13	4.20	0.57	22.65
	Age 35 to 44	-0.62	0.88	0.49	1	0.48	0.54	0.12	3.61
	Age 45 to 54	-1.08	0.51	4.52	1	**0.03***	0.34	0.13	0.93
	Age 55 to 64	-0.24	0.41	0.33	1	0.57	0.79	0.36	1.81
	Gender	-0.56	0.35	2.61	1	0.11	0.57		
	Less than $10,000**	0.17	0.59	0.08	1	0.78	1.18	0.37	3.71
	Less than $15,000 ($10,000 to less than $15,000)	-0.01	0.63	0.00	1	0.99	0.99	0.26	3.00
	Less than $20,000 ($15,000 to	0.89	0.53	2.87	1	0.09	2.44	0.80	6.21

	less than $20,000)							
	Less than $25,000 ($20,000 to less than $25,000)	-0.09	0.59	0.02	1	0.88	0.91	0.28	2.78
	Less than $35,000 ($25,000 to less than $35,000)	-0.24	0.54	0.19	1	0.66	0.79	0.28	2.33

*$p < .05$

**reference category

Research Question 3

Binary Logistic Analysis

Each variable in research question one was analyzed individually in a bivariate logistic model. When examining the independent variables, the physical health variable was found to be statistically significant (p = 0.01) in association with diabetes-related kidney disease. According to the odds ratio individuals in poor physical health have a 4% increase in odds of developing diabetes-related kidney disease (Table 16) [OR = 1.04, 95% CI (1.01, 1.07)]. The variable exercise was also statistically significant (p = 0.03) in association with diabetes-related kidney disease. Diabetes-related kidney disease is 51% less likely to occur in individuals who exercise (Table 19) [OR = 0.49, 95% CI (0.25, 0.93)]. No other variables were found to be significant.

Table 15

Binary Logistic Regression with Diabetes-Related Kidney Disease and Mental Health

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
Number of Days Mental Health Not Good	0.00	0.01	0.08	1.00	0.78	1.00	0.98	1.03

Table 16

Binary Logistic Regression with Diabetes-Related Kidney Disease and Physical Health

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
Number of Days Physical Health Not Good	0.04	0.01	6.66	1.00	**0.01***	1.04	1.01	1.07

*$p < .05$

Table 17

Binary Logistic Regression with Diabetes-Related Kidney Disease and BMI

	B	S.E.	Wald	df	p-value	OR	95% C.I.	
							Lower	Upper
BMI	1.29	0.75	2.95	1.00	0.09	3.63	0.83	15.82

Table 18

Binary Logistic Regression with Diabetes-Related Kidney Disease and Smoking Status

		B	S.E.	Wald	df	p-value	OR	95% C.I. Lower	95% C.I. Upper
Smoking Status	**Smokes Everyday****	-0.09	0.43	0.04	1.00	0.83	0.91	0.40	2.11
	Smokes Some Days	0.45	0.55	0.67	1.00	0.41	1.57	0.53	4.62
	Former Smoker	-0.32	0.35	0.86	1.00	0.35	0.73	0.37	1.43
	Never Smoked	0.19	0.31	0.36	1.00	0.55	1.21	0.66	2.22

reference category**

Table 19

Binary Logistic Regression with Diabetes-Related Kidney Disease and Exercise

	B	S.E.	Wald	df	p-value	OR	95% C.I. Lower	95% C.I. Upper
Exercise	-0.72	0.33	4.76	1.00	**0.03***	0.49	0.25	0.93

*$p < .05$

Multiple Logistic Analysis

Multiple logistic regression was used to investigate the extent to which there is a relationship between mental health, physical health, BMI, smoking status, and exercise with diabetes-related kidney disease when controlling for race, age, gender, and household income. The logistic regression model was statistically significant using the X^2 value for the Omnibus test of the model ($\chi 2(6) = 41.65$, $p = 0.01$). A post-hoc power analysis was performed using G* Power for the significant test result; statistical power was found to be 48%, indicating inadequate power, on an alpha level of 0.05. The low statistical power of the observed effect may be due to the smaller population. The model accounted for 15.0% of the variance (Cox & Snell, $R^2 = 0.15$) and correctly classified 81.3% of cases.

When examining the independent variables and covariates individually, individuals aged 25 to 34 were significantly associated with kidney disease (p = 0.01). According to the odds ratio, for individuals aged 25 to 34 there is a 26% increase in odds in association with diabetes-related kidney disease [OR = 25.55, 95% CI (2.65, 256.84)]. Individuals with a household income of less than $15,000 *($10,000 to less than $15,000)* were also significantly associated with kidney disease (p = 0.02). Household incomes of less than $15,000 are more than 4 times more likely to develop diabetes-related kidney disease [OR = 4.37, 95% CI (1.32, 15.08)]. No other associations were observed.

Table 20

Multiple Logistic Regression with Diabetes-Related Kidney Disease and Risk Factors

								95% C.I.	
		B	S.E.	Wald	df	p-value	OR	Lower	Upper
Independent Variables	Number of Days Mental Health Not Good.	-0.01	0.02	0.43	1	0.51	0.99	0.95	1.02
	Number of Days Physical Health Not Good	0.04	0.02	3.28	1	0.07	1.04	1.00	1.08

	BMI	1.57	0.89	3.08	1	0.08	4.80	0.83	27.64
	Smokes Everyday **	-0.14	0.53	0.07	1	0.79	0.87	0.30	2.46
	Smokes Some Days	0.48	0.74	0.42	1	0.52	1.61	0.38	6.81
	Former Smoker	-0.58	0.42	1.85	1	0.17	0.56	0.25	1.29
	Exercise	-0.63	0.41	2.33	1	0.13	0.53	0.24	1.20
Covariates	**White****	0.94	1.53	0.38	1	0.54	2.56	0.13	51.42
	Black	0.71	1.57	0.21	1	0.65	2.04	0.09	43.83
	American Indian	0.88	1.93	0.21	1	0.65	2.40	0.05	106.47
	Other Race	-19.03	28311.98	0.00	1	1.00	0.00	0.00	-
	Multiracial	0.83	1.77	0.22	1	0.64	2.29	0.07	73.19
	Age 18 to 24**	-19.15	27293.62	0.00	1	1.00	0.00	0.00	-
	Age 25 to 34	3.24	1.17	7.64	1	**0.01***	25.55	2.57	254.34
	Age 35 to 44	-1.25	1.16	1.15	1	0.28	0.29	0.03	2.81
	Age 45 to 54	-1.07	0.54	3.96	1	0.05	0.34	0.12	0.98
	Age 55 to 64	-0.62	0.44	1.97	1	0.16	0.54	0.23	1.28
	Gender	0.10	0.38	0.07	1	0.80	1.10	0.52	2.32
	Less than $10,000**	0.26	0.70	0.14	1	0.71	1.30	0.33	5.09
	Less than $15,000 ($10,000 to less than $15,000)	1.47	0.63	5.52	1	**0.02***	4.37	1.28	14.93

	Less than $20,000 ($15,000 to less than $20,000)	0.19	0.65	0.08	1	0.77	1.21	0.34	4.36
	Less than $25,000 ($20,000 to less than $25,000)	0.90	0.62	2.08	1	0.15	2.45	0.73	8.30
	Less than $35,000 ($25,000 to less than $35,000)	0.87	0.58	2.25	1	0.13	2.38	0.77	7.38

*$p < .05$

**reference category

Research Question 4

Binary Logistic Analysis

Each variable in research question four was analyzed individually in a bivariate logistic model. The independent variable, diabetes self-management classes, in research question four, was not found to be statistically significant.

Table 21

Binary Logistic Regression with Diabetes-Related Kidney Disease and Diabetes Self-Management

	B	S.E.	Wald	df	p-value	OR	95% C.I. Lower	95% C.I. Upper
Diabetes Self-Management Class	0.21	0.32	0.42	1.00	0.52	1.23	0.66	2.29

Multiple Logistic Analysis

Multiple logistic regression was used to investigate the extent to which there is a relationship between participation in diabetes self-management classes, with diabetes-related kidney disease, when controlling for race, age, gender, and household income. The logistic regression model was not statistically significant using the X^2 value for Omnibus test of the model ($\chi 2(6) = 24.35$, $p = 0.11$). A post-hoc power analysis was performed using G* Power for the significant test result; statistical power was found to be 47%, indicating inadequate power, on an alpha level of 0.05. The low statistical power of the observed effect may be due to the smaller population. The model accounted for 9.0% of the variance (Cox & Snell, $R^2 = 0.09$). The model correctly classified 80.5% of cases.

When examining the independent variables individually, individuals aged 25 to 34 were significantly associated with kidney disease ($p = 0.03$). Individuals aged 25 to 34 are 8.4 times more likely to develop diabetes-related kidney disease [OR = 8.41, 95% CI (1.32, 62.32)]. Individuals with a household income of less than $15,000 ($10,000 to less than $15,000) were also significantly associated with kidney disease ($p = 0.02$). Individuals with a household income of less than $15,000 are 4.1 times more likely to develop diabetes-related kidney disease [OR = 4.07, 95% CI (1.38, 13.67)]. No other associations were observed in the analysis of research question four.

Table 22

Multiple Logistic Regression with Diabetes-Related Kidney Disease and Protective Factors

		B	S.E.	Wald	df	p-value	OR	95% C.I. Lower	95% C.I. Upper
Independent Variable	Diabetes Self-Management Class	0.16	0.35	0.22	1	0.64	1.18	0.60	2.32
Covariates	**White****	0.49	1.31	0.14	1	0.71	1.64	0.12	21.56
	Black	0.31	1.34	0.05	1	0.81	1.37	0.10	18.88
	American Indian	-0.12	1.73	0.00	1	0.95	0.89	0.03	26.63
	Other Race	-19.54	28395.18	0.00	1	1.00	0.00	0.00	-
	Multiracial	0.94	1.58	0.36	1	0.55	2.56	0.12	56.32
	Age 18 to 24**	-19.96	28367.98	0.00	1	1.00	0.00	0.00	-
	Age 25 to 34	2.13	0.98	4.68	1	**0.03***	8.41	1.22	57.91
	Age 35 to 44	-1.48	1.12	1.74	1	0.19	0.23	0.03	2.05
	Age 45 to 54	-0.95	0.50	3.67	1	0.06	0.39	0.15	1.02
	Age 55 to 64	-0.50	0.42	1.47	1	0.23	0.60	0.27	1.36
	Gender	0.33	0.36	0.82	1	0.36	1.39	0.68	2.80
	Less than $10,000**	0.48	0.66	0.53	1	0.46	1.62	0.44	5.91
	Less than $15,000 ($10,000 to less than $15,000)	1.40	0.59	5.63	1	**0.02***	4.07	1.28	12.96
	Less than $20,000 ($15,000 to less than $20,000)	0.38	0.62	0.38	1	0.54	1.46	0.43	4.95

	Less than $25,000 ($20,000 to less than $25,000)	0.92	0.58	2.50	1	0.11	2.51	0.80	7.83
	Less than $35,000 ($25,000 to less than $35,000)	0.95	0.54	3.12	1	0.08	2.58	0.90	7.39

*$p < .05$

**reference category

Summary

This section contained a review of the descriptive statistics and multiple logistic regression that were run on the 2020 BRFSS data. The research questions proposed to test the relationship between risk and protective factors of diabetes-related kidney disease and diabetes-related retinopathy. No risk or protective factors were found individually to be statistically significant in the study utilizing a multiple logistic regression for each research question. Subsets of the control variables, age, and household income contributed, individually, to parts of the study significantly. When examining the independent variables collectively, research questions one through three were found to be statistically significant. When analyzing the variables separately through a bivariate logistic model, more statistically significant variables were found. The next section will interpret the findings of the study and present implications for social change.

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

In this study, I assessed the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). The purpose of this study was to address the gap in the literature assessing these variables in relation to the stated complications both collectively and individually.

Interpretation of the Findings

Results revealed that individuals in the 2020 BRFSS study population with diabetes were predominately White women aged 65 and older. Overall, the cumulative number of individuals that answered each of the factor questions in the survey for this study and had diabetes was low (n = 257).

RQ1 was used to address the relationship between mental health, physical health, BMI, smoking status, and exercise with diabetes-related retinopathy when controlling for race, age, gender, and household income. When conducting the multiple logistic regression, the independent variables were not statistically significant in this question. However, a significant relationship was indicated between the dependent variable (diabetes-related retinopathy) and the independent variables (mental health, physical health, BMI, smoking status, and exercise) collectively when controlling for race, age, gender, and household income. When analyzing the factors separately through a bivariate logistic model, only one of the covariates was significant: race (subcategory: White and Black individuals). Diabetes-related retinopathy is 66% less likely to occur among White individuals compared to all other races (in this study) and 2.5 times more likely in Black individuals compared to White individuals. This finding agrees with the existing literature indicating According to Zachary et al. (2017), Type II diabetes and its complications have a greater presence in minority communities, which agrees with the findings in the study. Tapager et al. (2022) assessed multiple factors together and found significance, which aligns with the findings. In the literature review, one study reported that the unique combination of socio-economic factors an individual faces can negatively affect Type II diabetes outcomes (Tapager et al., 2022). Therefore, the unique factor's outcomes of this study align with the findings of Tapanger et al. (2022) in the literature review.

RQ2 was used to address the relationship between participation in diabetes self-management classes with diabetes-related retinopathy when controlling for race, age, gender, and household income. The independent variable (diabetes self-management classes) was not statistically significant in this study individually when the multiple logistic regression. However, a significant relationship was indicated between the dependent variable (diabetes-related retinopathy) and the independent variable (diabetes self-management classes) when controlling for race, age, gender, and household income. As indicated in the interpretation of question one, this finding may result from the covariates (White and Black individuals) yielding significance in the study. Lorig et al. (2010) indicated that diabetes self-management classes are incredibly influential for individuals with diabetes, thereby aligning with the study. Yet, it would also support the need for further research on self-management classes' positive influence on diabetes complications. Diabetes self-management classes with focus groups for Black (p =

<0.001) individuals would be supported by this study as well. However, a larger study group could show greater significance and better align with the literature review.

RQ3 was used to address the relationship between mental health, physical health, BMI, smoking status, and exercise with diabetes-related kidney disease when controlling for race, age, gender, and household income. In the multiple logistic regression, the independent variables were not found to be significant individually; however, a significant relationship was indicated in the model of fitness between the dependent variable (diabetes-related kidney disease) and the independent variables (mental health, physical health, BMI, smoking status, and exercise) when controlling for race, age, gender, and household income ($\chi 2(6) = 41.65$, $p = 0.01$).

The control factors, age, and household income also had statistically significant outcomes under question three. When examining the independent variables and covariates individually in the multiple logistic regression model, individuals aged 25 to 34 were significantly associated with kidney disease and with a household income of less than $15,000 *($10,000 to less than $15,000)*. Individuals with household incomes of less than $15,000 are more than 4 times more likely to develop diabetes-related kidney disease. Siddique et al. (2017) found that finding supports related literature stating low socioeconomic status is often associated with substandard diabetes management, thus resulting in complications, this study aligns with that finding. According to the odds ratio, individuals aged 25 to 34 are 26 times more likely to be diagnosed with diabetes-related kidney disease. The age group identified as statistically significant does not agree with most existing research stating that diabetes-related complications increase with older age groups. However, it does support more recent research on the growing concern of Type II diabetes in younger individuals (Farnaz et al., 2019). If diabetes is diagnosed at a younger age more frequently, complications will, in turn, be diagnosed more frequently at younger ages. The high odds ratio may also be one of many results affected by the small sample size.

When conducting a separate analysis for each variable (bivariate logistic regression), physical health (p = 0.01) and exercise (p = 0.03) were both found to be statistically significant. According to the odds ratio, individuals in poor physical health are 1 time more likely to develop diabetes-related kidney disease. Diabetes-related kidney disease is also 51% less likely to occur in individuals who exercise. Sedentary behavior is associated with a greater likelihood of Type II diabetes and its complications (Marçal et al, 2020) and the study confirmed the existing literature. One of the covariates, ages 25 to 34 (p = 0.02), yielded a statistically significant p-value. This result aligned with the multiple logistic regression, thus yielding a more likely significance. The literature noted a growing concern of Type II diabetes in younger individuals (Farnaz et al., 2019).

Lastly, RQ4 addressed the relationship between participation in diabetes self-management classes, with diabetes-related kidney disease when controlling for race, age, gender, and household income. The independent variable (diabetes self-management classes) was not found to be statistically significant individually nor collectively with the dependent variable (diabetes-related kidney disease) when controlling for race, age, gender, and household income in the multiple logistic regression analysis. Unlike RQ2, the outcome of RQ3 does not support the existing literature framing this study, documenting diabetes self-management classes as influential (Lorig et al., 2010).

Two variables were found to be significant through bivariate logistic regression, individuals aged 25 to 34 and individuals with a household income of less than $15,000. Individuals aged 25 to 34 are 8.4 times more likely to develop diabetes-related kidney disease. Farnaz et al. (2019) emphasized the growing concern of Type II diabetes in younger individuals, and the study findings aligned with this finding. Individuals with a household income of less than $15,000 are 4.1 times more likely to develop diabetes-related kidney disease, which supports Siddique et al. (2017) in related literature stating low socioeconomic status is often associated with substandard diabetes management. The lack of significant findings for other variables could be attributed to the small sample size of the study. A larger study focused on these specific complications and factors may have yielded different results.

There is a gap in the literature in comparing these specific variables (diabetes-related kidney disease and diabetes-related retinopathy as complications and the independent variables (mental health, physical health, BMI, smoking status, and exercise)). According to Harding et al. (2019) complications like kidney disease are less explored complications of diabetes. Therefore, it is difficult to draw a concrete conclusion that the statistically significant findings are directly related. Yet there is enough statistical significance to warrant further study of the variables in relation to one another.

Limitations of the Study

I included in the study the cases of individuals who reported having diabetes and had a valid response for all variables (independent, dependent, and control). Because of this selection, the selected cases were narrowed to those that completed the optional section of the survey, limiting the total number of qualifying cases overall, thus yielding a small sample size. The study was further compounded by including all covariates in the same model. In addition, the low power level of each research question also presented limitations of the study, indicating that possibly fewer predictors may be needed in the model to better explain significant findings.

Recommendations

The purpose of this study was to examine the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). The study was limited in capacity due to the nature of the data (secondary data). I recommend further exploring this area of study as the primary focus, possibly a primary dataset. Also, most participants in the study were White women, with there being disparities in the related literature for minorities, an emphasis on a larger minority population would also be recommended. In addition, because of the nature of Type II Diabetes and the affect that self-management has been proven to have on the disease another recommendation would be to include variables that indicate medication usage and primary care visits. There are apparent significant relationships; however, a direct relationship is difficult to establish because of the limited data. An additional recommendation would be to add other covariates that support existing literature, such as education and health insurance status.

Implications for Professional Practice and Social Change

The first three research questions' outcomes were used to reject the null hypotheses, allowing for implications for professional practice and social change. RQ4 that examined the relationship between the protective factor (diabetes self-management classes) and diabetes-related kidney disease did not yield the same result, there is still an opportunity for implications for professional practice and social change. This study is of interest to public health workers (health educators, health directors), primary care providers, community health workers, health insurance companies, etc. As these priority populations work with individuals diagnosed with Type II every day, it is imperative that they are aware of the intervention options that are supported by the most recent data.

The selected variables in this study were unique to the study. The choice to include all variables in one regression model was also a unique factor that has pros and cons. By including all the variables in one model, there is an increased risk of overfitting the model and, thus, bias. However, the concept is also justified as it represents the many complexities of individuals with Type II diabetes. Some people with diabetes are inactive, overweight (BMI), experiencing mental health issues, etc., all at the same time. The issues are rarely siloed as they are a statistical study. Therefore, while it may alter the sample size, it gives a different perspective that is needed when dealing with people and not necessarily numbers or statistics. When doctors are talking with patients or caregivers are speaking with people, the human in front of them is at the forefront more so than the number.

As indicated in the significance section, an excellent opportunity for social change is now supported by the study's outcomes. There is an opportunity for interactions to occur that influence social institutions and cultures. The social institutions could include the effect it may have on the economy and the economic burden of families as they navigate providing support for family members as they care for someone with Type II diabetes. With the supporting data from this study, there can be targeted interventions initiated by families around the risk and protective factors (diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise to possibly prevent or delay diabetes-related complications (diabetes-related retinopathy and diabetes-related kidney disease).

The opportunity for permanent social change is also possible through policy change. Policy change is possible for employers as they make changes to allow for better diabetes self-management skills during the workday to decrease indirect costs such as absenteeism and presenteeism. Employers could offer employees the opportunity time that supports their mental and physical health and BMI, for example, by allowing for some walking time during the workday. Local government entities could also use the relationships identified in the study and similar studies conducted in the future to affect policy change and increase the number of sidewalks and grocery stores in neighborhoods. In some instances, the policy could involve making new housing developments and stores mandatory to add a sidewalk to their development plans within the area. These changes could affect the risk factors in the study, exercise, physical health, mental health, BMI, and diabetes self-management classes, giving people options to make the information they are learning a lifestyle. Policies around health care access through health insurance may also be supported through this study. The prevalence of diabetes-related complications and the protective and risk factors (diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise) may be enough for health plans to examine further for coverage so that complications (kidney disease and retinopathy) are prevented or at least delayed.

Conclusion

The purpose of this study was to examine the relationship between participation in diabetes self-management classes, mental health, physical health, BMI, smoking status, exercise, and possible diabetes complications (diabetes-related retinopathy and diabetes-related kidney disease). Significant relationships were found for risk and protective factors in relationships with diabetes-related retinopathy as well as the risk factors and diabetes-related kidney disease. When examining the covariates individually, age and household income also had conditions in the study that yielded significant relationships. The significant relationships identified in the study support the need for further research with greater data samples and targeted data.

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