Walden University

College of Health Sciences and Public Policy

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Peter Okeke

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Risk Factors Associated with Type 2 Diabetes among Adults in Alabama

by

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MA, National Open University of Nigeria, 2017
BS, University of Nigeria, 2010

Dissertation Submitted in Partial Fulfillment

Of the Requirements for the Degree of

Doctor of Philosophy

Public Health-Epidemiology I

Walden University

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Abstract

In the 21st century Diabetes mellitus is recognized as one of the most important public health challenges that carry a substantial individual and community burden.

It is necessary to do a detailed search regarding DM2 from adolescence till adulthood is in Alabama which should aim to provide recent information. T2D is influenced by a many factors including demographics including age, sex, income level, educational, BMI, physical activities, etc. Identification of the associated risk factors is very important to inform decision making by concerned bodies and T2D management. The study aimed to examine the risk factors associated with T2D in adults aged 18 years and older in Alabama, USA. The Social Ecological Model was used in the study. The research questions seek to find the relationship between diabetes and demographics, dietary intake, physical activities, BMI and smoking in adults 18 years and older in Alabama while controlling for s age, income, educational level and employment status as confounders. In the study used a quantitative and cross-sectional research design was used and the data was collected from BRFSS 2019. 6,892 respondents were used these included adults 18 years and older in who reside in Alabama, who were eligible to participate in the 2019 BRFSS survey. Chi- square was used to show the relationship between diabetes and the different risk factors and Binomial logistic regression was further used to control for confounder. Results showed that employment status, age, smoking, educational level, income category and race significantly predicted diabetes. Dietary intake did not significantly predict diabetes, while BMI and Physical activities significantly had effect on the risk of diabetes. Knowing he risk factors associated with diabetes will inform decision making and better diabetes management program.

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Dedication

I dedicate this thesis to the Almighty God for His infinite love for me, to my family for being part of my story and to my thesis chairperson and committee members for their guidance to ensure a job well done.

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Firstly, it is my pleasure to appreciate my thesis chairperson Dr. Davis Bill for his motivation and continuous support for my research work. May God reward you mightily.

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Thirdly, to my Program Director and other executive I might come across in this thesis journey, in advance I say to you all, God bless you.

Finally, to my beloved family whom I have not seen for a long time, I know you cannot wait to have me finish my study and return to you. I will do my best and God will make a way to see again.

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Chapter 1: Introduction to the Study

Introduction

Diabetes as defined by the World Health Organization as a chronic, metabolic disease characterized by elevated levels of blood glucose that leads to serious damage to the heart, blood vessels, eyes, kidneys and nerves over time (WHO, 2021). Type 2 diabetes (T2D) is the most common type of diabetes usually in adults, which occurs when the body becomes resistant to insulin or doesn't make enough insulin. Type 1 diabetes (T1D), once known as juvenile diabetes or insulin-dependent diabetes, is a chronic condition in which the pancreas produces little or no insulin by itself. In the past three decades, the prevalence of Type 2 diabetes has risen dramatically in countries of all income levels (WHO, 2021). Type 2 Diabetes is a disorder related to a progressive loss of beta-cell insulin secretion, frequently on the background of insulin resistance in the setting of metabolic stressors, inflammation and genetic risk (American Diabetes Association, 2018). T2D is different from T1D because the autoimmune β-cell destruction, which usually leads to insulin deficiency and other causes of diabetes mellitus in children, such as monogenic diabetes. Access to affordable treatment, insulin and good health maintenance is critical to the survival for people living with T2D. Until recently, there has been an increase of T2D in younger adults which has been reported from various research as a consequence of their lifestyle, a worldwide obesity epidemic and lack of exercise.

As an unfortunate consequence due to the current epidemic of obesity and sedentary lifestyle seen amongst children and adolescents, the health system is likely to encounter an increased number of young patients presented initially with signs and symptoms associated

with uncontrolled hyperglycemia and subsequently, relatively advanced cases of diabetes (Copeland et al., 2005). The United States is one of the nation's most affected by this epidemiological phenomenon. The estimate in United States indicates that recently, diagnosed DM2 cases in individuals between 10 and 19 years of age correspond to 33% of all cases of DM2 in the country (Araujo, 2010). According to WHO (2014), in 2013, 382 million that is about (7.7%) were affected with diabetes and it has been estimated that in 2030 that 483 million (8.3%) would be affected by diabetes. Also, they reported more than half of the people with type 2 diabetes mellitus to be older than 65 years and only 8% less than 44 years of age in developed countries while in developing countries, approximately 75% of diabetic patients are 45 years old and above and 25% of adults with diabetes mellitus are less than 44 years. Having seen these figures, it gives course for alarm for the present and future.

The incidence and prevalence of DM2 in Alabama for some years now are not known. A detailed search regarding DM2 from adolescence till adulthood is needed to be carried out which should aim to provide a recent information. A lot of researches have been done to find a way forward to reducing T2D among adolescents and adults including community and school-based programs and interventions which helps to educate the people about various risk factors of Type 2 Diabetes Mellitus (T2DM), how it can be managed and to promote behavioral change for primary prevention of T2DM. These interventions would only be successful if the risk factors of T2DM is known in these different age groups and would also help in planning the intervention. With this background, I carried out the study to find out the associated risk factors for T2DM in Alabama, USA.

Background

In the 21st century, Diabetes mellitus is now recognized as one of the most important public health challenges that carry a substantial individual and community burden (Zimmet et al., 2014). This burden is seen in individuals, families, communities, states, country and the whole world at large. People with diabetes spend twice more than people who live without diabetes. Diabetes has financial implication. In Alabama, the total direct medical expenses for diagnosed diabetes as reported by American Diabetes Association in 2018 was at $4.2 billion in 2017. Additionally, lost from productivity cost was about $1.7 billion due to diabetes (ADA, 2018). Diabetes mellitus used to be an adult disease and hence little attention was paid to the younger people but recently the prevalence of T2DM has increase in both the younger and older population and has spread across the United States. The increase of this chronic disease is directly proportional to the increase in disease like obesity. And it is evident that the minority groups are disproportionally affected. According to the American Diabetes Association, it recommended that screening for type 2 diabetes begins at 10 years of age or the onset of puberty in children who are overweight or obese and have two additional risk factors (Xu et al, 2018). Risk factors are important determinants of diseases. When the risk factors of a particular disease are discovered especially among a certain age and population and helps in better management of the disease. Identifying individuals at high risk for type 2 diabetes allows early intervention that improves modifiable risk factors (Kolahdooz, 2018).

According to the new National Diabetes Statistics Report (2020) which features trends in prevalence and incidence estimates over time using data from CDC, HIS, AHRQ, NHANES, BRFSS, USDSS, NDW and US resident population estimates. It estimated 1.5

million cases approximately 6.9 per 1,000 persons with diabetes in 2018 for adults 18 years and older. When compared to adults aged 18 to 44 years the incidence rate of diagnosed diabetes was higher among adults for 45 to 64 years and 65-years and above (National Diabetes Statistic Report, 2020). From their results, among the US population, the overall crude estimates for 2018 included 34.2 million people of all ages (10.5%) of the US population with diabetes. Approximately 34.1 million adults aged 18 years or older (13.0%) of all US adults were diabetic (National Diabetes Statistic Report, 2020). From the report, number of adults with diabetes increased with age, reaching 26.8% among those aged 65 years or above. According to the National Diabetes Statistics Report in 2020, they identified risk factors such as smoking, overweight, obesity, physical inactivity, high blood pressure, and high cholesterol as the risk factors of T2DM in youths (CDC, 2020). Some of these risk factors can be caused by the environment and some can be modified while some can't be modified. Other risk factors of T2DM are age, sex, race, family history, etc.

There is a Significant gap in the start of the 21st century in our understanding of risk factors of diabetes Alabama, including limited data on the burden of diabetes and trends in incidence and prevalence by type, age, sex and race/ethnicity, the natural history and etiologic classification of childhood diabetes and risk factors.

Also, there are little information on the risk factors for diabetes-related early complications, and the quality of health care and quality of life for people aged 18 and older in Alabama. A lot of research has been conducted to find the risk factors of T2DM in Alabama. Assessing associated risk factors of diabetes is vital for national health planners;

therefore, this study is aimed at determining the associated risk factors of diabetes mellitus on adults 18 years and older.

Problem Statement

The situation that prompted me to search the literature is Type 2 diabetes mellitus as a global pandemic and a public health burden ranking very high on the international health agenda as a threat to human health (Bellou et al., 2018). 34.2 million Americans which is about 10.5% of the population had type 2 diabetes in 2018 with 26.9 diagnosed and 7.3 non-diagnosed. This chronic disease was the 7th leading cause of death in the United States in 2017 (CDC, 2017). In Alabama, diabetes has been identified as the 9th greatest and current health concern and it has the third highest prevalence of diabetes in United States. In 2012, it was the 7th cause of death and in 2013 with about 1,346 people dying of diabetes (Alabama Public Health, 2019). In Alabama, approximately 550,149 adults that is, 14.1% of the adult population, have been diagnosed with diabetes. And studies established that an additional 119,000 people in Alabama have undiagnosed diabetes without their knowledge and this greatly increases their health risk. Annually, it was estimated that 34,668 adults in Alabama are diagnosed with diabetes (ADA, 2018).

Type 2 Diabetes is influenced by a many factor including demographics like age, sex, income level, educational level, socio-economic status and other factors like stroke, blood pressure, heart attack, BMI, physical activities etc. Research has shown that obesity, sedentary lifestyle and diet are top risk factors and people who are obese have higher risk of having type 2 diabetes. These factors can increase the risk of diabetes in human. In Alabama, a lot of research has been conducted on older people because diabetes is most common among older people. About 29.4% among those who are 65 and older are diabetic

and it's least common among young people with 5.3% among those between the ages of 18 to 49 (CDC, 2017).

The aim of this research is to analyze the risk factors associated with type 2 diabetes in Alabama, USA from 18 years and above. Studies have been conducted in adults ranging from 50 years and above, but no recent studies have analyzed the risk factors in this population in Alabama.

Purpose of the study

The study aims to examine the risk factors associated with Type 2 Diabetes in adults aged 18 years and older in Alabama, USA. Due to the increase of Type 2 diabetes and its complications in Alabama, it is very important to start from the roots to look for a solution that begins with the related risk factors of diabetes. Since diabetes is more prevalent in adults from 18 years, in this regard; the study also examined the relationship between risk factors such as Demographics, Dietary Intake, Physical Activities, BMI, Smoking and Type 2 Diabetes in adults aged from 18 years and older in Alabama. In this study, the dependent variable is Type 2 Diabetes and the independent variables are Demographics, Dietary Intake, Physical Activities, BMI and Smoking

Research Questions and Hypothesis

The quantitative research questions (RQ), their corresponding null hypotheses (H0) and alternative hypothesis (H1) for this study are stated below.

RQ1: Is there an association between Demographics (employment status, educational level, income, sex and age) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

$H0_1$: There is no association between Demographics (employment status, educational level, income, sex and age) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

HA_1: There is an association between Demographics (employment status, educational level, income, sex and age) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

RQ2: Is there an association between Dietary Intake and Type 2 DM among adults aged 18 years and older in Alabama, USA?

$H0_1$: There is no association between Dietary Intake and Type 2 DM among adults aged 18 years and older in Alabama, USA?

HA_1: There is an association between Dietary Intake and Type 2 DM among adults aged 18 years and older in Alabama, USA?

RQ3: Is there an association between Physical Activity and Type 2 DM among adults aged 18 years and older in Alabama, USA?

$H0_1$: There is no association between Physical Activity and Type 2 DM among adults aged 18 years and older in Alabama, USA?

HA_1: There is an association between Physical Activity and Type 2 DM among adults aged 18 years and older in Alabama, USA?

RQ4: Is there an association between Body Mass Index and Type 2 DM among adults aged 18 years and older in Alabama, USA?

$H0_1$: There is no association between Body Mass Index and Type 2 DM among adults aged 18 years and older in Alabama, USA?

HA_1: There is an association between Body Mass Index (BMI) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

RQ5: Is there an association between Smoking and Type 2 DM among adults aged 18 years and older in Alabama, USA?

$H0_1$: There is no association between Smoking and Type 2 DM among adults aged 18 years and older in Alabama, USA?

HA_1: There is an association between Smoking and Type 2 DM among adults aged 18 years and older in Alabama, USA?

Theoretical Framework

The theories, concepts and behavioral models that ground this study includes the Social Ecological Model Theory (SEMs). Giving the environment people find themselves today including family, school, in peer groups, work environment, social organizations and the society. These different environments affect their lifestyle and their life in many aspects, it is very important to consider this model because different groups have influences on health behaviors (Bronfenbrenner, 1979). The Social Ecological Model is a model that emphasizes on the individuals are influenced by the multiple levels including individual, interpersonal, organization, community and public policy and also it also believes that

one's behavior are by the social environment (Bronfenbrenner, 1977). Some of the risk factors which were examined like BMI, Physical Activities, Smoking, and dietary intake are all modifiable and these can be influenced through these different levels described by Bronfenbrenner, which is the SEMs. It helps understand the factors affecting behaviors and also gives guidance for developing a successful program in a social environment (Glanz, 2008).

The Ecological Model systematically categorizes these factors into five levels of influence: Firstly, the individual level which includes beliefs, values, educational level, skills and other individual factors. Secondly, the interpersonal level, including interpersonal relationships between individuals and others. Thirdly, the organizational level, which covers the way relevant institutions are organized and managed. Fourthly, the community level, which includes the communities that individuals operate on, such as professional associations, attitudes and the relationship among different institutions within communities. And fifthly, the policy level, which refers to policies and regulations affecting intervention participants and the institutions in which they function (McLeroy et al.,1988).

The Social-ecological model shows how the different levels affect the individual development. These different levels can affect the risk factors been examined. Since the aim of the study is to examine the risk factor, the different levels would show how these factors can influence Type 2 Diabetes. And these separate groups have influences on health behaviors, expansion of the management program from individual levels to family, communities and societies is very important (Bronfenbrenner, 1979).

The logical connections between the framework presented and the nature of my study include the Social Ecological Model theory that will help explain the different levels of the environment that affects the lifestyle and health of the individuals and it includes the risk factors that were considered in this study; such as Demographics, BMI, Smoking, Dietary Intake, Physical Activities and how they affect Type 2 Diabetes and to understand the different factors that affect individual behavior which will guide the development of good program in the environment (Glanz, 2008).

Nature of Study

To address the research question(s) in this quantitative study, across – sectional design was used to determine the relationship between risk factors such as Demographics, Dietary Intake, Physical Activities, BMI, Smoking and Type 2 Diabetes in adults 18 years and older in Alabama, United States. The quantitative method of research described the outcome of these interventions. The quantitative method examined the relationship between variables and help in answering the research question and hypothesis through survey. Cross-sectional is suitable for the studies because it measures the exposure and disease status at the same time. Also, are better suited for descriptive epidemiology than causation. The cross-sectional design enabled the examination of the risk factors of type 2 diabetes on the desired population.

The 2019 BRFSS Survey contains all the variables required to conduct this study which includes; the dependent variable which Type 2 Diabetes Mellitus and the independent variables including; Demographics (employment status, educational level, income, sex and age) BMI measured as Underweight = 2, Normal Weight: 1850 < = _BMI5 < 2500 = 2, Overweight: 2500 < = _BMI5 < 3000 = 3, Obese: 3000 < = _BMI5 < 9999 =

4, physical activity index: Highly Active = 1, Active = 2, Insufficiently Active = 3, Inactive = 4, dietary intake measured as consumed vegetables one or more times per day = 1, consumed vegetables less than one time per day = 2, and consumed fruit one or more times per day = 1, consumed fruit less than one time per day = 2. The study has also two confounder variables sex and race. The sex variable is measured as male = 1 and female = 2 and race is measured as White only, non-Hispanic = 1, Black only, non-Hispanic = 2, American Indian or Alaskan Native only, Non-Hispanic = 3, Asian only, non-Hispanic = 4, Native Hawaiian or other Pacific Islander only, Non-Hispanic = 5, Other race only, non-Hispanic = 6, Multiracial, non-Hispanic = 7, Hispanic = 8.

Definitions

T2D: Type 2 diabetes. It is the dependent variable in this study. It is a type of diabetes that occurs when the body becomes resistant to insulin or doesn't make enough insulin (WHO, 2021).

Demographics: This is one of the predictor variables in the study. The demographics used in this study includes: employment status, educational level, income, sex and age

Dietary Intake: This is one of the predictor variables in the study measured using Consumed vegetables one or more times per day = 1, consumed vegetables less than one time per day = 2, and Consumed fruit one or more times per day = 1, consumed fruit less than one time per day = 2.

Physical Activities: This is one of the predictor variables in the study measured using by how often exercises are engaged in physical activities. It was measured in the dataset using Meet Aerobic Recommendations = 1

Did Not Meet Aerobic Recommendations = 2 and physical activity index: Highly Active = 1, Active = 2, Insufficiently Active = 3, Inactive = 4,

BMI: Body Mass Index is one of the predictor variables in the study. Its measured using the weight and the height of the participants in the study.

Smoking: This is one of the predictor variables in the study. It measures if the participants smokes or not smoking.

Sex: This is one of the confounder variables in the study. It is a measure of participants gender either male or female.

Race: This is one of the confounder variables in the study. It was measure of the race of the individuals, White, Hispanic, Black

BRFSS: The Behavioral Risk Factor Surveillance System (BRFSS) a system of health-related telephone surveys. (CDC, 2020). The BRFSS was established in 1984 with the inclusion of 15 states which collect state data about U.S. residents and about their health-related risk behaviors, chronic health conditions, and use of preventive services. Currently, the BRFSS collects data in all 50 states as well as the District of Columbia and three U.S. territories and is the largest continuously conducted health survey system in the world (CDC, 2020).

2019 BRFSS: The 2019 BRFSS data is a continuation of the 2011 data and reflects the changes initially made in 2011 for weighting methodology (raking) and adding cell-phone-only respondents (CDC, 2020).

T1D: Type 1 diabetes, also known as Juvenile diabetes or Insulin-dependent diabetes, is a chronic condition in which the pancreas produces little or no insulin by itself. (WHO, 2021).

Assumptions

Some assumptions where made on this research. The first assumption is the sample size of the Alabama survey participants are enrolled in the 2019 BRFSS survey would be large enough to generate significant results and would be representative of the overall Alabama adolescents and youths. One of the importance of using a suitable sample size is to produce studies capable of detecting clinically relevant differences (Faber & Fonseca, 2014).

The second assumption is that the data in the 2019 BRFSS survey were weighted. According to CDC (2020), when data are unweighted, each record counts the same as any other record therefore making assumption that each record in the analysis has an equal probability of being selected and that no coverage and non-response are equal among all segments of the population. But when data are weighted even if the deviations from these assumptions are large enough to affect the results from a data set, weighting can help to adjust for assumption violations (CDC, 2020). The third assumption is that all the data collected from the participants were reported correctly and accurately by the BRFSS interviewers during the survey. The accuracy of the data collection process is very vital as its dependent on the validity of the result. A study is said to be internally valid if the study conclusions represent the truth for the individuals studied because the results were not likely due to the effects of chance, bias, there it is important that the participants information are well reported to give valid result.

Scope and Delimitation

The scope of the study refers to the boundaries within which a research project was performed to define the scope of the current study the aspects that were considered in this study was discussed. The scope of this study is limited to adolescents aged 18 years and older in Alabama in the United States who participated in the 2019 BRFSS survey. The individuals who participated in the BRFSS survey met the required criteria. The information about the risk factors of diseases was collected including the demographic factors as well as the modifiable and non-modifiable factors as well. The information published in the 2019 BRFSS survey is appropriate to use in this current research as the data covers the scope of the current research which focuses on examining the risk factors of diabetes in adolescents in Alabama, the dataset contains information needed for the research. Because the risk factors of chronic diseases are related to the various risk factors of diabetes and are extracted from the dataset as well as the dataset from the specific state of interest. Using the risk factors from the BRFSS dataset enabled the identification of the prevalent risk factors of type 2 diabetes in adults 18 years and older in Alabama and saved time and funds for data collection.

Delimitations in research is an issue of external validity. It deals with the inclusion and exclusion criteria used by the researcher. Delimitations in this study are concerned with the definitions that are decided to set as the boundaries or limits of the study so that the study's aims and objectives do not become impossible to achieve (Dimitrios & Antigoni, 2019). The primary delimitation of the current study was the focus on adults 18 years and older in Alabama in the United States who participated in the 2019 BRFSS survey. Children and adolescents who are less than 18 were excluded in the study as well as individuals who

did not enroll in the 2019 BRFSS survey. Pregnant women were excluded from the study, Any theoretical frame work that does not highlight the relationship between people and their environment were excluded as the study used the social ecological framework which explains the multiple levels of influence including in individual, interpersonal, organization, community, public policy and has the idea that behaviors both shape and are shaped by the social environment. (Bronfrnbenner, 1977). Some of the risk factors examined like BMI, physical activities, smoking, dietary intake are all modifiable and these can be influenced through these different levels described by Bronfrnbenner which is the SEMs. It helps understand factors affecting behavior and also gives guidance for developing successful program in social environment (Glanz, 2008).

Limitations

The current study has some limitation which includes: The BRFSS used for this study being a cross-sectional, self-report survey which implies that such is subject to recall bias and social desirability bias, and may influence which events respondents recall or report at the time of the interview (Anderson & Marcum, 2019). Because a secondary data was used, the BRFSS data is collected through a landline and telephone call, the respondents might not recall some questions very well and this can cause information bias.

Secondly, the data used for this study is a secondary data and as a result, some medical reports such as type 2 diabetes were done by medical personnel which implies that the study is dependent on medical personnel to correctly examine, diagnose, and record patient findings in the medical record. Another limitation is the use of cross-sectional design in the study, the cross sectional cannot assess incidence and it has the inability to make a causal inference (Wang & Cheng, 2020).

Access to Data is also one of the limitations, the BRFSS Survey uses telephone and landline to collect information, a limitation or challenge is the representation of the whole population in the secondary data; the diabetic population might be under represented. Because not all U.S household have telephone, there is a high tendency of response bias due to under sampling of population most likely to lack of phone coverage. However, the data is free for public use.

Significance

This study is significant because it could help inform future decision–making around implementation of diabetes management policies in adolescents, especially decision on adjustable risk factors such as BMI, Physical Activities, Dietary Intake and other adjustable risk factors of type 2 diabetes. The result from this study could help the researchers to find ways of managing Type 2 Diabetes in adolescents and find ways of avoiding the disease and possibly reducing the risk of having type 2 diabetes in adolescents.

It can also show the risk factors that have a higher tendency of increasing the risk of Type 2 Diabetes in adults 18 years and older and help researchers make informed decisions. The results from this study can as well reduce the incidence of Type 2 Diabetes in Alabama and USA and help researchers to focus more on improving, encouraging and supporting the more effective ways of Type 2 Diabetes management. Understanding the risk factors that affects T2DM in Alabama can help improve data collection on this population age group and proactively refer them to appropriate social support and interventions. It can improve the ability of clinicians and health system to help the individuals who have the identified risk factor and refer them for appropriate intervention or education to reduce the incidence of T2DM.

Summary

The search for solutions on type 2 diabetes is ongoing worldwide by researchers these recent researches are more focused on the adult older than 45 years since type 2 diabetes have been an adult disease but for some time now T2D have been prevalent in younger people less than 45 years and this calls for a great attention. A lot of studies have been conducted in adults ranging from 50 years and above but few studies have analyzed the risk factors in youths, this might be due to the fact that diabetes are seen more in adults than young people.

In order to reduce the prevalence and the incidence of these chronic disease, risk factors which could increase the risk of an individual or a group of people having diabetes should be known in order to control the disease. Using the BRFSS dataset, the study aims to examine the risk factors of type 2 diabetes in people 18 years and older in Alabama, USA.

Chapter 2: Literature Review

Introduction

Type 2 diabetes still remains one of the public health burdens in recent times. In the last two decades, type 2 diabetes was only thought to be a metabolic disorder exclusively of adulthood, but unfortunately is has become increasingly more frequent in younger people especially obese individuals (Pinhas-Hamiel & Zeitler, 2005). Globally, the International Diabetes Federation (IDF) reported that 352 million adults have high risk of developing T2D due to impaired glucose tolerance by 2045 (Bommer *et al* 2018). 9.4% of the US population (30.3 million people) was estimated to have diabetes in 2015, also, the global number of adults with diabetes was estimated at 415 million, with a projected increase to 642 million by 2040 (CDC, 2017). According to CDC (2021), 8.7 million of US population of all ages or 8.7% had diagnosed diabetes. This includes 283,000 children and adolescents younger than age 20 years and 1.6 million adults aged 20 years or older, approximately 5.7% of all US adults. Among US adults aged 18 years or older, the CDC reported in 2019 an estimate for 2019 to be approximately 1.4 million new cases of diabetes (5.9) per 1,000 persons who were diagnosed (CDC, 2021). Recent reports have shown an increasing prevalence of type 2 diabetes mellitus in the younger population, the increase is seen more in some countries and some specific ethnic groups for instance Reinehr, (2013) found in his work that many young people diagnosed with type 2 diabetes mellitus are African-American, Hispanic, Asian/Pacific Islanders and American Indians in America. Similar to that for young adults in many other parts of the world, the burden of diabetes among US young adults has been increasing recently and this is also similar to other parts of the world as well. Later-onset diabetes, when compared to young-onset diabetes is associated with

worse glycemic control, progressed to adverse cardiometabolic risk profiles more rapidly, and had greater lifetime risk of vascular and nonvascular complications (Lascar et al., 2018).

A study from Asiiwme et al., (2020) reported that there was a high prevalence of type 2 diabetes observed in his current study when compared to studies done in previous years and this should raise a public health concern.

Having seen the health effects of type 2 diabetes it is important to identify the high risk groups such as obese adults. Clinicians should be aware of the risk factors that increase the risk of type 2 diabetes in youth and adults in Alabama especially as it concerns this study as it can enable the prevention and the management of type 2 diabetes.

According to the 2020 National Diabetes Statistics Report, smoking, overweight/obesity, physical inactivity, high blood pressure and high cholesterol were mentioned as the risk factors of diabetes and related complications. Other factors have been consistently acknowledged as being associated with T2DM include, DM2 family history, obesity, sedentary lifestyle, and hypertension, (Age, gender and high capillary glucose level are added to these factors (Addams & Lammon, 2007). In order to find solutions to this public health issue, a lot of researches has been done to find a way forward to reducing T2D among individual adults including community and school based programs and interventions which helps to educate the people about various risk factors of Type 2 Diabetes Mellitus (T2DM), how it can be managed and to promote behavioral change for primary prevention of T2DM. Without knowing the risk factors of T2D in these population, it would be practically impossible to manage and prevent T2DM. Giving the need to identify the associated risk factors of T2D and also the fact that the current risk factors of

T2D in Alabama are unknown, this research is aimed at examining the risk factors of type 2 diabetes in youths and adults from 18 years and older in Alabama, USA.

This chapter is divided into 4 sections; first is the introductory part, the problem and purpose restated and a concise synopsis of the current literature that establishes the importance of the problem was given. Secondly, the literature search strategy section; a list of accessed library database and search engines used were given and also key search terms and combinations of search terms are given. Also, the scope of literature as well as types of literature and sources searched were given. Thirdly, the theoretical foundation; the theoretical framework was explained including the name of theories that was used, sources of literature and research-based analysis of how the theory has been used in similar current study were analyzed, as well and rationale used for selecting the theory were stated and how the theory relates present study and how research questions relates to challenges. Fourthly, the literature review related to the key variables and concepts, studies to the constructs of interest and chosen methodology and methods that are consistent with the scope of study were highlighted and ways researchers in the discipline have approached the problem, strength and weaknesses were explained. A rationale for selecting variables or concepts. A review and synthesis of studies related to key independent, dependent and covariates variables were given in order to produce a description and explanation of what is known about the variables and what is yet to be known about the variables. A review and synthesis of the studies that are related to the research question was done. Finally, a concise summary of major themes in the literature was given and a summary of how the present study fills at least one of the gaps in the literature and how it extended the knowledge in the

discipline and a summary of the gabs in literature to the methods described in chapter 3 of this study.

Literature Search Strategy

To understand the associated risk factors of type 2 diabetes mellitus in adults 18 years and older in Alabama. I conducted an online literature search using the following database; Google Scholar, PUBMED and ScienceDirect. The search terms used are; *Risk factors of type 2 diabetes mellitus in adults 18 years and older in Alabama, United States, Risk factors of type 2 diabetes mellitus in adults 18 years and older in Alabama United States using 2019 BRFSS database, Risk factors of type 2 diabetes mellitus in adults 18 years and older in Alabama, United States, Risk Factors of in adults 18 years and older in United States, Type 2 diabetes mellitus in Alabama with 2019 BRFSS. Other search terms are Type 2 diabetes, the associated risk factors of type 2 diabetes.*

The search terms were both combined and also used individually in some cases so as to narrow the results of the search. The search results were restricted to peer-reviewed journals and the websites of federal and state governmental agencies, international public health organizations. Other search included diabetes care organizations and universities websites. The search results were restricted to articles and work published between 2015 to 2021.

Theoretical Foundation

The research's theoretical framework was based on the Social Ecological Model Theory (SEMs). The non-communicable disease just like diabetes and obesity are often criticized for focusing on lifestyle change while ignoring contextual forces that influence health such as the environment. Stokols, (1992, 1996) argues that the social, physical, and cultural aspects of an environment have a cumulative effect on health. And as such that the social ecological model assumes that not only that multiple levels of influence exist but also that these levels are interactive and reinforcing. The model lays emphasis on multiple levels of influencing people and includeds the individual himself as a level, interpersonal, organization, community and public policy (Bronfrnbenner, 1977). Stokols argues that the environment itself is multilayered, since institutions and neighborhoods belong and are part of larger social and economic structures, and that the environmental context may likely influence the health of individual people differently, depending on their unique beliefs and practices.

The Ecological models are now major topics in public health discussions. Organizations like the World Health Organization commonplace in public health discourse (Blas & Kurup, 2010) and Healthy People 2010 (U.S. Department of Health and Human Services, 2000) and CDC interprets health as determined by activities of environments and individual factors, and has urged the adoption of the social ecological model in the design of health models. Also, The Centers for Diseases and Prevention have adapted the SEM for various health promotion endeavors to include the spheres of interpersonal, organizational, community, and policy (Sallis, 2008). Prevalence and incidence of type 2 diabetes in adults is as a result of health behaviors from childhood, adolescent and the social ecological model

explains how these health behaviors are associated with the environments which were divided into different levels. The model provides an approach which is needed for examining the multiple level factors that might be determinants of type 2 diabetes in adolescents. It can help in identification of opportunities to promote better health behaviors by recognizing the individual (e.g. sex, beliefs, and attitudes), behavioral (sedentary and active time), and social environment (family, teachers, peers) and physical environment (McLeroy, 1988).

The socio-ecological model (SEM) in the year 1970, was introduced as a conceptual model for understanding human development by Urie Bronfenbrenner and in 1980s it was formalized as a theory in the (Bronfenbrenner, 1997, 1986, 1989). The first theory proposed by showed illustration of an individual been in the center surrounded by microsystem, mesosystem, exosystemic, macrosystem and chronosystem.

Figure 1 shows the Bronfenbrenner's ecological systems theory. The microsystem was the closest system to the individual and it contains and represent strongest influences and encompasses the interactions and relationships of the immediate surroundings (Kilanowski, 2017). The mesosystem is the second and closer to the individual, it looks beyond immediate interactions and contains those the individual has direct contact with such as work, school, church, and neighborhood. The exosystemic is the third circle, it has no direct impact on the individual rather exerts both negative and positive interactive forces on the individual such as community contexts and social networks. The fourth is the macrosystem which includes societal, religious, and cultural values and influences. Finally, the chronosystem contains both internal and external elements of time and historical

content; in revised models, this level includes the influence of policy (Bronfenbrenner, 1986).

The Social Ecological Model was conceptualized using the construct of health and a great focus on the major factors that might affect health and it states that health is affected by the interaction between the characteristics of the individual, the community and the environment that includes the physical. As a theory-based framework for understanding the multifaceted and interactive effects of personal and environmental factors, I have chosen Social Ecological Model to examine a wide breadth of elements that influence and contribute to prevalence and incidence of type 2 diabetes in adults by examining the associated risk factor of type 2 diabetes.

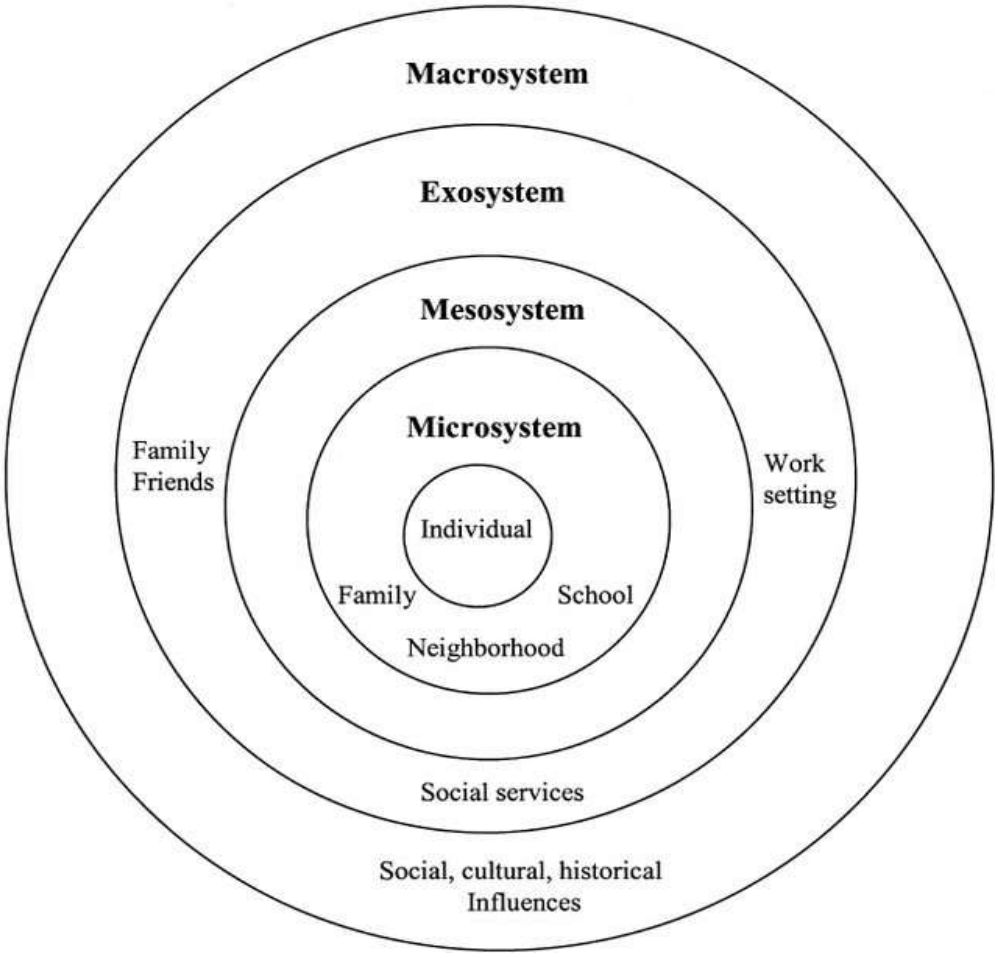

Figure-1

Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1979, 1989, 1993; Spencer & Harpalani, in press).

The Social Ecological Model shows how the different levels affect the Childs development. These different levels can affect the risk factors been examined. Since the aim of the study is to examine the risk factor the different levels shows how these factors can influence type 2 diabetes. Since these different groups have influences on health behaviors, expansion of the management program from individual levels (children) to family, communities and societies is very important (Bronfenrenner, 1979).

Some of the risk factors which were examined like BMI, physical activities, smoking, dietary intake are all modifiable and these can be influenced through these different levels described by Bronfenbrenner which is the SEMs. It helps understand factors affecting behavior and also gives guidance for developing successful program in social environment (Glanz, 2008).

The ecological model systematically categorizes these factors into five levels of influence: First is the individual level which includes beliefs, values, education level, skills and other individual factors between an individual and others. Second is the interpersonal level, including interpersonal relationships between individuals. Third is the organizational level, which covers the way communities and school relates, how related institutions are organized and managed. Fourth is the community level, which includes professional associations, attitudes and the relationship among different groups within communities. And the fifth is the public policy level, which refers to policies and regulations affecting intervention participants and the institutions in which they function (McLeroy et al.,1988).

Appropriateness to the current study

Identifying the associated risk factors of type 2 diabetes in adults is as important as preventing it in this population. A knowledge of the risk factors helps in the management and prevention of the disease. The social ecological model uses the multilevel individual relationship and interaction to show how an individual is affected by the relationship between himself, his immediate and outside environment. These levels includes individual, interpersonal, organization, community and public policy. And also, has the idea that behaviors both shape and are shaped by the social environment (Bronfenbrenner, 1977).

Some of the risk factors which were examined like BMI, physical activities, smoking, dietary intake are all modifiable and these can be influenced through these different levels described by Bronfenbrenner, which is the SEMs. It helps understand the factors affecting behaviors and also gives guidance for developing a successful program in a social environment (Glanz, 2008). Public health programs that are successful are mostly based on an understanding of health behaviors and the contexts in which they occur (Glanz, 2002). The socio-ecological approach emphasizes that health promotion should focus not only on intrapersonal behavioral factors but also on the multiple-level factors that influence the specific behavior in question such as the physical activity, dietary behavior and smoking. The socio-ecological model thus focuses on the interrelationships between individuals and the social, physical and policy environment (Stokols, 1996). The social ecological model is appropriate in this study in examining the multiple level factors that might be determinants of the selected risk factors such as physical activity, dietary behavior and smoking. Not only can it help in using its multilevel to examine the determinants of the risk factors, it could as well identify opportunities to promote these behaviors by recognizing the individual (sex, beliefs & attitude), behaviors such as sedentary life styles and activities lifestyles (physical activities), eating habits, social environment (family, teachers, peer groups) and as well physical environment. Giving the environment people find themselves today including family, school, in peer groups and the society, these different environments affect their lifestyle and their life in many aspects and since these individuals find themselves in these different environments, it is very important to consider this model because different groups have influences on health behaviors (Bronfenbrenner, 1979).

Literature Review Related to Key Variables and/or Concepts

Type 2 diabetes

Type 2 diabetes is a chronic metabolic disorder which is featured by persistent hyperglycemia, due to impaired insulin secretion, or when the body has resistance insulin (WHO, 2021). The chronic disease affects mostly adults but recently its incidence is on the increase in youths and children, the International Diabetes Federation (IDF) reports that approximately 415 million adults between the ages of 20 to 79 years had diabetes mellitus in 2015 (Zheng et al., 2018). The fact that it affects people of different races, ages, countries has made it a global public health burden as this number is expected to rise to another 200 million by 2040 (Zheng et al., 2018).

Worldwide, T2DM and its complications have contributed greatly to the burden of mortality and disability. In 2010, globally it was estimated that T2DM caused 3.96 million deaths in adults aged 20-79 causing 6.8% of global mortality (Roglic, & Unwin, 2010). This estimate increased to 5.0 million deaths in its complications during 2015 in an IDF report, which is equivalent to one death every six seconds (IDF, 2015). In 2013, the Global Burden of Disease Study identified diabetes mellitus as the ninth major cause of reduced life expectancy (GBD 2013 Mortality & Causes of Death Collaborators, 2015). T2DM financial burden is felt directly and indirectly. In 2015, IDF estimated about US$673 billion (12% of global health expenditure) spent on treating diabetes mellitus and its related complications (IDF, 2015).

With the rising prevalence of childhood obesity in many countries, the prevalence of T2DM is increasing in young people.

T2DM management

One of the successful ways of managing type 2 diabetes is the lifestyle and behavioral interventions. Lifestyle interventions are one of the many non-pharmacological solutions to reduce diabetes and obesity in adults and have been proven by several researchers to be very effective in reducing weight and improving the lives of diabetic and obese patients. According to Zheng, et al., (2018), lifestyle modification which includes weight loss, increasing physical activity and adopting a healthy diet, remains one of the first-line strategies for the management of T2DM. Wadden, et al (2006) conducted a study in the Look AHEAD (Action for Health in Diabetes) trial in the USA. In the study, a 4-year intensive lifestyle intervention performed through caloric restriction and increased physical activity showed increased weight loss, improved cardiometabolic risk profiles and as well reduced requirement for medication to control CVD risk factors when it was compared with the control group who had diabetes mellitus and received support and education about lifestyle modifications (Wing, 2013).

Risk factors of type 2 diabetes

In the past three decades, a lot of advancements have been made in epidemiological research on T2DM and these have improved our understanding of a wide range of risk factors for the development of T2DM in all populations (Zheng et al., 2018). The determinants of T2DM consist of a matrix of genetic, epigenetic and lifestyle factors that interact with one another and operate within the larger physical– sociocultural environment (Zheng et al., 2018). Zheng et al., (2018) identified some risk factors of T2DM diet and lifestyle factors, overweight and obesity, diet, alcohol intake, physical activities, smoking,

genomics, gene environmental interactions and cardiovascular disease. Kolahdooz et al., (2019), studied the prevalence of known risk factors for Type 2 Diabetes Mellitus in Multiethnic Urban Youth in Edmonton: Findings from the WHY ACT NOW Project. They aimed to examine the risk factors for type 2 diabetes in multiethnic urban youth in Edmonton, Alberta. From the studies it was found that the most prevalent risk factors were ethnicity, followed by physical inactivity, overweight or obesity, low fruit and vegetable consumption. The study is related to my current study because it studies the risk factors of T2DM in youths and as well has the same aim of my current study which is to examine the risk factors of T2DM in adults 18 years and older as part of the population examined in the study. As well it examined some of the risk factors including race, physical activity, obesity and diet which are contained in my predictor variables, but this time in a different population. Steinarsson et al., (2018). studied short-term progression of cardiometabolic risk factors in relation to age at type 2 diabetes diagnosis. They evaluated the clinical characteristics at type 2 diabetes diagnosis and the broad trajectories in cardiometabolic risk factors over the initial years following diagnosis in relation to age at diagnosis. Males were more often diagnosed with diabetes at a younger age and individuals who develop type 2 diabetes at a younger age were more frequently obese, display a more adverse lipid profile, have higher HbA_{1c} and a faster deterioration in glycaemia control compared to individuals who develop diabetes later in life. Lascar et al., (2018) studied type 2 diabetes in adolescents and young adults and describe the epidemiology and existing knowledge regarding pathophysiology, risk factors, complications, and management of type 2 diabetes in adolescents and young adults. The results show that young-onset of T2DM has a stronger family history, a greater association with obesity, early loss of both first and second phases of insulin secretion alongside with often severe insulin resistance. The study found that

family history and obesity are one of the risks of T2DM in young people. My study as well wishes to find the risk factors of T2DM in adolescents which is the same age population with the study used. A study by US Preventive Services Task Force and Davison et al., (2021) on Screening for Pre-diabetes and Type 2 Diabetes: US Preventive Services Task Force Recommendation Statement. They aimed to update its 2015 recommendation and evaluated screening for pre-diabetes and type 2 diabetes in asymptomatic, non-pregnant adults and preventive interventions for those with pre-diabetes. The study used non pregnant adults from 35 years to 75 years seen in primary health care setting who were obese and also those who had no symptoms of diabetes. Results from their studies showed that 13% of all US adults (18 years or older) have diabetes, and 34.5% meet criteria for pre-diabetes. Moreover, the research discovered that the prevalence of diabetes was higher in the older population. The study recommended screening for pre-diabetes and type 2 diabetes in adults aged 35 to 70 years who have overweight or obesity. This study is related to my current study as it was conducted in United States and with the adult population which I worked with. This shows the increase in the prevalence of diabetes in adult population. Another study conducted by Wang et al., (2021) aimed to determine the trends in prevalence of diabetes and control of risk factors in diabetes among US adults between 1999-2000 and 2017-2018. The cross-sectional study included ten cycles of NHANES data between 1999-2000 and 2017 to 2018 including adults 18 years and older except pregnant women. Results from the study revealed that throughout the study period, these 3 goals (were individualized HbA_{1c} targets, blood pressure less than 130/80 mm Hg, and low-density lipoprotein cholesterol level less than 100 mg/dL) were significantly higher in older adults 65 years and older than younger adults 18 years to 44 years.

Type 2 Diabetes and Demographic factors

Demographic factors used in the current research include educational level, sex, employment status, income and race. These factors have effects in the individuals in determining who is at higher risk of type 2 diabetes. Aguayo-Mazzucato et al., (2019) studied the growing epidemic of type 2 diabetes in the Hispanic population living in the United States. It focuses on understanding the Hispanic population living in the United States from a multidisciplinary approach and underlines the importance of cultural, social, and biological factors in determining the increased risk of T2D in this population. Result from the study concluded that from the particularities of the Hispanic population and the results of the different prevention trials, life style modifications that reduce weight and met expectations were in the most impactful interventions to avoid the progression to T2D. This study is important to my study because it uses race (Hispanic population) to understand the different risk factors of T2DM and results encourage weight loss to avoid T2DM. Race is one of the demographic factors considered in the present study. Some demographic factors have been reported as risk factors of type 2 diabetes and they include age, gender, ethnicity, education, marital and unemployment status which may also increase the risk of developing morbidity and mortality associated with diabetes mellitus (Pinchevsky, 2020). Research has it that lifestyle habits and health behaviors are directly linked to risk factors and prevalence of DM (Pérez-Escamilla, & Putnik, 2007) while classical risk factors such as raised blood pressure, dyslipidemia, smoking and obesity contribute towards the development of DM. These factors are considered more susceptible in certain ethnic groups, for instance, the search for diabetes in Youth Study (observational multicenter study conducted in the United States) found that the incidence of type 2 diabetes was the highest

among American Indians and the second and third highest incidence belonged to the Black race, Asians and Islanders of the Pacific,. (Writing Group for the Search for Diabetes in Youth Study Group, Dabelea, 2007). This shows the difference effects of race on type 2 diabetes; this might be as a result of their cultural lifestyle or behavior. Gender is another factor that affects type 2 diabetes, there is growing evidence that T2DM and its complications are related to gender differences, the differences might be as a result of hormonal variations, socio-cultural behavior, environmental changes (diet, lifestyle, stress, attitudes) and gene-environment interactions (Ober et al., 2008). For instance, Ng et al, (2012) reported that men are more likely to be diagnosed with T2DM at an earlier age and with a lower BMI, whilst obesity, a strong risk factor of T2DM, is more commonly found in women upon diagnosis. Therefore, females who attain a higher BMI tend to develop DM faster than men. Women experience a change in the glucose metabolism appears to reverse this phenomenon (Wannamethee, et al., 2012) and this might be attributed to the fact that females have increased capacity for adipocyte enlargement which could lead to fat deposition abnormalities (Medrikova et al., 2012). Furthermore, during menopause, the endocrine changes lowers estrogen production, leading to changes such as an increase in proinflammatory abdominal adipose tissue. As a result, the estrogen-derived cardio protection normally active in women is lost over time, increasing the cardiovascular risk (Carr et al., 2004).

Again, employment status is another factor that affects T2DM, it is believed that the onset of T2DM usually occurs during the working life of individuals, with peak incidence in the fourth decade of life (Koopman, 2005). Employment-related stressors such as stress from work may trigger the development of T2DM.

Dietary Intake

There are a lot of evidences from observational and interventional studies on the associations between the risk of T2DM and the intake of nutrients and food groups, as well as dietary patterns. There are some diets recommended for preventing T2DM and they typically promote diets rich in whole grains, fruits, vegetables, nuts and legumes and low in refined grains, red or processed meat and sugar-sweetened beverages (Ley et al., 2014). Dietary intake affect the risk of having type 2 diabetes from a study by Hirahatake et al., (2019), which examined the association between dietary pattern scores created to reflect the 2015 Dietary Guidelines for Americans (DGA) Scientific Report, a Paleolithic (Paleo) diet, a diet high in 'empty calories', and the Priori Diet Quality Score (APDQS) (cohort reference) and type 2 diabetes risk over time. The results showed higher levels of the APDQS, which largely aligns with the 2015 DGA, were strongly inversely associated with 30-year type 2 diabetes risk in the CARDIA cohort. The study concentrates more on the dietary intake which is one of the risk factors of T2DM and how it affects the population. Diet is very important in both prevention and management of type 2 diabetes. Many studies have proven that good dietary management through lifestyle interventions reduced type 2 diabetes, as a result of this the family who is the primary organization where all these individuals come from must be encouraged to make gradual dietary changes consistent with healthy eating recommendations, and healthy parenting practices related to diet and activity should be applauded (Serbis, 2021). Smart et al., (2018) recommended that dietary recommendations must be adjusted to each family's possible cultural or financial constraints and should focus on the following; elimination of sugar-sweetened soft drinks and fruit juices, reduced consumption of processed and prepackaged foods, decreased intake of refined, simple sugars and corn syrup, reduced saturated and total fat intake, increase in

the fruit and vegetable intake, increased consumption of fiber-rich foods such as whole grain products and legumes preferable consumption of foods with low glycemic index, better portion control, and elimination of meals eaten away from home or while screen watching.

Physical activity

Increased physical activity is an essential component and has a significant role in the management of youth with type 2 diabetes (Serbis, 2021). It is as well essential for all effective lifestyle-based trials for the prevention of T2DM. When there is increase physical activity, it will not only help in weight reduction but also increases insulin sensitivity and improves blood glucose control (Serbis, 2021). Grontved et al., (2012) in his studies showed that both aerobic exercise and resistance training independently have beneficial effects on preventing T2DM.

Overweight and obesity

The prevalence of T2DM is increasing directly proportional with the escalating incidence of obesity in most developed countries, such as the USA(CDC, 2016), as well as in developing countries. According to Eli Polmiti (2021), successful weight loss is considered to be an integral part of the therapy for type 2 diabetes. The DIFE in cooperation with the German Center for Diabetes Research (DZD) support the current recommendations of physicians and the findings published in the journal diabetology suggest that obesity and weight gain can lead to vascular disorders, the leading cause of disease and death for people with type 2 diabetes (Eli Polmiti, 2021). Studies have shown that weight loss is highly beneficial in the treatment of type 2 diabetes (Rubino et al., 2016). Increase BMI can lead

to abnormalities and hence is related to many metabolic abnormalities that can cause type 2 diabetes in people. A lot of research has proven that obesity is a risk factor of type 2 diabetes and hence preventive measure should be taken to reduce obesity in the adolescents. Weight gain at adulthood occurs frequently and gradually during the middle life stage while one is still an adolescent and this is an independent predictor of T2DM (Zheng, 2017). Obesity is one of the risk factors of T2DM in my research which is defined by BMI variable here and was found to be a consistent risk factor of T2DM

Type 2 diabetes and Smoking.

A meta-analysis which aimed to find the relationship between smoking and T2DM found a dose–response relationship between the number of cigarettes smoked and its risk of T2DM. Current smokers had a 45% higher risk of T2DM than non-smokers (Willi, 2007). In another study, researchers found a high level of exposure to second-hand smokers has been associated with an increased risk of T2DM (Hayashino, 2008). A study by Chen et al., (2021) evaluate the effect during a smoking cessation program on glycemic control and cardiometabolic risk factors in patients with type 2 diabetes and to determine factors associated with the observed effect. Results revealed improvements in glycemic control and cardiometabolic risk factors after three months of participation in the smoking cessation program. The improvement in glycemic and cardiometabolic risk factors was more predominant in patients who were younger and in those with lower baseline smoking amount and higher baseline FTND scores. This showed that decrease in smoking was

associated or gave rise to improved glycemic control and cardiometabolic risk factors. In order to reduce smoking, GBD recommended education campaigns to reduce smoking and should be a major public health strategy to curb the epidemic of T2DM (GBD 2015 Tobacco Collaborators, 2017)

Summary and conclusion

In order to better understand the associated risk factors in adults 18 years and older the literatures of past studies have been done and it is evident that a lot of researches have been carried out in the current study in different parts of the world but little with the Alabama using both younger adults less than 45 years. The key variables used in the studies are type 2 diabetes which is the dependent variables, demographics, dietary intake, physical activities, smoking, BMI, as the independent or predictor variables. These variables have been researched in previous studies and some have proven to have association with type 2 diabetes. The focus of this study on younger people as well as the older people is very important as well as the state of Alabama because few studies have recently focused on young people while most studies focus more on adults.

Chapter 3: Research Method

Introduction

Type 2 diabetes is a public health burden which is known is our 21st sentry, it causes both financial, health, psychological burden to the individuals. T2D was an adult disease until recently it now affects all ages and population. The face of youth diabetes has undergone striking changes over several decades. Epidemiological research has shown that type 1 diabetes and type 2 diabetes incidences has been increasing worldwide, in different countries both developed and developing countries. The recent increase in type 2 diabetes could be likened to, the obesity epidemic which has increase like never before. It had the third highest prevalence of diabetes in United States in 2012, it was the 7th cause of death in 2013, with about 1,346 people dying of diabetes (Alabama Pubic Health, 2019). 34.2 million Americans which is about 10.5% of the population had type 2 diabetes in 2018 with 26.9 diagnosed and 7.3 non-diagnosed and this chronic disease was the 7th leading cause of death in the United States in 2017 (CDC, 2017). Globally it has become a major concern to public health considering its impact to human life and also its impacts in the social, economic and financial life of people and countries around the world. This study focused on Alabama youths and adults 18 years and older in the United States and this are because type 2 diabetes is as well increased in all population including the younger ones as well. According to Alabama Public Health, (2019). Diabetes has been identified as the 9th greatest current health concern. In Alabama a lot of research has been conducted on older people only because diabetes is most common among older people. 29.4% among those who are 65 and older are diabetic and least common among young people with 5.3% among those 18 years to 49 (CDC, 2017).

In the quest to get solutions for the chronic disease in all population and in the world a lot of research has been conducted by researchers on ways of preventing and managing the chronic disease. One of the important things to note when dealing with a chronic disease is to understand the associated risk factors that can increase the risk of an individual having such disease. A lot of factors can affect Type 2 diabetes including modifiable and non-modifiable factors such as demographics like age, sex, income level, educational level, socio-economic status and other factors like stroke, blood pressure, heart attack, BMI, physical activities e.tc. Research has shown that obesity, sedentary lifestyle, diet is top risk factors and people who are obese have higher risk of having type 2 diabetes. These factors can increase the risk of diabetes in human. From research it is believed that environmental risk factors should be considered as statistically significant differences in incidence have been reported in populations from the same ethnic group living in different environments to each other (Karvonen, et al., 2000). Other studies have shown as well that demographic factors such as race, age, and socioeconomic status are risk factors of type 2 diabetes. Since type 2 diabetes is seen more amongst adult older than 65 years, little research has been done on type 2 diabetes in younger people less than 65 years. This study examined the associated risk factors f type 2 diabetes in adults 18 years and older in Alabama.

This chapter provided an overview of this quantitative cross-sectional designed study. It explained the research design, the sampling strategy and populations. It also, explained the research design and rationale for its selection and give the methodology, threats to validity, and ethical procedures used to examine the relationships between the independent and dependent variables.

Research Design and Rationale

The current study examined the relationships between independent and dependent variables participants with type 2 diabetes enrolled in the BRFSS. In the study the dependent variable is type 2 diabetes and the independent variables include participant's demographics, BMI, physical inactivity, dietary intake and smoking. According to the five different research question in the study, the dependent variable in the first research question is type 2 diabetes, while the independent variable is demographic which includes, income and employment status, educational level, sex, race and age. The dependent variable in the second research question is type 2 diabetes, and the independent variable is dietary intake. The dependent variable in the third research question is type 2 diabetes, while the independent variable is physical activity. The dependent variable in the fourth research question is type 2 diabetes, while the independent variable is body mass index. The dependent variable in the fifth research question is type 2 diabetes, while the independent variable is smoking.

In the current research a quantitative research design was used to examine the relationship between the independent variables and the dependent variable. The quantitative research design is appropriate for this study since the data used for the study is quantifiable or contains discrete values and the objective of the study can be used to generalize the findings in the study to a larger population. (Creswell, 2009; Labaree, 2017). According to Rovai et al., (2014), quantitative design give has an objective reality which is independent of any observations in the study.

A cross-sectional study design was also used in the study design to determine the relationship between risk factors such as demographics, dietary intake, physical activities, BMI, smoking and type 2 diabetes in adults 18 years and older in Alabama, United States.

A cross sectional study design measures the outcome and the exposures in the study participants at the same time and (Setia, 2016). Just like the current studies, the BRFSS survey is observational and the data was used in this study to compare multiple variables like the risk factors such as dietary intake, physical activity, smoking, demographics and BMI and health outcome like type 2 diabetes in the study at a single point. Unlike the case-control study which is experimental it doesn't assign participant to control and case group rather it uses the observed data to compare multiple variables and outcomes at a single point. Cross-sectional studies are very useful in public health especially in prolonged or chronic evolution. It can as well be used in studies that investigate causal and effect relationships, which seek, at least preliminarily, to analyze the relationships between risk factors, determinants and what are supposed to be their outcomes (Zangirolami-Raimundo et al., 2018). Just like in this current study which seeks to examine the effect and analyze the relationship between risk factors of type 2 diabetes cross-sectional studies matches the aim of the study. the participants in a cross-sectional study are just selected based on the inclusion and exclusion criteria set for the study (Setia, 2016). Just like in the current study, the participants are selected based on the stated inclusion and exclusion criteria in the study.

In order to be able to calculate the ORs of the several risk factors and its statistical significance the cross-sectional design was used in order to analyze multi-variables. According to Zangirolami-Raimundo, et al., (2018), the design can analyze multi-variables such as binary logistic regression, so as to simultaneously calculate the ORs of several risk factors and their statistical significance, ranking them by order of influence on the outcome under analysis. In order words, binary regression can be used in the cross-sectional design. The cross-sectional design has disadvantages which is primarily the inability to analyze

associations to access possible cause and effect relationship, this is due to the fact that the data are collected in a snap shot that is in a single moment. (Zangirolami-Raimundo et al., 2018),

The study is also a survey research since it provides a numeric description of attitudes, opinions or trends of a population by studying a sample of that population and large amounts of data in statistical forms are obtained from large number of people or a large population in a relatively short period using closed-ended questions (McNeill & Chapman, 2005).

Methodology

Population

The study population for the current study is adults 18 years and older in who reside in Alabama, who were eligible to participate in the 2019 BRFSS survey and were enrolled for the BRFSS survey.

Sampling and Sampling Procedures

Sampling strategy

It is impossible to collect data from all adults in Alabama, in order to answer the research questions in the study; there is a need to select a sample**.** In the current study the BRFSS dataset was used and, a purposive sampling and a convenience sampling strategy was used since secondary data is been made use of. These sampling methods are non-probability sampling methods. In non-probability sampling, randomization is not important

in selecting a sample from the population of interest as the probability sampling, rather, samples are gathered without considering all the participants or units in the population equal chances of being included (Etikan, et al., 2016).

The convenience sampling is a type of nonprobability sampling that includes members because they meet the inclusion and exclusion criteria of the study, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study (Dörnyei, 2007).

One of the advantages of the Convenience Sampling is that it is very affordable, easy and the subjects are readily available (Etikan, et al., 2016). Because the study already has already criteria for including and excluding the participants the convenience sampling was used as convenience sampling assumes that the members of the target population are homogeneous. The weakness of convenience sampling is that it is prone to Selection bias and the selected sample might not be representative of the population (Taherdoost, 2016)

Just like the convenience sampling the purposive sampling is also a non-probability sampling selects participants based on the judgments of the researcher. This sampling is mostly based on what the researcher wants in his study he selects participants that have the qualities he needs. The weakness of this sampling method is that it is prone to researcher bias, particularly if the researcher poorly explains the judgment and it as well difficult to defend the representativeness of the population (Berndt, 2020). Both the purposive and convenience sampling are cheap, convenient, they are not time consuming (Malhotra & Birks, 2006).

Sampling Frame: participants who are within the age range of 18 years and above who has met the criteria set by the BRFSS standard for the participating states' sample designs, the participants who have type 2 diabetes was included in the study. The study included adults 18 years and older in Alabama in the United States who participated in the 2019 BRFSS survey. Adolescents and children who are below 18 years and pregnant women with diabetes were excluded in the study as well as adults who did not enroll in the 2019 BRFSS survey. Participants who have complete data and information on demographics and the selected risk factors such as dietary intake, physical activities, BMI, smoking and demographics was included and participants who have missing data in the named variables was excluded. The availability of type 2 diabetes variable in the dataset and demographic data determined eligibility for participation in this study as well as having the required data for each research questions

RQ1: the aim of the first research question is to examine the association between demographics (employment status, income, educational level, sex, race, age) and Type 2 DM among adults 18 years and older in Alabama, USA, the participants that were selected was based on the availability of demographics data and type 2 diabetes medical data.

RQ2: the aim of the second research question is to examine the association between dietary intake and T2DM among adults 18 years and older in Alabama, USA. The participants that were selected here was based on the availability of the dietary intake data and type 2 diabetes medical data.

RQ3: the aim of the third research question is to examine the association between physical activity and Type 2 DM among adults 18 years and older in Alabama, USA. The participants that were selected here was based on the availability of the physical activity data and type 2 diabetes medical data.

RQ4: the aim of the fourth research question is to examine the association between BMI and Type 2 DM among adults 18 years and older in Alabama, USA. The participants that selected here were based on the availability of the BMI data and type 2 diabetes medical data.

RQ5: the aim of the fifth research question is to examine the association between smoking Type 2 DM among adults 18 years and older in Alabama, USA. The participants that selected were based on the availability of the smoking data and type 2 diabetes medical data.

Power analysis and sample size: for each of the research question the he required sample size was calculated using G-Power version 3.1.9.7. According to Serdar, (2021), G-Power is a free-to use tool that be used to calculate statistical power for many different statistical tests such as t-tests, F-tests, χ^2 tests, z-tests and some exact tests.

RQ1: Is there an association between Demographics (employment status, income, educational level, sex, race and age) and Type 2 DM among adults 18 years and older in Alabama, USA? This research question was analyzed using a binomial logistic regression because the dependent variable is categorical that is diabetes (yes or no) and the independent variable is categorical and continuous. The G-Power parameters for these research questions are: Test family = F-test, Statistical test = multiple regression, Type of power analysis = A priori: compute required sample size given alpha, power, and effect size,

Effect size = 0.15, Alpha = 0.05, power = 0.95, and Number of predictors = 7. From the above sampling criteria, the minimum total sample size needed was 153 participants.

For the second, third, fourth and fifth research questions, the research questions were analyzed using a binomial logistic regression. The G-Power parameters for these research questions are: Test family = Z-test, Statistical test = multiple regression, type of power analysis = A priori: compute required sample size given alpha, power, and effect size. Effect size = 0.15, Alpha = 0.05, Power = 0.95, and Number of predictors = 7. From the above sampling criteria, the minimum total sample size needed was 153 participants.

From the above sampling criteria, the minimum total sample size needed for each research question is below

RQ2: Is there an association between Dietary Intake and Type 2 DM among adults 18 years and older in Alabama, USA? From the criteria, the minimum total sample size needed is 153 participants.

RQ3: Is there an association between Physical Activity and Type 2 DM among adults 18 years and older in Alabama, USA? This research questions need a minimum of 153 participants.

RQ4: Is there an association between Body Mass Index Type 2 DM among adults 18 years and older in Alabama, USA? And RQ5: Is there an association between Smoking and Type 2 DM among adults 18 years and older in Alabama, USA? The required number of participants needed for these research questions are 153 participants.

From the G-power analysis the minimum sample size for this research study is 153. This minimum sample size was selected because it represented the largest number generated

by G-Power for all five of the research questions and was the appropriate number when utilizing binomial logistic regression.

Weighted Data. It is very important to weight data used in research. According to CDC, (2020), when data are un-weighted, it's as good as each record counting the same as any other record and it make the assumption that each record has an equal probability of being selected and among all segment of the population, that non-coverage and non-response are equal (CDC, 2020). But when data are weighted, it helps adjust for violations of some assumptions, therefore weighting is necessary making generalizations from the sample to the population. In the 2019 BFRSS used in the current study, the data were weighted in two ways, the design weighing and some form of demographic adjustment of the population by iterative proportional fitting or raking. The design rating which was done by using the weight of each geographic stratum (_STRWT), the number of landline phones within a household (NUMPHON3), and the number of adults who use those phones (NUMADULT) (CDC, 2020) and ranking. In the study weighting of data helped to eliminate the external validity which helps the result be generalizable.

The BRFSS also uses iterative proportional fitting, or "raking" to adjust for demographic differences between those persons who are sampled and the population that they represent. The weighting methodology is therefore comprised of two sections: design weight and raking. Design weights are calculated using the weight of each geographic stratum (_STRWT), the number of landline phones within a household (NUMPHON3), and the number of adults who use those phones (NUMADULT). (CDC, 2020)

Data Collection Procedures

In the current study BRFSS was used which is a secondary source of data because it was not originally collected by me. It was available free on the CDC website. The BRFSS data is collected across 53 states in the United States, in 201953 states or territories used Computer-Assisted Telephone Interview (CATI) systems and the CDC supports CATI programming using the Ci3 Win-CATI software package these were used to collect the data of the participants. The BRFSS gave out guidelines and the State health personnel conducted the interviews. Following guidelines provided by the BRFSS, state health personnel or contractors conduct interviews. The telephone survey questionnaire lasts an average of 17 minutes and according to CDC, (2020) the Interview time for modules and state-added questions last from 5 to 10 minutes depending on the number of questions. Each state including Alabama conducted telephone interviews during each calendar months and calls were made 7 days per week, during both daytime and evening hours following the standard BRFSS procedures for rotation of calls over days of the week and time of day.

Instrumentation and Operationalization of Constructs

The table 1 shows the list of my variable, the variable name, type and how they were coded during the data analysis. In the study there are five independent variables, one dependent variable and two confounder variables, the dependent variable is diabetes, the independent variables are first, demographics which includes income and employment status, educational level, sex, race and age, the second independent variable is dietary intake which is a measure of the type of dietary take and how often it's taken, the third is the physical activity which measures the physical activities of the participants, the type of physical activities they engage in and how often they engage in the physical activities, the

fourth independent variable is body mass index (BMI) which is a measure of the weight and height of the individual, the BMI was also provided in the BRFSS dataset to get the BMI, the last independent variable is smoking which measures if the participants smokes and what amount.

Diabetes: diabetes is the dependent variable in the study and is a measure if the participant has diabetes or not. In the data set it is giving the information if the participant is a female and was diagnosed when pregnant or not. It is a categorical variable. In the data analysis, it was coded diabetes yes = 1 and diabetes no = 3.

Demographics: this is a categorical independent variable. In this study income and employment status, educational level, sex, race and were considered. The income is a measure of the amount the participants made annually, in the dataset it is coded, $15,000-$25,000) = 1, $25,000-$50,000 = 2, $50,000 and more = 3. In the dataset it is coded as male = 1 and female = 2. In the data analysis it was changed from sex to gender with the same coding. Educational level was coded dint go to high school = 1, High school graduate = 2, attended college or high school = 3, graduated college or high school = 4

Age was coded: Age 18 to 34 =1, age 35 to 64 = 2, age 65 to older = 3,

Race: race is a categorical variable, in the dataset it was coded as White, Non-Hispanic = 1, Black, Non-Hispanic = 2, Asian, Non-Hispanic = 3, American Indian/Alaskan, Native, Non-Hispanic = 4, Hispanic = 5, Other race, Non-Hispanic = 6, this as well were used in the data analysis

Participants with missing data were excluded during the data analysis.

Dietary intake: the dietary intake is a measure of the dietary intake consumed. From the dataset consumed fruit and vegetables were used and the number of times consumed. Its coded

Consumed vegetables one or more times per day = 1, consumed vegetables less than one time per day = 2, consumed fruit one or more times per day = 1, consumed fruit less than one time per day = 2

Physical activity: this a categorical variable, it is a measure of the how physically active the participants, the dataset has computed the activities and coded it as physical activity index: Highly Active = 1, Active = 2, Insufficiently Active = 3, Inactive = 4

BMI: the Body Mass Index is a continuous variable. It is an independent variable. In the dataset, the weight and height were given while the BMI wasn't given but the weight and height can be used to calculate the BMI. Therefore, during the data analysis SPSS was used to compute the weight and height to get a BMI variable. This variable was continuous as it is a numeric variable.

Smoking: smoking is a categorical variable, it is a measures if the participants smoke or not and how often they smoke and the quantity, in the data set there are data such as (smoked at Least 100 cigarettes) coded as Yes = 1, No = 2 and frequency of days now smoking coded as Every day = 1, Some days = 2, Not at all = 3.

Table 1

Research Variable Summary

Research Question	Variable Name	Variable Type	Coding
RQ1	Demographic Employment status	Independent	Employed for wages or Self-employed - = 1, Out of work for 1 year or more = 2, A homemaker = 3, A student = 4, Retire or Unable to work = 5
	Income		$15,000) – $25,000, = 1 $25,000 - $50,000) = 2, $50,000 and more = 3,
	Sex		Male =1 Female = 2
	Race		White only, non-Hispanic = 1, Black only, non-Hispanic = 2, American Indian or Alaskan Native only, Non-Hispanic =3, Asian only, non-Hispanic = 4, Native Hawaiian or other Pacific Islander only, Non-Hispanic = 5, Other race only, non-Hispanic = 6, Multiracial, non-Hispanic = 7, Hispanic = 8
	Educational level		Educational level was coded dint go to high school =1, High school graduate = 2, attended college or high school = 3, graduated college or high school = 4
	Age		Age 18 to 34 =1, age 35 to 64 = 2, 65 and older = 3
	diabetes	Dependent	Yes = 1 No = 2
RQ2	Dietary intake	Independent	
	Consumed vegetables		Consumed vegetables one or more times per day = 1, Consumed vegetables less than one time per day = 2,
	Consumed fruits		Consumed fruit one or more times per day = 1, Consumed fruit less than one time per day = 2
	diabetes	dependent	Yes = 1 No = 2
RQ3		Independent	
	Physical Activity Categories		Highly Active = 1, Active = 2, Insufficiently Active = 3, Inactive = 4
	diabetes	Dependent	Yes = 1 No = 2

RQ4	BMI (Computed body mass i ndex categories)	Independent	Underweight = 1, Normal Weight Notes: 1850 <= _BMI5 < 2500 = 2, Overweight Notes: 2500 <= _BMI5 < 3000 = 3, Obese Notes: 3000 <= _BMI5 < 9999 = 4,
	diabetes	Dependent	Yes = 1 No = 2
RQ5	Smoking	Independent	Current smoker: smoke sever day = 1, current smoker smokes some days = 2, former smoker = 3, never smoked = 4
	Diabetes	Dependent	Yes = 1 No = 2
	sex	Covariates	Male = 1 Female = 2
	Race	Covariates	White only, non-Hispanic = 1, Black only, non-Hispanic = 2, American Indian or Alaskan Native only, Non-Hispanic = 3, Asian only, non-Hispanic = 4, Native Hawaiian or other Pacific Islander only, Non-Hispanic = 5, Other race only, non-Hispanic = 6, Multiracial, non-Hispanic = 7, Hispanic = 8

Data Analysis plan

In the current study the Statistical Package for the Social Sciences (SPSS) version 25 was used to conduct the descriptive and inferential statistical analysis. The descriptive analysis was conducted according to the type of variables such as categorical and continuous variables. For the continuous variables measures of central tendencies including mean and standard deviation and for all independent continuous variables were used to analyze it while for the categorical variable's frequency distributions and percentage and bar charts.

In order to answer my research questions bivariate analysis will be carried out for each of the dependent variable and each of the independent variables then. A chi square analysis was conducted for each of the independent variable and the outcome variable after

those variables that were significant were selected and included in a binomial logistic regression**.**

Threats to Validity

The concept of validity in a research study refers to how well the results among the study participants represent true findings among similar individuals outside the study and there are two domains to consider including external and the internal validly (Patino & Ferreira, 2018). External validity according to by Cook and Campbell, external validity is defined as the inference of the causal relationships that can be generalized to different measures, persons, settings, and time.(Steckler& McLeroy, 2008). The current study can be generalized to the adolescents who participated in the Alabama 2019 BRFSS survey but cannot necessarily be generalized to the generalized to the entire adolescent or youth in the United States or Beyond.

Internal validity is defined as the extent to which the observed result is representative of the truth in the study population and not as a result of methodological errors. ((Patino & Ferreira, 2018). When there is no internal validity in a study it means that the results of the study deviate from the truth, and, therefore, we cannot draw any conclusions. Internal validity is always occurring during the recruitment strategies, data collection, data analysis, and sample size also it can be threatened by many factors, including errors in measurement or in the selection of participants in the study (Patino & Ferreira, 2018). In the current study, the data collection especially for the used variables was carried out by professionals. The BRFSS recruit's health officials and give guidelines for the collection of the data inform of interviews.

Ethical Procedures

The study used a secondary data and because there was no direct communication or interaction between I and the participants informed consent was not necessary therefore the consent of the participants was presumed. The data from BRFSS was approved by Walden University as required by IRB approval to be obtained before accessing secondary data. The used BRFSS data was de-identified and received form the CDC and BRFSS.

Summary

Chapter 3 provided the research methodology and the study design in the study. It as well identified the research design and its connection to the research questions. It defined the population and sampling procedures used, rationale, methodology, threats to validity, and ethical procedures used to examine the relationships between the independent and dependent variables.

Chapter 4: Results

Introduction

The purpose of this study was to examine the related risk factors associated with Type 2 Diabetes among adults aged 18 years and older in Alabama, USA. The study examined the relationship between risk factors such as socio-demographics factors (employment status, income, sex, race, educational level), Dietary Intake (as defined by how many times vegetables and fruits were consumed daily), Physical Activities (as defined by how often engaged in physical activities), BMI (as defined by the Body Mass Index of participant and its measured using the weight and the height of participants), Smoking (as defined by if a participant smokes or not and how often they smoke and the quantity), and Type 2 Diabetes in adults aged from 18 years and above in Alabama. The study controlled for age and race as confounders.

The research questions and hypothesis were used to examine if there was a relationship between the dependent variable Type 2 Diabetes and the Independent Variables including Demographics, Dietary Intake, Physical Activities, BMI and Smoking in DM among adults aged 18 years and older in Alabama.

The quantitative research questions (RQ), their corresponding null hypotheses (H0) and alternative hypothesis (H1) for this study are stated below.

RQ1: Is there an association between Demographics (employment status, educational level, income, sex and age) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

$H0_1$: There is no association between Demographics (employment status, educational level, income, sex and age) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

HA_1: There is an association between Demographics (employment status, educational level, income, sex and age) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

RQ2: Is there an association between Dietary Intake and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

$H0_1$: There is no association between Dietary Intake and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

HA_1: There is an association between Dietary Intake and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

RQ3: Is there an association between Physical Activity and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

$H0_1$: There is no association between Physical Activity and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

HA_1: There is an association between Physical Activity and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

RQ4: Is there an association between Body Mass Index and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

$H0_1$: There is no association between Body Mass Index and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

HA_1: There is an association between Body Mass Index (BMI) and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

RQ5: Is there an association between Smoking and Type 2 DM among adults aged 18 years and older in Alabama, USA. While controlling for age and income, educational level and employment status?

$H0_1$: There is no association between Smoking and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

HA_1: There is an association between Smoking and Type 2 DM among adults aged 18 years and older in Alabama, USA while controlling for age and income, educational level and employment status?

In this chapter the data collection procedure was discussed including how the data was collected then the results from the analysis were shown including the descriptive statistics of the participants, evaluating the statistical assumptions, and statistical analysis findings were reported as organized by research questions and/or hypotheses, including: exact statistics associations, confidence intervals, effect size and reports of results from statistical analysis using tables and figures as appropriate.

Data Collection

The data for the current study was sourced from the Center for Disease Control and Prevention (CDC) and Behavioral Risk Factor Surveillance System (BRFSS) on the October 1, 2021.

Initial Collection of Secondary Data

The BRFSS data used were provided by the Behavioral Risk Factor Surveillance System and originally collected by Center for Disease Control. It is an annual, state based survey funded by the CDC. It is an ongoing health-related telephone surveys which is designed to collect data on health-related risk behaviors, chronic health conditions, and use of preventive services from the non-institutionalized adult population (≥ 18 years) residing in the United States (CDC, 2019). The core questions of BRFSS include age, sex, race/ethnicity, smoking status, alcohol use, and questions on general health and health conditions like diabetes, CVD, Cardiovascular disease, asthma e.tc.

Weighted secondary data.

The BRFSS included case weighting variables for each participant, the FINAL WEIGHT BRFSS rates the design weight to 8 margins (gender by age group, race/ethnicity, education, marital status, tenure, gender by race/ethnicity, age group by race/ethnicity, and phone ownership). According to BRFSS If they included geographic regions, it would include four additional margins (region, region by age group, region by gender, and region by race/ethnicity). This simplifies that if at least one county has 500 or more respondents,

BRFSS includes four additional margins (county, county by age group, county by gender, and county by race/ethnicity).

Table 2

Weighted Data Sample for Alabama

State	Landline interview N	Cell Phone Interview N	Weighted AAPOR Cooperation Rate (COOP2) %	Weighted AAPOR Response Rate (RP4) %
Alabama	2,223	4,747	70.0	45.9

Data Cleaning

In the dataset provided by BRFSS a total of 418268 participants were enrolled in the 2019 BRFSS out of the 418,268, some data that were irrelevant to the study were removed, 411,216 were removed because the participant were not residents of Alabama which is the study focus, then 667 was removed because they had missing data. After cleaning the dataset, I determined that 6,379 individuals were eligible for inclusion and according to the statistical G-power analysis to reach appropriate statistical power for each

of the research question 153 participants are needed to be enrolled in the study so this met the equipment.

Results

Demographics of Samples

As shown Table 2, a majority of survey respondents were white only, non-Hispanic (68%, n = 4682) and female (59.1%, n = 4070). Additionally, most respondents were 65 years and older (38.1%, n = 2628) and the majority were college graduate (colledge4 years), (32.5%, n= 2239), moreover, majority of the respondents were employed for wages (34.1%, n= 2350). Finally, most respondents had an annual household income level of $75,000 or more (22.5%, n = 1550).

Table 3

Variable Descriptive-Socio-demographics Characteristics of the Study Population

Variables	Frequency	Percent
Education Level		
Did not graduate high school	617	9.0
High school graduate	2050	29.7
Attend colleges or technical school	1967	28.5
Graduate from college or technical school	2239	32.5
Sex		
Male	2822	40.9
Female	4070	59.1
Employment Status		
Employed for wages or self-employed	2825	41.0
out of work for more than a yea	275	4.0
A homemaker	381	5.5
A student	140	2.0
Retired or unable to work	3179	46.1

Income Level

less than $15,000 -less than $25,000	1789	25.2
$25,000 - less than $50,000	1343	19.5
$50,000 or more	3692	53.6

Computed Five Level Race/Ethnicity Cate

White only, Non-Hispanic	4684	68.0
Black only, Non-Hispanic	1749	25.4
Other race only, Non-Hispanic	185	2.7
Multiracial, Non-Hispanic	82	1.2
Hispanic	92	1.3

Age

Age 18-34	302	4.7
Age 35-64	302	9.7
Age 65 years and older	2628	38.1

Variable Descriptive

Among the survey participants in table 3 18.7% (n = 1286) had diabetes while 81.3% (n = 5606) don't have diabetes.

Table 4

Variable Descriptive-Diabetes

	Frequency	Percent
yes	1286	18.7
no	5606	81.3
Total	6892	100.0

From table 4, majority of the respondents were obese at 32.9% (n=2267) followed by overweight at 32.7% (n= 2251). The least were normal weight and underweight.

Table 5

Variable Descriptive -Computed body mass index categories

	Frequency	Percent
Underweight	127	1.8

Normal Weight : 1850 <= _BMI5 < 2500	1734	25.2
Overweight: 2500 <= _BMI5 < 3000	2251	32.7
Obese: 3000 <= _BMI5 < 9999	2267	32.9
Total	6892	100.0

From table 5, majority of the respondent never smoked with 54.2% (n = 3734) and 25% were former smokers (n = 1722), 11.6% of the respondents were current smokers and smoked now for every day (n = 801) while 4.9% were current smokers who smoked for some days (n = 336)

Table 6

Variable Descriptive -Computed Smoking Status

	Frequency	Percent
Current smoker - now smokes every day	801	11.6
Current smoker - now smokes some days	336	4.9
Former smoker	1722	25.0
Never smoked	3734	54.2
Total	6892	100.0

Majority of the respondents were inactive at 32.7% (n = 2255), followed by respondents who were highly active with 25.8% (n = 1780) and15.8% insufficiently active (n = 1092) and active were 14.3% (n = 989).

Table 7

Variable Descriptive -Physical Activity Categories

	Frequency	Percent
Highly active	1780	25.8
Active	989	14.3
insufficiently active	1092	15.8
Inactive	2255	32.7
Total	6892	100.0

Majority of the respondents consumed fruit one or more times per day with 49.3% (n = 3399) while 39.7% (n = 2738) consumed fruit less than one or more times in a day.

Table 8

Variable Descriptive-Dietary Intake (fruits)

	Frequency	Percent
Consumed fruit one or more times per day	3399	49.3
Consumed fruit less than one time per day	2738	39.7
Total	6892	100.0

Majority of the respondents consumed vegetables one or more times per day with 67.6% (n=4661) while 18.9% (n=1304) consumed vegetables less than one or more times in a day.

Table 9

Variable Description-Dietary Intake (Vegetables)

	Frequency	Percent
Consumed vegetables one or more times per day	4661	67.6
Consumed vegetables less than one time per day	1304	18.9
Total	6892	100.0

Assumptions

Chi-square: A chi-square test has two assumptions that must be satisfied before one can proceed with it to run a test. The two assumptions (categorical variables and an independence of observations) were met based on the design of the study. The variables are categorical in nature with different levels.

Binomial Regression: For the analysis of all the research questions I used binomial logistic regression. Before one can use this statistical test there are certain assumptions that the data must be met. These assumptions are six (6). The first assumptions that the dependent variable should be a dichotomous categorical variable; the second assumption is that the independent variables should include two or more variables measure either on a continuous or nominal scale. The third assumption is the independent of observation which implies that there should be no relationship between the observations, the fourth assumption is multicollinearity, the data must not show multicollinearity.

The first two assumption was met as the dependent variable and is dichotomous; ever had diabetes coded yes = 1 and No = 2. The second assumption was also met as the independent variables and are all measured on the nominal scale including, demographics (employment status, educational level, race, sex, age), BMI, smoking, physical activities and dietary intake.

The third assumption was independence of observations/residual and was confirmed as the use of weighted data in this study, eliminating the possibility of autocorrelation between the variables (Laerd Statistics, 2018). The fourth assumption was multicollinearity, it was checked using VIF method in SPSS. The output showed that the person correlation values were all less than 0.8. The tolerance value for all the variables were greater than 0.1

and VIF values for all the variables were less than 10. The maximum was 4. 563. It can be concluded that there are no multicollinearity symptoms in the variables.

Research Questions Results

Research Question 1. Is there an association between Demographics (employment status, educational level, income, sex, race and age) and Type 2 DM among adults aged 18 years and older in Alabama, USA?

A chi square analysis was conducted to determine if there was a statistical significance association between the individual demographics (employment status, educational level, income, sex and age) and Type 2 DM among adults aged 18 years and older in Alabama. As shown in table 10 there was a statistically significant difference between the diabetes and all the demographic variables groups except sex. There was a statistical significant association between diabetes and employment status, age, educational level and income at P = 0.000 but there was no significant difference between diabetes and sex. This implies that both male and female have equal chances of having diabetes.

Table 10: *Chi-Square Test for Diabetes and Demographics*

Chi-Square Tests

Demographic variables	Pearson Chi-Square Value	df	Asymptotic Significance (2-sided)
Employment status	399.781[a]	4	.000
Age	309.777[a]	2	.000
Race	56.138[a]	5	.000
Sex	.050[a]	1	.823
Educational level	46.157[a]	4	.000
Income level	87.088[a]	2	.000

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 26.15.

Research Question 2:

Is there an association between Dietary Intake and Type 2 DM among adults aged 18 years and older in Alabama, USA?

A chi square analysis was conducted to determine if there was a statistical significance association between dietary intake (as defined by consumed fruit or vegetable once or more per day) and Type 2 DM among adults aged 18 years and older in Alabama As shown in table 11there was no statistically significant difference between diabetes and dietary intake at X(2) = 3.671, P = .160. therefore, we fail to reject the null hypothesis.

Table 10

Chi-Square Test for Diabetes and Dietary Intake

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.671[a]	2	.160
Likelihood Ratio	3.760	2	.153
Linear-by-Linear Association	2.537	1	.111
N of Valid Cases	6892		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 140.88.

Research Question 3.

Is there an association between Physical Activity and Type 2 DM among adults aged 18 years and older in Alabama, USA?

A chi square analysis was conducted to determine if there was a statistical significance association between physical activities (as defined by how active a person was) and Type 2 DM among adults aged 18 years and older in Alabama. As shown in table 12 there was statistically significant difference between diabetes and physical activities at x(4) = 72.149, P = .000. therefore, we reject the null hypothesis and accept the alternative hypothesis. This means that physical activity is associated with diabetes.

Table 11

Chi-Square Test for Diabetes and Physical Activities

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	72.149[a]	4	.000
Likelihood Ratio	70.374	4	.000
Linear-by-Linear Association	7.118	1	.008
N of Valid Cases	6892		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 144.80.

Research Question 4.

Is there an association between Body Mass Index and Type 2 DM among adults aged 18 years and older in Alabama, USA?

A chi square analysis was conducted to determine if there was a statistical significance association between BMI and Type 2 DM among adults aged 18 years and older in Alabama. As shown in table 13 there was statistically significant difference between diabetes and physical activities at X(3) = 251.347, P= .000. Therefore, we reject the null hypothesis and accept the alternative hypothesis. This means that BMI is associated with diabetes

Table 12

Chi-Square Test for Diabetes and BMI

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	251.347[a]	3	.000
Likelihood Ratio	260.054	3	.000
Linear-by-Linear Association	246.115	1	.000
N of Valid Cases	6379		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 23.93.

Research Question 5.

Is there an association between Smoking and Type 2 DM among adults aged 18 years and older in Alabama, USA?

A chi square analysis was conducted to determine if there was a statistical significance association smoking and Type 2 DM among adults aged 18 years and older in Alabama. As shown in table 14 there was statistically significant difference between diabetes and physical activities at x(4) = 22.246, P = .000. Therefore, we reject the null hypothesis and accept the alternative hypothesis. This means that smoking is with diabetes

Table 13

Chi-Square Test for Diabetes and Smoking

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.246[a]	4	.000
Likelihood Ratio	22.165	4	.000
Linear-by-Linear Association	.106	1	.745
N of Valid Cases	6892		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 55.79.

Table 14

Variables in Equations-Binomial Regression for Diabetes and Demographics, Dietary Intake, Physical Activities, Smoking and BMI

Variables in the Equation

							95% C.I.for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	Physical Activity Categories (highly active)			14.078	4	.007			
	Active	.172	.127	1.837	1	.175	1.188	.926	1.523
	insufficiently active	.300	.124	5.899	1	.015	1.350	1.060	1.721
	Inactive	.366	.101	13.208	1	.000	1.442	1.184	1.757
	Computed BMI Categories (underweight)			161.687	3	.000			
	Normal Weight: 1850 <= _BMI5 < 2500	.887	.530	2.803	1	.094	2.427	.860	6.853
	Overweight: 2500 <= _BMI5 < 3000	1.570	.525	8.927	1	.003	4.807	1.716	13.462
	Obese: 3000 <= _BMI5 < 9999	2.205	.525	17.646	1	.000	9.067	3.241	25.363
	Dietary intake(Consumed vegetables one or more times per day)			.969	2	.616			
	Consumed vegetables less than one time per day	-.005	.096	.003	1	.958	.995	.824	1.202
	Computed Smoking Status (smokes everyday)			5.100	4	.277			
	Current smoker - now smokes some days	-.005	.211	.001	1	.980	.995	.658	1.504
	Former smoker	.226	.139	2.661	1	.103	1.254	.955	1.646
	smoked	.193	.132	2.146	1	.143	1.213	.937	1.570
	Age categories (18-34 years)			75.064	2	.000			
	35 - 64 years	2.033	.271	56.496	1	.000	7.641	4.496	12.984
	65years and older	2.385	.280	72.410	1	.000	10.855	6.267	18.800
	Employment status category (employed for wages or self-employed)			65.596	4	.000			
	out of work for less than a year or more	.170	.233	.533	1	.466	1.186	.750	1.874
	Homemaker	.502	.194	6.685	1	.010	1.652	1.129	2.416
	Student	-17.523	3909.971	.000	1	.996	.000	.000	.
	retired or unable to work	.821	.103	63.731	1	.000	2.273	1.858	2.781
	Income categories of participants (>$15,000)			7.312	2	.026			
	$25,000 - less than $50,000	-.134	.103	1.672	1	.196	.875	.714	1.071
	$50,000 or more	-.291	.108	7.288	1	.007	.747	.605	.923
	Race (White only, Non-Hispanic)			17.606	5	.003			

Black only, Non-Hispanic	.339	.089	14.398	1	.000	1.404	1.178	1.672
Other race only, Non-Hispanic	.384	.236	2.639	1	.104	1.468	.924	2.332
Multiracial, Non-Hispanic	.055	.372	.022	1	.882	1.057	.509	2.192
Hispanic	.282	.395	.507	1	.476	1.325	.611	2.876
Computed Level of Education Category (did not graduate high school)			3.350	4	.501			
High school gradate	.074	.142	.270	1	.604	1.077	.815	1.423
Attended college or technical school	.014	.147	.008	1	.927	1.014	.760	1.353
Graduated College or technical school	-.113	.155	.531	1	.466	.893	.658	1.211
Constant	-5.994	.608	97.210	1	.000	.002		

a. Variable(s) entered on step 1: @_PACAT2, @_BMI5CAT, @_VEGLT1A, @_SMOKER3, Agecat, Employcat, Incomecat, @_RACEGR3, @_EDUCAG.

A binomial logistic regression was conducted to examine the association between Demographics (employment status, educational level, income, and age), smoking, physical activities, BMI and Type 2 DM among adults aged 18 years and older in Alabama. The summarized results including the wald significance and EXP(B) odds were shown in table 15. The logistic regression model was statistically significant at X^2 (30) = 725.110, P = 0.00, the model explained only (Nagelkerke) 20.8% of the model of variance in diabetes and correctly classified 80.8 of the cases. All categories of educational level did not significantly predict the model, the P value was > 0.05. This means that educational level did not predict diabetes. Employment status predicted the model at P<.05. Those employed for wage or self-employed, out of work for more than one year and students did not predict the model, but homemakers and retired or unable to work predicted the model at P = .000. Age significantly predicted the model at P< 0.05, all the age groups predicted model significantly, the odds of diabetes increased with age. The categories of household income did not predict the model except those who earned from $50,000 and above. This implies that highly earned participants were more likely to have diabetes than the lower income

earners. Race was statistically significant at P= .000, in all the categories of race only Blacks only, no Hispanic showed significant association with diabetes, this shows that blacks are more likely to have diabetes than other race category in the research. For physical activities, participants who were active were not statistically significant at P = .175 while those who were inactive and sufficiently inactive statistically significant at P <0.05. This implies that those who are inactive and sufficiently inactive have higher odds of having diabetes than the highly active participants. From the result, all the BMI categories significantly predicts the model at P > 0.05 Respondents who are between 1850 < = 2500 (Normal weight) were not statistically significantly at P = .094. But those who are overweight (Overweight 2500 < = _BMI5 < 3000) and obese were statistically significantly at p = .003 and .000 respectively. The odds of having diabetes increases by a factor of .4.807 with every 1kg increase in weight for those overweigh when compared to those who are underweight. Also, for every 1kg increase in weight for those obese (@BMICAT3) the odd of having diabetes increase by a factor of 9.067 compared to those who are underweight. This implies that participant who were overweight and obese are at a higher risk of having diabetes than participants who were underweight and normal weighted. Dietary intake was not statistically significant in the regression analysis at P = .958. Lastly, smoking showed no statistically significant association with diabetes at p = .277. All the categories of smoking were not statistically significant. And this implies that smoking is not associated with diabetes.

Summary

Chapter 4 showed the statistical results for the five (5) research questions included in this study. Chi-square test was used to test the association between the outcome variable diabetes and the independent variables demographic, BMI, dietary intake, smoking and physical activities. In the demographics' variable income, educational level, race, employment status and age showed statistically significant association with diabetes while sex was not statistically significant. BMI, Smoking and physical activities showed a statistically significant association with diabetes at $P < 0.05$ while dietary intake was not significant. Variables that were statistically significant and showed association with diabetes were further included in a logistic regression. The binary logistic regression was conducted to examine the association of physical activity, BMI and smoking while controlling for demographics like educational level, income, employment status and age for confounders. Result showed that Respondents are homemaker and those who retired are unable to work and has higher odds of having diabetes when compared to the reference which were self-employed or employed for wages. Age significantly predicted the model at $P < 0.05$, all the age groups predicted model significantly, the odds of diabetes increased with age. Respondents who earned $50,000 and more annually had higher odds of having diabetes than other income categories. Education did not significantly show association with diabetes. Race was significant and the regression shows that blacks have higher risk of diabetes than other race. Physical activities predicted the model at $P = 0.00$ which is less than 0.05. In all, the category participants who were inactive and insufficiently inactive had higher odds of diabetes when compare to those who were highly active. In the fourth research question, BMI significantly predicts the model at $P = .000$ which is less than .05. Respondents who are between 1850 < = 2500 did not significantly predict the model. But

those who are overweight and obese predicted the model significantly. Dietary intake was not associated with diabetes. Finally, smoking did not significantly predicted diabetes for respondents in all the categories at $p > 0.05$. This means smoking was not associated with the risk of diabetes.

Chapter 5 is the final chapter of this study; here the researcher provided an interpretation of the statistical findings and a review of the limitations of the study. Recommendations for further studies were discussed here as well as the implications of study findings.

Chapter 5: Discussion, Conclusions, And Recommendations

Introduction

The purpose of my study was to determine the relationship between diabetes and demographic factors (income level, education level, race and sex), dietary intake, physical activities, BMI and smoking. I examined the relationship between diabetes and the respective predictor variables while controlling for age, educational level and income as confounders. Five research questions were addressed in this study. Using secondary data provided by The Behavioral Risk Factor Surveillance Survey, I analyzed the data for each of the five research questions.

For the first research question, a chi square test was conducted in the first research question and only employment status, educational level, age, income category and race significantly predicted the model at $P > 0.05$. Sex was not significantly associated with diabetes. A binominal logistic regression was also conducted including only age, educational level and income. The odd ratios showed that as respondents, age increase the odds of having diabetes increased. The odds were particularly higher in age category 35 to 65. Respondents are homemaker and those who retired or unable to work add higher odds of having diabetes when compared to the reference which were self-employed or employed for wages. Respondents who earned $50,000 and more annually had higher odds of having diabetes than other income categories. Race was statistically significant at $P= .000$, in all the categories of race only Blacks only, no Hispanic showed significant association with diabetes, this shows that blacks are more likely to have diabetes than other race. Educational level was statistically insignificant

For the research question 2, a chi square test was conducted to determine the association between dietary intake and diabetes. Dietary intake was not statistically significantly associated with diabetes with P > 0.05 it was further included in the logistic regression and was still not statistically significant.

For the third research question, a chi square test was conducted to determine the association between physical activities and diabetes. Physical activities was significantly associated with diabetes at P = 0.00 which is less than 0.05. Furthermore, it was included in the binary regression which controlled for income, educational level, age and physical activities was significant at P = 0.00 which is less than 0.05. In all, the category participants who were inactive and insufficiently inactive had higher odds of diabetes when compared to those who were highly active. Age, employment status and income and race also had a confounding effect in this relationship at P < 0.05. The result showed that respondents who were older were more at risk of having diabetes than the younger ones and respondents who earned higher from $50,000 and more annually had higher odds of having diabetes than other income categories and respondents who are homemaker and those who retired or unable to work had higher odds of having diabetes when compared to the reference which were self-employed or employed for wages. Also it showed that respondents who are Blacks hve higher risk of having type 2 diabetes.

For the fourth research question, a chi square test was conducted to determine the relationship between BMI and diabetes. BMI was significantly associated to diabetes at P = .000 which is less than .05. BMI was further included in the logistic regression which controlled for age, income, educational level and employment status. Respondents who are between 1850 < = 2500 did not show significant association. But those who are

overweight and obese predicted the model and showed statistical significant association with diabetes. The odds of having diabetes increase with increase in the BMI of the participants. Age, employment status and income also had a confounding effect in this relationship at $P < 0.05$. The result showed that respondents who were older were more at risk of having diabetes than the younger ones and respondents who earned higher from $50,000 and more annually had higher odds of having diabetes than other income categories and respondents who are homemaker and those who retired or unable to work had higher odds of having diabetes when compared to the reference which were self-employed or employed for wages. Also it showed that respondents who are Blacks have higher risk of having type 2 diabetes.

Finally, for the fifth research question, a chi-square test was conducted to determine the relationship between smoking and diabetes. Results showed that smoking was associated with diabetes at $P < .05$. smoking was included in the logistic regression analysis and age, income, educational level and employment status was controlled. After controlling for these confounders, smoking did not show association with diabetes.

Interpretation of the Findings

Research Question 1

The first research question addressed the relationship between diabetes and demographic factors including (income level, employment status, education level, age, race and sex), employment status, age, educational level income category and race had statistical significant association with diabetes at $P > 0.05$, sex did not significantly show association with diabetes. Furthermore, the odd ratios from the logistic regression showed that as respondents age increases, the odds of having diabetes also increases. The odds were particularly higher in age category 35 to 65. Respondents are homemaker and those who retired or unable to work adds higher odds of having diabetes when compared to the reference which were self-employed or employed for wages. Respondents who earned $50,000 and more annually had higher odds of having diabetes than other income categories. Respondents who are Blacks have higher risk of having type 2 diabetes. Also, respondents aged from 35 year and above had more risk of having diabetes than those who are younger. Age is one of the risk factors of diabetes, as one ages he is at more risk of having diabetes, according to CDC (2021). T2DM develops more in people over 45 years although younger people can have it but it is seen more in 45 years and older, this is similar to the studies of Islam (2017), he found in their research that age, education, area of residence, physical activity are associated with T2DM. In the current study age from 35 years and above are significantly associated with T2DM, Employment status also was significant; respondents who were homemakers, retired and unable to work were more at risk of having diabetes. This could be attributed to the fact that they earn less or the fact that they are not physically

engaged when compared to those who work for wages, are self-employed and those who work for one year or more.

Research Question 2

The second research question addressed the relationship between diabetes and dietary intake. The study used consumed fruits once or more per day and consumed vegetable once or more per day to measure dietary intake. Dietary intake was not statistically significantly associated with diabetes in both the chi square analysis and regression analysis with $P > 0.05$ This could be as a result of the measure of the dietary intake in the BRFSS. Diet is very important in both prevention and management of type 2 diabetes. Many studies have proven that good dietary management through lifestyle interventions reduces type 2 diabetes. Hirahatake et al., (2019), examined the association between dietary pattern scores created to reflect the 2015 Dietary Guidelines for Americans (DGA) Scientific Report. His research shows that diet is a very important factor for T2DM.

Research Question 3

The third research question addressed the association between diabetes and physical activities. Physical activities showed statistically significant relationship with diabetes at P <b0.05. In the binary logistic regression, participants who were insufficiently active and inactive predicted the model at $P < 0.05$ while controlling for age, income, employment status, educational level. Respondents who were insufficiently active and inactive had more risk of having T2DM than those who were highly active and active. This implies that physical activities can predict the risk of T2DM. Those who were physically inactive tend to have higher risk of type two diabetes while those who were highly active did not have

risk of T2DM. Serbis, (2021), reported that increase in physical activities is very important and plays a vital role in T2DM. Increased physical activities reduce weight and also increases insulin sensitivity and improves blood glucose control (Serbis, 2021). Age, educational level, employment status and income were controlled as confounders but only age, employment status and income also had a confounding effect in this relationship at P < 0.05. Age significantly confounded the relationship between diabetes and physical activities. Those who were 35 years to 65 years and 65 and older had more risk of diabetes than those from 18 to 34. Those participants who are older don't have a lot of physical activities and therefore were in the insufficiently active and inactive category which could result to been overweight and increase the risk of type 2 diabetes. Respondents who earned higher from $50,000 and more annually had higher odds of having diabetes than other income categories and respondents who are homemaker and those who retired or unable to work had higher odds of having diabetes when compared to the reference which were self-employed or employed for wages. Also it showed that respondents who are Blacks have higher risk of having type 2 diabetes.

Research Question 4

The fourth research question addressed the relationship between diabetes and body mass index. BMI was significantly associated with diabetes at P = .000, < 0.05. From the regression analysis, it showed that respondents who are between 1850 < = 2500 (normal weight) did not show statistical significantly while those who are overweight (Overweight 2500 < = _BMI5 < 3000) and obese (3000 < = _BMI5 < 9999) significantly showed association with diabetes. Overweight or obesity has been one of the major risk factors of diabetes. This result is similar to a study by Valaiyapathi et al., (2020). In their study

obesity was a consistent risk factor for type 2 DM, it was recommended that obesity progression should reduce. Similarly, Spurr et al., (2017) showed that obesity and overweight were risk factors of T2DM. Age, educational level, employment status and income were controlled as confounders but only age, employment status and income also had a confounding effect in this relationship at $P < 0.05$. Age significantly confounded the relationship between diabetes and physical activities. Those who were 35 years to 65 years and 65 and older had more risk of diabetes than those from 18 to 34. Those who were 35 years to 65 years had more risk of diabetes than those from 18 to 34. Those participants who are overweight are under this age category and this puts them in a very high risk of having diabetes. Also it showed that respondents who are Blacks hve higher risk of having type 2 diabetes. Respondents who earned higher from $50,000 and more annually had higher odds of having diabetes than other income categories and respondents who are homemaker and those who retired or unable to work had higher odds of having diabetes when compared to the reference which were self-employed or employed for wages.

Research Question 5

The fifth research question addressed the relationship between diabetes and smoking. Smoking showed significant association with diabetes for respondents. Smoking was included in the logistic regression analysis and age, income, educational level and employment status was controlled. After controlling for these confounders, smoking did not show further association with diabetes which implies that the demographic confounded the association. FAD, (2020) reported that smokers are 30% to 40 % more likely to have T2DM when compared to those who don't smoke and also it makes regulation of insulin level more

difficult due to high level of nicotine. And Maddatu et al (2018) epidemiological studies showed a significant association between cigarette smoking and an increased risk of T2DM. And also, clinical data suggest its effect on insulin sensitivity, body composition and pancreatic beta cell which is contrary to my results. Study by Campagna et al (2019) reported that no much evidence has been proven that smoking can cause or is a risk factor of type 2 diabetes but they recommended the modification of the risk factors of smoking to prevent the onset of diabetes. The current study found no relationship between smoking and diabetes while controlling for age and sex.

Interpretation of the Findings in Relation to the Theoretical Framework

The research's theoretical framework was based on the Social Ecological Model Theory (SEMs). The social ecological model was conceptualized using the construct of health and a great focus on the major factors that might affect health. And It states that health is affected by the interaction between the characteristics of the individual, the community, and the environment that includes the physical as a theory-based framework for understanding the multifaceted and interactive effects of personal and environmental factors. The various risk factors of T2DM found in the studies include BMI, Physical activities, demographics such as age, income, employment status and race. These factors exist in the different levels of the social ecological model. The multifaceted and interactive effects of the personal and environmental factors that affect diabetes are not far from these results.

The ecological model systematically categorizing these factors into five levels of influence: Firstly, the individual level which includes beliefs, values, education level,

income, employment, skills and other individual factors between an individual and others. At this level in the study, employment was significantly a risk factors, those who did not work or did little work had more chances of having T2DM than those who work. Secondly, the interpersonal level, including interpersonal relationships between individuals and relationship institutions are organized and managed; here the individual is expected to interact with others in different institution he/she finds himself/herself. For instance, in the school, church and other peer groups. The life style of people are affected by these groups in many ways. In the study of physical activity, dietary intake and BMI were addressed, in institutions like school physical activities and dietary intake can be managed as they have shown in the study to be significant in predicting T2DM. This simply implies that more physical activities can be added to the school, church and work program that can encourage people to engage in active physical activities. Interaction with these institutions have effect on the people positively especially towards health, school canteens can remove some foods that contain a lot of crabs, more physical activities added to the school program and activities of other institutions. Fourthly, the community level, which includes the communities that individuals operate in like association the individual might be including professional associations, attitudes and the relationship among different institutions within communities; and (5) the policy level, which refers to policies and regulations affecting intervention participants and the institutions in which they function (McLeroy et al.,1988). The government and many authorities come under this level. Some of the risk factors discussed like BMI, smoking, can be adjusted here especially in the institutions as policies. Smoking should be prohibited to an extent. The government can make policies that can help reduce these risk factors in the society since the policies and regulations affect the people. Both the individuals, communities, institutions and higher authorities that can

make policies and regulations all affect the human lifestyle and behavior which in turn affect their health. A positive turn to encourage the reduction of these risk factors can help in the reduction of the incidence of T2D.

Limitations of the Study

Some of the assumptions made in the beginning of the study were confirmed such as the first assumption is the sample size of the Alabama survey participants who enrolled in the 2019 BRFSS survey would be large enough to generate significant results and would be a representative of the overall Alabama youths and adults aged 18 and above. I confirmed in the course of the study, the total sample size used for the study was 6,379 and after the data cleaning, the G-power recommended a sample size of 153. Participants exceeded the G-power minimum of 153. The second assumption was that the data in the 2019 BRFSS survey were weighted. This was also confirmed by using a weighted dataset and getting a weighted data for the particular state (Alabama) I researched on from the BRFSS website. The third assumption is that all the data collected from the participants were reported correctly and accurately by the BRFSS interviewers during the survey. This was confirmed as well through different research from different researchers, the BRFSS provides a list of publications that provides information across topics and illustrates the future of the BRFSS as a reliable and valid source of information. Results from some of the researchers as Pierannunzi, Chu, & Balluz (2003) shows that the BRFSS is a reliable and valid source of data.

Recommendations

The researcher recommends for further studies to use other measures for dietary intake. In the current study, dietary intake was measured using consumption of fruit and vegetable once or more per day, but it should be known that fruits and vegetables are not the best measure of dietary intake. Further studies can use other measurements to measure the dietary intake.

Secondly, the researcher also recommends the use of primary data in researches like this so as to collect all the necessary data. Secondary data limits the type of data a researcher can collect.

Implication

Implication for social change

This study has implication for social change. When the risk factors of a disease are known in a particular population and state, it helps to guide and inform decision making among the population. From my studies, it is evident that physical activities, smoking, demographics and BMI are risk factors of T2DM. Physical activities among this population should be encourage both in the diabetic and non-diabetic population because it has be proven to reduce the risk of diabetes as well in the management of diabetes. Also, smoking should be discouraged both from the diabetic patients and from the non-diabetic respondents because it increases insulin insensitivity. Socially, it can help people to change their lifestyle and behaviors towards getting a better health.

Implication for Practice

Practically, it would guide families, institutions, associations and communities with diabetic patients in their life style decisions and in managing diabetes. Policies from institutions, associations and regulated bodies towards management and prevention of T2DM.

Conclusion

Diabetes is a public health burden and has caused burdens to different families and societies. Finding the risk factor of a disease is one of the ways to find solutions to the disease. This study has succeeded in finding some of the risk factors that are significantly associated with T2DM in Alabama including demographics like employment status, age, income and race. Others include BMI, and physical activities. Age was controlled as a confounder and was found to have confounding or interacting effect in the different risk factors excluding demographics. This shows how important age is in type 2 diabetes. The older people get the more weight they gain due to little or no physical activities which increases the risk of type 2 diabetes. As diabetes is a disease that can be managed, guidelines and informed decisions can be made from the findings of this research and such decisions can include, diabetes awareness and management education, control policy like patient education, disease counseling, early diagnosis, life style and behavioral interventions can be started and encouraged in Alabama population. Also, healthy lifestyle and good dietary intake should be adopted by schools, work places and other organized institutions.

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Appendix

Apendix1