Spring 2021

Body Mass Index, Waist Circumference, and Hemoglobin A1C in the Lower Income African Americans

Lisa Gabel
The University of Akron, ldg28@zips.uakron.edu

Joci Verb
The University of Akron, jmv81@zips.uakron.edu

Lauren Windham
The University of Akron, lrw50@zips.uakron.edu

Body Mass Index, Waist Circumference, and A1C in the Lower Income African Americans

Lauren Windham, Joci Verb, Lisa Gabel

College of Health Professions, The University of Akron

Abstract

This research project is a sub-study of a larger intervention study, Finding A Better U! (FABU). The larger parent study involved faculty co-investigators and examined the effects of a weekly exercise and nutrition intervention on cardiovascular disease (CVD) and type 2 diabetes (T2DM) outcomes in lower income African Americans. Since few researchers have specifically evaluated the relationship between body mass index (BMI), waist circumference (WC), and A1C in this particular population, this Honors project originally planned to analyze a smaller dataset from the larger intervention study to answer the following research question: What is the relationship between BMI, WC, and A1C in minority adults with CVD and T2DM? The non-experimental correlational study was to be guided by the Transtheoretical Model of Health Behavior and Change. The COVID-19 pandemic disrupted the larger study, and this project's research question was revised: What is the relationship between BMI and A1C in minority adults with CVD and T2DM? In the project sample (N=9), there was a significant inverse relationship between BMI and A1C, supporting that as BMI increased, A1C decreased. This was an inconsistency with previous findings and may be explained by poor study internal validity (threat of history and small sample).

The Centers for Disease Control and Prevention (2019) reported that within the United States, more than 34 million individuals have diabetes which is about 1 in 10 people; 90-95% of these individuals have type 2 diabetes (T2DM). When looking specifically at diabetes prevalence in African Americans, ages 50 and 64 years, they are at 23% while whites are at 14%. This chronic disease can affect all ages (CDC, 2019). T2DM is a disease process in which pancreatic cells cannot produce enough insulin or the body does not use insulin properly to maintain blood glucose levels which is referred to as insulin resistance. When the blood sugar rise is uncontrollable, this leads to prediabetes and T2DM. Insulin allows the cells of the body to take up glucose and use it for energy (CDC, 2019). Type 1 diabetes (T1DM) differs from T2DM, in that with T1DM, the pancreas does not make any insulin. T1DM is also less common and unpreventable (CDC, 2020). Further, T2DM is a risk factor for cardiovascular disease(CVD), vision impairments, and kidney disease (CDC, 2019). A major risk factor for developing this disease is obesity (Luo et al., 2019). Obesity can be defined with anthropometric measurements of body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR) (Luo et al., 2019). Rates of T2DM and obesity in the United States are high in the minority African American population (West et al., 2019), compared with others. Studies also show that rates of poorer outcomes involving CVD are higher in the African American population (Bell, Thorpe, Bowie, & Laviest, 2018). In a specific study about CVD and socioeconomic status, it was found that CVD and diabetes were associated with similar behaviors such as diet and physical activity (Bell et al., 2018). The prevalence of death by heart disease in African American adults, ages 18 to 49 years, is two times more likely than white counterparts (CDC, 2017).

Exercise and nutrition interventions have shown evidence for improving outcomes in those with T2DM (West et al., 2019). These interventions also affect WC and BMI in those with

T2DM (West et al., 2019). It is understood that weight loss is the priority intervention for individuals with T2DM and obesity (West et al., 2019). Implementing interventions to improve lifestyle choices among this population can contribute to weight loss in hopes to decrease the prevalence of T2DM and obesity as well. Interventions include increasing physical activity, decreasing calorie and fat intake, and weighing oneself. These interventions were effective in a study for weight loss over time in multiple minorities, including African Americans (West et al., 2019).

This Honors research study was in conjunction with a larger parent study, an interdisciplinary, state funded research study titled, "Finding a Better U (FABU)". The FABU project was headed by university faculty members, Dr. Carolyn Murrock, Dr. Mary Jo MacCracken, Dr. Judi Juvancic-Heltzel, and Alexis Holt. The purpose of the FABU project was to evaluate the effects of a twice/weekly exercise and nutrition education programs on risk factors for heart disease and T2DM in minority populations. In the FABU study, analyzing data quarterly would have allowed the researchers to see the individual effects of BMI and WC on A1C over time. However, the purpose of this Honors research was to analyze data at one point in time to determine the relationship between BMI, WC, and A1C. Hence, this Honors project was going to answer the following research question: What is the relationship between BMI, WC, and A1C in the low income African Americans? The introduction of this paper, as well as the review of literature, theoretical framework, and methods were written in line with that research question. Due to the effects of COVID 19, the FABU study was ceased until further notice. Therefore, this Honors research project has been adapted to evaluate the relationship between BMI and A1C at baseline, rather than the relationship between BMI, WC, and A1C as effects of the exercise and nutrition interventions over time. The Honors research project was originally aimed at determining relationships between body mass index (BMI), waist circumference (WC), and A1C among African Americans of the local low-income community. The new research question is: What is the relationship between BMI and A1C at baseline in minority adults?

The original inclusion of WC was based on research finding that WC shares a positive correlation with BMI (Albrecht et al., 2017); however, WC provides a better indication of central adiposity of the body (Higuchi et al., 2019), which may have more of an effect on insulin resistance than general adiposity. Further, the variables were chosen due to the known increased risk of heart disease and T2DM among this population. Obesity is related to increased BMI, which can lead to increased mortality due to CVD (Sisodia & Chouhan, 2019). With an increase in T2DM, there is a risk for increased vascular damage among many parts of the body including the kidneys, eyes, extremities, and blood vessels (Sisodia & Chouhan, 2019).

Review of Literature

Research on diabetes and CVD is certainly not in short supply. However, when studying specific minority populations, the research diverges to include various populations but little specifically focused on low income African Americans. Although one may be able to hypothesize and speculate outcomes based on findings about other populations, one cannot necessarily apply these findings to practice with a different population (Luo et al., 2019). Many researchers have found positive correlations between WC, BMI, and A1C in all racial and ethnic groups (Albrecht et al., 2017; Luo et al., 2019). Researchers have also found that T2DM is a risk factor for CVD and that socioeconomic status also contributes to risk for impaired glycemic control (Bell et al., 2018). There are limitations to these studies which are discussed in the paragraphs to follow, along with an integrated review of studies with examples of specific findings. This research paper will build upon what is already known about the African American population and their risk for T2DM and CVD, specifically research about the relationship of BMI, WC, and A1C levels in the lower income African American population. An extensive matrix of evidence is located in Appendix A.

Type 2 Diabetes

Approximately 70% of United States (US) adults are overweight or obese which is a primary risk factor for T2DM (Firouzi et al., 2018). Diabetes is a serious risk factor for CVD which is currently the leading cause of death in the United States. Central and abdominal obesity are more significant counterparts to glucose intolerance and insulin resistance than generalized obesity (Firouzi et al., 2018). Among lower socioeconomic status (SES) individuals, the incidence of T2DM and other cardiovascular health problems is higher than in individuals of higher socioeconomic status (Bell et al., 2018). Further, African Americans have higher incidences of diabetes than white people (Bell et al., 2018). Likewise, African Americans also have higher incidence of CVD, compared with white people, which supports the correlation for T2DM and CVD (Bell et al., 2018). Factors that contribute to the prevalence of T2DM include higher BMI, and greater WC (Albrecht et al., 2017). Daily weighing, meal replacements, and attendance of educational group meetings have been shown to affect factors related to diabetes and weight loss management (West et al., 2019). Limitations among these studies were their cross-sectional designs with one data collection of BMI, A1C, and WC; self-reporting which could lead to inaccurate data; and, attrition due to the long-term commitment of the study.

Obesity

In general, researchers have found that there is a positive correlation between obesity and T2DM. Specifically, among the African American (AA) population, these correlations were stronger as evidenced by higher BMI in this group compared to their white counterparts (Conway et al., 2018). Sisodia and Chouhan (2019) and Conway et al. (2018) show consistent findings in that with increasing BMI, there are increases in A1C values, leading to an increase in T2DM prevalence. It was specifically found that those with BMIs greater than 30 also had A1C greater than 8% (Sisodia & Chouhan, 2019). Other factors, such as age, WC, and waist to hip ratios, also are risks for diabetes and positively correlated with diabetes (Luo et al., 2019). Among these studies, it was consistently found that age and WC have the strongest positive correlations to T2DM in the AA population, i.e., as age increases, WC increases, and risk of T2DM increases (Conway et al., 2018; Luo et al., 2019; Sisodia & Chouhan, 2019).

Waist Circumference

Waist circumference has been found to be a strong predictor of glucose metabolism as it accounts for abdominal adiposity rather than generalized adiposity which is more consistently demonstrated through BMI (Firouzi et al., 2018). This finding is consistent among a few studies that examined African Americans and Asians. Firouzi et al. (2018) and Mashele, Mogale, Towobola, and Moshesh (2019) found that WC strongly predicted glucose metabolism and glycemic control. Specifically, poor glycemic control was more strongly predicted by WC greater than 94 centimeters in males and WC greater than 80 centimeters in females (Mashele et al., 2019.) Limitations of this study were the small sample, data collection at a single institution, and the sample of participants who were already diagnosed with T2DM (Mashele et al., 2019). WC shows higher predictability of diabetes alone because it is measuring abdominal adiposity (Higuchi et al., 2019). Measuring variables such as WC and BMI are convenient to measure for the general public. Because fat distribution plays a large role in glycemic control, it is imperative that WC be included in the evaluation of individuals at risk for diabetes, supported by findings that BMI only accounts for partial explanation about adiposity. Considering that individuals with higher BMIs may be extremely muscular, rather than carrying large amounts of subcutaneous and visceral adipose tissue, BMI alone is not reliable for building clinical practice. Ultimately, BMI and WC together can be useful predictors of risk for T2DM and thus, CVD. Despite these findings across studies, the Honors research project is needed to determine specific parameters for the specific population of African American individuals residing in low income housing in an urban setting.

Theoretical Framework

This research was originally guided upon the Transtheoretical Model of Health Behavior and Change (Clark et al., 2019). This model describes five stages of how individuals view and change lifestyle based on information in their environment. According to the model, individuals move through stages of precontemplation, contemplation, preparation, action, and maintenance (see Figure 1). Each stage reflects the individual's process in change, self-efficacy, and decision making. During any of the stages, individuals can relapse and return to prior stages (Clark et al., 2019). The model guides clinical interventions aimed to support health behavior change. This fit the Honors researchers' study because the model informs that the overall FABU project will be incorporating nutrition and exercise interventions in an attempt to bring about behavior changes, although individual participants will be the agents deciding whether or not to make the changes.

Figure 1.

Stages of the Transtheoretical Model

Note. This shows the five stages with a definition and exemplifies the circular and non-linear progression of this theory. Reprinted from Meeting Employees Where They're At Using the Transtheoretical Model, by B. Vigna, 2019, https://packhealth.com/news-change-readiness-transtheoretical-model/. Copyright 2020 by Pack Health. Reprinted with permission.

The Honors researchers were initially going to specifically examine the relationships between the anthropometric measurements of BMI, WC, and A1C. This model fit the research because prior to the enrollment in the intervention research, all the participants may have been in a contemplation phase of not exercising yet, but committed to taking action within six months. After convenience sampling based on flyers advertising FABU at the research sites, then those individuals could have been moving toward the preparation phase of more seriously considering how to start exercising and eating better. The following steps of preparation and action may be further activated and reinforced by attending the nutrition and exercise classes and data collection. Action and eventually maintenance may be achieved when they take what is learned at the exercise and nutrition classes held once a week and implement them into their daily lives and then eventually maintain that change despite times of increased stress. At any stage, the participant can relapse to another or previous stage. This theory proposed a non-linear but cyclical change process. Based on this theory, the researchers expected to find that because of the action and maintaining of a healthy lifestyle, anthropometric measures might decrease and may then hopefully lead to a decreased risk of diabetes and CVD.

Methods

Design

The methodology for this Honors project consisted of a non-experimental, correlational, cross-sectional design. Data were collected and assessed from one collection point of biophysiological measures. A subset of data from the convenience sample of participants of the larger parent study was analyzed, and the Honors project sample was described using demographics. The clinical outcome indicators for heart disease and diabetes risk factor reduction for this Honors project are BMI, WC, and A1C, which were assessed in the larger parent study at baseline and then quarterly. After reviewing the prior literature about the relationship between BMI, WC, and A1C in the African American population, limitations and gaps were found. Therefore, these provided the foundation for this Honors research project. The FABU project received university IRB approval, and the researchers of the Honors project team were listed in IRB documents as part of the research team.

Sample and Site

As described previously, the Honors project was an arm of the currently funded faculty research project Finding a Better U! (FABU). The FABU project was funded by the Ohio Commission on Minority Health and supports the Commission's priority of lifestyle modification through exercise, nutrition, and screenings in the program design. The Honors researchers planned to analyze a subset of data to determine preliminary findings. Data was collected from Saferstein Towers I, which is one of the Akron Metropolitan Housing Authority. This facility is for low-income families, elders, and the physically disabled (Akron Metropolitan Housing Authority, n.d.). Some inclusion criteria for the participants were that they must be a resident of one of the AMHA facilities (Paul Belcher North and South buildings, Saferstein Towers I and II, and Fred W Nimmer) and at 3 Alpha Phi Alpha homes: Charles H. Wesley Tower, John R. Williams Tower, and Henry A. Callis Tower, and required to have a healthcare provider and be medically cleared to participate in the research project. Criteria that excluded participants were unstable angina, uncontrolled hypertension, uncontrolled diabetes (A1C greater than 10%), and unstable mental illness. This Honors project looked specifically at the African American residents enrolled in the Saferstein Tower I of the FABU project with the intention to analyze data from at least 20 African American FABU participants who completed baseline data collection.

Sampling

To recruit participants for the FABU project, flyers and posters were placed in the common areas of study sites, such as the main entrance and community room areas. These flyers outlined the purpose of the study and the days and times the exercise and nutrition programs that would be conducted in their facility. All the participants' information and rights were protected throughout the entire FABU and Honors research project. Informed consent was obtained prior to baseline data collection and collected by Alexis Holt, the Program Manager for FABU. All FABU participants were informed that they were free to withdraw from the study without penalty.Full FABU consent is available in Appendix B.

Data Collection Methods

Since FABU participants agreed to complete data collections that would include BMI, WC, A1C, and demographics, no additional data were collected for the Honors project. Data was collected originally on paper and then entered into an electronic database on a computer that is password protected. The paper copies were kept in a secured office in a locked file cabinet accessible only by Dr. Carolyn Murrock, Principal Investigator. Alexis Holt, and research team members have access to the data as well as the Honors students.

The Honors researchers participated in data collection in March 2020 and had planned to participate again in summer 2020 data collection at the same site. The Honors researchers that collected data for this Honors project authored this Honors paper. During data collection different methods were used, such as paper questionnaires and surveys to measure dependent variables, along with measuring body weight, WC, and A1C. To measure BMI, participants stood on an electric scale to determine body weight. The same scale was used on everyone and at similar times during the data collection day for consistency. The procedure of measuring weight was done consistently according to study protocol. Participants consistently wore shoes when stepping on the scale. There were no specifics on clothing, with the data collectors suggesting removal of coats and extra belongings. There were differences among participants that wore sweatshirts versus lightweight short sleeve shirts. The participants then self-reported their height. Although this is not the most accurate, FABU researchers determined to allow self-reporting of this variable to ensure all people, including wheelchair bound, could participate. Participants that were wheelchair bound or could not stand independently on the foot scale self-reported their weight the last time they were at a doctor's appointment. These measures then were computed in the equation of ($BMI = kg/m^2$) to determine BMI. To measure WC, a research team member used a flexible tape measurer and measured the waist of individuals in centimeters. To determine the A1C, a trained research member pricked the fingers of participants to withdraw a drop of blood that was placed on a specific testing strip that the A1CNow SelfCheck electronic glucometer would measure, providing the A1C number within five minutes (“A1C-Hemoglobin”, n.d.).

Measures

To collect the quantitative data questionnaires, scales, and physiological measures were used. BMI, WC, and A1C are the physiological measures used in this Honors project. BMI was measured by calculating weight in kilograms divided by self-reported height in meters squared (BMI = kg/m^2). Due to this being a correlational study, the BMI was not categorized into the five common ranges of weight class. It was kept as a continuous interval-level variable measure so a relationship could be established. WC was measured by a flexible tape measure and measured right above the navel of the participant in centimeters. Lastly, A1C was measured with a fingerstick by one of the FABU research team members. The electronic glucometer that was used was A1CNow SelfCheck. This monitor could obtain accurate A1C results within five minutes (“A1C-Hemoglobin”, n.d.). A1C is a gold standard measurement for both type 1 and type 2 diabetes. The target range for A1C is around 7%. 7% is the average number reflecting the blood sugar level was between 70-180 mg/dL (Wright & Hirsch, 2017). Below 7% means there is less risk to develop T2DM, and above it means there is a high risk and interventions should be started by a healthcare professional. When the percentage reaches 6.5%, assessment and interventions should also be started to prevent long term diabetic treatment (Wright & Hursch, 2017). The FABU researchers focused on gathering demographics which included age, race, genger, income, and household status. However, many of these demographics were unable to be obtained due to clients preferring not to say.

Data Analysis Plan

All data were entered into a statistical analysis software program. Outliers and missing data were discussed with the project sponsors and addressed, by re-checking data in hard data collection forms and/or by imputing values in the case of missing data. To begin analysis, a descriptive analysis of the sample was conducted to determine the average age, percentage of males and females, and other demographics. Correlational data analysis was used to determine relationships by using Pearson's r statistical test since all variable data were at the interval level of measurement. To determine if the relationships were statistically significant, a p value < 0.05 was set. A Pearson's test determines the significance, strength, and direction of the relationship between two continuous variables.

Results

The original research question for this study was: What is the relationship between BMI, WC, and A1C? Due to COVID 19, FABU and Honors researchers were unable to be onsite until further notice. Therefore, no summer data collection occurred and only March 2020 baseline BMI and A1C data were available to determine correlation. As a result, the research question was revised to be: What is the relationship between BMI and A1C at baseline in minority adults? The Honors researchers used data from a sample of 16 adults, although only 9 of the 16 submitted complete data in terms of BMI and A1C data. Changes in the FABU faculty research team resulted in barriers to getting demographic data for this small subsample. Therefore, the FABU sample (N=54) is described in this Honors paper. Of the 54 participants, approximately 32% (n=16) of the sample was African American and 6% was White (n=6). Approximately 57%

(n=31) preferred not to report race. Approximately 91% (n=40) of the sample was female. Approximately 45% (n=24) reported non-Hispanic as ethnicity with the remaining preferring not to say. Regarding age, 30% (n=16) were 65-75 years, 11% (n=6) were 55-64 years, 6% (n=3) were older than 75 years. Approximately 17% (n=9) reported annual household incomes of less than $9,000, less than 1% (n=4) reported annual household incomes of $10,000-14,999, and remaining preferred not to say. Twenty-six percent (n=14) reported having public health insurance, with the remaining preferred not to say. Unfortunately, there is no way to compare the sample of 54 to the sample of 9 in this analysis

Pearson coefficient correlation analysis was run to answer the research question: What is the relationship between BMI and A1C at baseline in minority adults? The strong, negative correlation between baseline BMI and A1C was statistically significant ($r\ (14) = -.75$, p=.02). The results showed the correlation between BMI and A1C at baseline with a sample size of 9. Therefore r(7) indicates the correlation (r) degrees of freedom, calculated as 9 minus 2 with the two variables being correlated (BMI and A1C). The Pearson's coefficient correlation value of -0.75 indicates the strength of the relationship, which is strong. A *p* value of -1 indicates a perfect negative correlation. It is also a negative or inverse relationship indicating that as BMI increases, A1C levels decrease. Lastly, the *p* value was 0.02 which is less than 0.05, deeming the correlation to be statistically significant. This sample was very small and was a sub-population of the larger study population.

Discussion

The key finding of this study was that within this very small sample, there was a strong negative correlation between BMI and A1C at baseline indicating that as BMI increases, A1C decreases in this sample. This finding is inconsistent when compared to findings of other studies, which found positive correlations between BMI and A1C (Conway et al., 2018). Further, based on the literature, it was expected to find a positive correlation between BMI and A1C. The Honors researchers speculate that the negative correlation was due to lack of statistical conclusion validity, meaning that the sample was too small to provide valid and meaningful findings. This may be directly or indirectly related to a threat of internal validity, that being the threat of history. A threat of history is when an event takes place during the study which is outside of anyone's control and therefore, makes the study impossible to conclude the validity of the findings. In this study, the study methods were not conducted in the ways planned by the FABU and Honors researchers. COVID-19 proved to be a large threat to internal validity as data collection had only just begun when researchers were forced to quit visiting sites of data collection and to no longer conduct intervention sessions. The theoretical framework for this project was the Transtheoretical Model of Health Behavior and Change. This theory describes the process of change and is used to anticipate that the implemented interventions would contribute to changed behaviors. With the change of research question and not being able to compare data from two separate calendar year quarters, this theory was unable to be used appropriately.

Conclusion

Again, results of this study showed a strong negative correlation between BMI and A1C. Limitations of the study were the effects of COVID-19 and being unable to perform complete data collection or implement the interventions set out by the FABU project team. Due to lack of statistical conclusion validity, there are no implications of findings for nursing practice. The researchers that participated in this project recommend further studies when the situation would allow for onsite intervention and thorough data collection. Researchers hope for this study to later be conducted as originally planned in order to provide meaningful results to research, clinicians, and the population of individuals impacted by such health interventions intended by the FABU project.

References

A1C-Hemoglobin Tests (n.d). Test Medical Symptoms At Home, Inc. Retrieved April 6, 2020, from https://www.testsymptomsathome.com/tms_productsbytype.asp?itemtypeid=dia2

Akron Metropolitan Housing Authority. (n.d.). *AMHA Public Housing Program.* Akron Metropolitan Housing Authority. https://www.akronhousing.org/pages/AMHA-Public-Housing-Program.html

Albrecht, S. S., Mayer-Davis, E., & Popkin, B. M. (2017). Secular and race/ethnic trends in glycemic outcomes by BMI in US adults: The role of waist circumference. *Diabetes/Metabolism Research and Reviews*, *33*(5), 1-9. DOI:10.1002/dmrr.2889

Bell, C.N., Thorpe, R.J., Bowie, J.V., & Laviest, T.A. (2018). Race disparities in cardiovascular disease risk factors within socioeconomic status strata. *Annals of Epidemiology, 28* (3), 147-152. DOI: 10.1016/j.annepidem.2017.12.007

Centers for Disease Control and Prevention. (2017, July 3). *African American Health.* Retrieved April 5, 2020 from https://www.cdc.gov/vitalsigns/aahealth/index.html

Centers for Disease Control and Prevention. (2020, March 11). *Type 1 Diabetes.* Retrieved April 5, 2020 from https://www.cdc.gov/diabetes/basics/type1.html.

Centers for Disease Control and Prevention. (2019, May 30). *Type 2 Diabetes.* Retrieved April 5, 2020 from https://www.cdc.gov/diabetes/basics/type2.html.

Clark, P. G., Greene, G. W., Blissmer, B. J., Lees, F. D., Riebe, D. A., & Stamm, K. E. (2019). Trajectories of maintenance and resilience in healthful eating and exercise behaviors in older adults. *Journal of Aging and Health*, 31(5), 861–882. https://doi.org/10.1177/0898264317746264

Conway, B. N., Han, X., Munro, H. M., Gross, A. L., Shu, X.-O., Hargreaves, M. K., Zheng, W., Powers, A. C., & Blot, W. J. (2018). The obesity epidemic and rising diabetes incidence in a low-income racially diverse southern US cohort. *Plos One*, 13(1), 1-18. DOI:10.1371/journal.pone.0190993

Firouzi, S. A., Tucher, L. A., LeCheminant, J. D., & Bailey, B. W. (2018). Sagittal abdominal diameter, waist circumference, and BMI as predictors of multiple measures of glucose metabolism: An NHANES investigation of US adults. *Journal of Diabetes Research,* 2018, 1-14. DOI: 10.1155/2018/3604108

Godin, G. (2011). The Godin-Shephard leisure-time physical activity questionnaire. *Health & Fitness Journal of Canada*, 4(1), 18-22. DOI: 10.14288/hfjc.v4i1.82

Higuchi, R., Iwane,T., Suwa, K., & Nakajima, K. (2019). Adjustment for waist circumference reveals a U-shaped association between glycated hemoglobin levels and body mass index in young adults. *Canadian Journal of Diabetes,* 43, 201–206. DOI:10.1016/j.jcjd.2018.09.007

Luo, J., Hendryx, M., Laddu, D., Phillips, L. S., Chlebowski, R., LeBlanc, E. S., Allison, D. B., Nelson, D. A., Li, Y., Rosal, M. C., Stefanick, M. L., & Manson, J. E. (2019). Racial and ethnic differences in anthropometric measures as risk factors for diabetes. *Diabetes Care*, 42(1), 126–133. doi: 10.2337/dc18-1413

Mashele, T.S., Mogale, M.A., Towobola, O.A, & Moshesh, M.F. (2019). Central obesity is an independent risk factor of poor glycaemic control at Dr George Mukhari Academic Hospital. *South African Family Practice, 61*(1), 18-23. DOI: 10.1080/20786190.2018.1527134

Sisodia, R.K., & Chouhan, M. (2019). The study of correlation between body mass index and glycemic control HbA1c in diabetes type 2 patients. *International Journal of Advances in Medicine*, 6(6), 1788-1791. DOI: 10.18203/2349-3933.ijam20195228

Vigna, B. (2019). *Meeting Employees Where They're At Using the Transtheoretical Model.* Packhealth. https://solutions.packhealth.com/change-readiness-transtheoretical-model/

West, D.S., Dutton, G., Delahanty, L.M., Hazuda, H.P., Rickman, A.D., Knowler, W.C., Vitolins, M.Z., Neiberg, R.H., Peters, A., Gee, M., Begay, M.C., & Look AHEAD Research Group. (2019). Weight loss experiences of african american, hispanic, and non-hispanic white men and women with type 2 diabetes. *Clinical Trials and Investigations*, *27* (8), 1275-1284. DOI: 10.1002/OBY.22522

Wright, L.A-C & Hirsch, I.B. (2017). Metrics beyond hemoglobin A1C in diabetes management: time in range, hypoglycemia, and other parameters. *Diabetes Technology & Therapeutics*, 19 (2), 16-26. DOI: 10.1089/dia.2017.0029

Appendix A

Figure 2.

Table of Evidence

APA formatted reference	Purpose statement. Research Question	Theoretical Framework	Design of study, Site, Sampling Method, Sample Size	Variables and measurement tools	Findings, Conclusion	Limitations of Findings

1. Firouzi, S. A., Tucher, L. A., LeCheminant, J. D., & Bailey, B. W. (2018). Sagittal abdominal diameter, waist circumference, and BMI as predictors of multiple measures of glucose metabolism: An NHANES investigation of US adults. *Journal of Diabetes Research*, 2018, 1-14. https://doi.org/10.1155/2018/3604108	**Purpose statement:** "The objective was to compare associations between sagittal abdominal diameter (SAD), waist circumference, and BMI to the oral glucose tolerance test (OGTT), along with fasting glucose, HbA1c, and HOMA-IR, in a nationally representative sample of 3582 US adults." (p.1) **Research question:** Are Sagittal Abdominal Diameter, Waist Circumference, and BMI predictors of glucose metabolism?	None	**Design:** Cross-sectional **Site:** National Health and Nutrition Examination Survey (NHANES) **Sampling method:** age, gender, race, sagittal abdominal diameter (SAD), waist circumference, BMI (based on height and weight), oral glucose tolerance test (OGTT), fasting glucose, HbA1c, and HOMA-IR. **Sample size:** 3582 participants, representing all noninstitutionalized, civilian US adults aged 20–84 years.	Variables and measurement instruments: **weight**-Mettler Toledo digital weight scale **Height**-fixed stadiometer with adjustable headboard BMI-kg/m^2 **Sagittal abdominal diameter (SAD)**- abd. Caliper measured distance b/t front of abdomen and small of back **OGTT**- 9 hr fasting blood glucose drawn and then 2 hrs after drinking 75 g trutol solution **HbA1c**- Tosoh Automated Glycohemoglobin Analyzer HLC-723G8	"SAD was the best predictor of the glucose metabolism variables, followed by waist circumference and the BMI." (p. 5) "SAD was not a better predictor of OGTT than waist circumference or BMI within the subsample of normal- weight adults or among Black individuals" (p.8)	"waist circumference can be a challenge to reliably measure due to larger girths, sagging skinfolds, and difficulty locating the correct landmarks for the measurement. Furthermore, the waist circumference measurement includes both the depth (or height) and the width of the abdomen." (p.8) "There were many different relationships analyzed due to the large number of variables and statistical models included in the investigation. Because of the many comparisons, there was an increased risk of type I error." (p.12)

2 Albrecht, S. S., Mayer-Davis, E., & Popkin, B. M. (2017). Secular and race/ethnic trends in glycemic outcomes by BMI in US adults: The role of waist circumference. *Diabetes/Metabolism Research and Reviews*, *33*(5), 1-9. https://doi.org/10.1002/dmrr.2889	**Purpose-** The purpose of this study was to evaluate the differences between diabetes and prediabetes with BMI over time. Waist circumference and race and ethnicity patterns of glycemic outcomes were also evaluated. **Research Question-** How does BMI and waist circumference affect diabetes and pre-diabetes prevalence in the United States and for different race/ethnic groups.	None	**Design-** Cross-sectional **Site-** Diabetes and metabolism research and reviews **Sampling Method-** Waist circumference, BMI, diabetes and prediabetes, race, ethnicity **Sample Size-** 12,614 participants aged 20-74 years old from 1988-1994 and 2007-2012.	**Variables-** Diabetes and prediabetes over time by BMI, waist circumference, race, ethnicity **Measurements-** Measurement tools- National Health and Nutrition Survey, an ongoing survey about health, functional, and nutritional statuses of the US population.	**Conclusion-** According to the article, it was found that the prevalence of diabetes rose over time due to increasing waist circumference and obesity. (p.1)	This analysis only used cross-sectional data with a singular evaluation of hemoglobin A1c, BMI, and WC. This did not allow for measurement over time and could have led to misclassification of diabetes and prediabetes measurement. (p. 7) "Because of the cross-sectional design, we were unable to eliminate residual confounding and the potential role of other unmeasured factors that may have contributed to the patterns we report" (p.7) With this design, the major limitations include not reevaluating HbA1c, BMI, and waist circumference. Also with a cross sectional design, they were unable to evaluate other factors contributing to the results.

3 Juhua Luo, Hendryx, M., Laddu, D., Phillips, L. S., Chlebowski, R., LeBlanc, E. S., Allison, D. B., Nelson, D. A., Yueyao Li, Rosal, M. C., Stefanick, M. L., Manson, J. E., Luo, J., & Li, Y. (2019). Racial and Ethnic Differences in Anthropometric Measures as Risk Factors for Diabetes. *Diabetes Care*, 42(1), 126–133. https://doi-org.ezproxy.uakron.edu:2443/10.2337/dc18-1413	**Objective:** The purpose of this study was to determine the relationship between anthropometrics (including BMI, WC, and WHR) and risk for diabetes with varying race/ethnicity cohorts to identify which anthropometric measure best predicts risk of diabetes within each group **Research Question-** How does BMI, waist circumference (WC), and waist-to-hip ratio (WHR) measurements impact the risk of diabetes for women of different races and ethnicities	None	**Sample size-** 136,112 postmenopausal women aged 50–79 followed for 14.6 years. **Site** recruited from 40 clinical centers throughout the U.S. between 1993 and 1998 from Women's Health Initiative **Design-** clinical trials and observational. Regression design **Sampling method-** anthropometric measurements by research team of weight, height, waist ad hip circumference. BMI. **Statistical analysis-** Multivariate Cox proportional hazards regression models were used to assess associations between anthropometrics and diabetes incidence.	**BMI**-was categorized into the following categories: normal, <25 kg/m2; overweight, 25 to <30 kg/m2; and obese, ≥30 kg/m2 **WC** (≤88 cm) **WHR** (≤0.85 cm) i	All three anthropometric measurements BMI, WC, and WHR were positively associated with diabetes risk in each racial and ethnic group WC had the strongest association with risk of diabetes across all racial and ethnic groups WHR had the highest association for black females BMI and WC relationship were the weakest in blacks In African American postmenopausal women, there is a twofold higher risk than compared to Caucasian women. Obesity is one of the major risk factors for type 2 diabetes. WC better predicted risk of diabetes than BMI across all racial	This study included only black and white participants With diabetes being self-reported, it might be of lower significance due to misunderstanding of the diagnosis. the information on race/ethnicity was also self-reported. So, all information might not be highly reliable of genetic and culture differences w The sample size of each racial and ethnic cohort was small and did not account for American Indian/Alaska Native and Asian women. This was done only to postmenopausal women in the U.S. so may not be able to be generalized to other populations

						or ethnic groups among postmenopausal women **Outcome** The primary outcome was incident diabetes during follow-up, by self-reporting by report of new diagnosis or new medication	

4 Conway, B. N., Han, X., Munro, H. M., Gross, A. L., Shu, X.-O., Hargreaves, M. K., Zheng, W., Powers, A. C., & Blot, W. J. (2018). The obesity epidemic and rising diabetes incidence in a low-income racially diverse southern US cohort. *Plos One*, 13(1), 1-18. https://doi-org.ezproxy.uakron.edu:2443/10.1371/journal.pone.0190993	**Objective:** Assessing rates and risks factors that might lead to diabetes in a diverse southern population where obesity is prevalent **Research Question** How does factors like SES, healthy eating and exercise, and BMI affect the risk for diabetes in	None	**Sample Size:** 24,000 black and 14,064 white adults aged 40–79 **Site-** Southern Community Cohort Without diabetes at the beginning of the study. Followed between 2002–2009 was followed for up to 10 (median 4.5) years. **Sampling-** recruiting at community health centers, random sampling **Procedure-** completed questionnaires and personal interviews, weight and height self reported **Statistical analysis -** Pearson's chi-square, analysis of variance (ANOVA), and Kruskal-Wallis tests to test for differences in study variables between blacks and whites.	BMI was categorized as <20, 20–24.9 (normal), 25–29.9 (overweight),	Risk of incident diabetes rose with increasing BMI and the trends difference between African American and Caucasians Diabetes incidence was two times higher among blacks than compared to white with a normal BMI. However, this drastic difference dropped and was almost insignificant in 5-year probability of developing diabetes reaching close to the same for both blacks and whites with a BMI greater than 40. Other risk factors such as low SES, cigarette smoking, lower healthy eating and physical activity, however, BMI remained the highest risk factor for both white and black.	With the only two racial groups being African American and Caucasians, this does not give a meaningful representation of the general population Self-reporting of diabetes Studied sample is not representative of the general population of the 12 southern states

5 Philipsen, A., Jørgensen, M.E., Vistisen, D., Sandbaek, A., Almdal, T.P., Christiansen, J.S., Lauritzen, T., & Witte, D.R. (2015). Associations between ultrasound measures of abdominal fat distribution and indices of glucose metabolism in a population at high risk of type 2 diabetes: The ADDITION-PRO study. *PLOS ONE* 10(4), 1-13. doi:10.1371/journal.pone.0123062	**Purpose statement:** "The purpose of this study was to examine if abdominal fat distribution, when assessed by ultrasound, is associated with detailed indices of glucose metabolism derived from a 3 point OGTT, and whether this assessment adds information regarding such risk above that obtained from other commonly used measures of obesity." (p.2) **Research Question:** is abdominal fat distribution associated with indices of glucose metabolism? Is ultrasound the best way to determine hyperglycemic risks?	None	**Design:** cross-sectional **Site:** 2009–2011 ADDITION-PRO examination **Sampling method:** detailed measurement of anthropometry, biochemistry and physical activity, and completion of validated questionnaires **Sample size:** 1342	Variables and Measurement tools: <u>Under section titled obesity measures</u> (p.3)-waist circumference, height, BMI, body fat percentage, waist to height ratio, and abdominal fat distribution <u>Under indices of glucose metabolism</u> (p.4)- OGTT, HOMA-S, and HbA1c Finally, <u>covariates</u> (p. 4-5)	Ultrasound is a useful technique for evaluating the distribution of abdominal fat (visceral vs subcutaneous). Visceral fat may have a larger effect on glucose metabolism. Waist circumference and BMI were comparable evaluation tools in determining risk for prediabetes or t2DM.	Limitations- cross sectional analysis, majority of participants are Caucasians in their 60's normal/overweight

6. Mashele, T.S., Mogale, M.A., Towobola, O.A, & Moshesh, M.F. (2019) Central obesity is an independent risk factor of poor glycaemic control at Dr George Mukhari Academic Hospital. *South African Family Practice, 61*(1), 18-23. https://doi.org/10.1080/20786190.2018.1527134	**Purpose:** "The aim of this cross-sectional, hospital-based study was to investigate the status of glycemic control and some of its determinants among adult black T2DM patients at DGMAH, Gauteng Province, Republic of South Africa." (p.18) **Research Question:** How do certain determinants among adult black T2DM patients at DGMAH predict or affect their glycemic control?	None	**Design:** cross-sectional, hospital-based study **Site:** Dr George Mukhari Academic Hospital (DGMAH), a tertiary hospital in the Gauteng province of the republic of South Africa that caters for mostly black African patients **Sampling method:** A random sample of adult black subjects, diagnosed with and treated for T2DM at the outpatient's diabetic clinic of DGMAH **Sample size:** 176 (123 females and 53 males), mean age of 58.95 (± 11.5) years	Under data collection-detailed procedures for collection of BP, WC, BMI, WHR, FBG and HbA1c Also, a questionnaire was given to participants to determine other variants (p. 19)	Poor glycemic control was associated with those with waist circumference >94 cm (M) and >80 cm (F) Central obesity is an independent risk factor for poor glycemic control in T2DM patients.	Small sample size, cross-sectional study, patients recruited from a single institute

7 Bell, C.N., Thorpe, R.J., Bowie, J.V., Laviest, T.A. (2018). Race disparities in cardiovascular disease risk factors within socioeconomic status strata. *Annals of Epidemiology*, *28* (3), 147-152. https://doi.org/10.1016/j.annepidem.2017.12.007	Purpose: The purpose of this study was to assess whether racial disparities in CVD risk factors differ by socioeconomic status levels (p. 147) **Research Question:** How do racial differences in cardiovascular risk factors differ among different levels of socioeconomic status?	None	**Design-** cross-sectional **Site-** civilian noninstitutionalized of low-income individuals **Sample-** ages 12-19 years and adults over 60 years old **Sampling Method-** Data from the National Health and Nutritional Examination Survey 2007–2014 were used to calculate racial differences in hypertension, high cholesterol, diabetes and obesity. Interactions between race and SES were assessed. Survey was multistage sample design collected in 2 phases	**Variables and measurement tools** IDV- self reported race Variables- race, cholesterol, hypertension, diabetes, socioeconomic status, and obesity Measurement tools- National Health and Nutrition Survey, an ongoing survey about health, functional, and nutritional statuses of the US population.	African Americans had higher incidences of hypertension, diabetes, and obesity than whites. In the higher SES groups, diabetes was evaluated, but not in the lower SES groups. Therefore, in the higher socioeconomic status groups, African Americans had a higher incidence of diabetes than whites.	Some respondents of the study did not report a specific income and the sample is large, as it extends across the United States. The system of using individual reporting can lead to inaccurate numbers.

8 West, D.S., Dutton, G., Delahanty, L.M., Hazuda, H.P., Rickman, A.D., Knowler, W.C., Vitolins, M.Z., Neiberg, R.H., Peters, A., Gee, M., Begay, M.C., & Look AHEAD Research Group. (2019). Weight Loss Experiences of African American, Hispanic, and Non-Hispanic White Men and Women with Type 2 Diabetes. *Clinical Trials and Investigations*, *27* (8), 1275-1284. DOI: 10.1002/OBY.22522	**Purpose-** "The aim of this study was to characterize weight loss, treatment engagement, and weight control strategies utilized by African Americans for health in diabetes." (1275). **Research Question-** How do lifestyles and management of weight affect health and diabetes?	None	**Design-** Meta-analysis **Site-** multi center clinical trial all through the United States **Sample-** adults 45-76 years with BMI> 25 and T2DM. Total of 2,570 participants **Sampling method-** followed for 13.5 years and assessments made at 1, 4, and 8 years. Participants either in ILI or diabetes support and education classes	**Variables and measurement tools-** weight loss, treatment engagement, and weight control strategies. African Americans, whites, Hispanics, and non-Hispanics. **Measurement tools-** weight measured using digital scale, height measured using wall mounted stadiometer, engagement measured by attendance, behavior weight management was self-reported	**Conclusions:** Type II diabetes prevalence increases with minority populations. The ability to understand behavioral weight control practices and weight loss management. Different weight loss strategies worked better for different ethnicities. Factors like daily weighing, meal replacements, and attendance all played factors in the effectiveness of diabetes and weight loss management.	**Limitations:** Report of weight loss is self-reported and can be biased based on the individual. The commitment and burden of this study also contributed to the limitations of this study. It had the potential of individuals not being fully engaged in the study. The weight loss by the group of diabetes support and education also does not show a full representation of the treatment effects of the study.

9 Higuchi, R., Iwane,T., Suwa, K., Nakajima, K. (2019) Adjustment for waist circumference reveals a U-shaped association between glycated hemoglobin levels and body mass index in young adults. *Canadian Journal of Diabetes, 43* (2019), 201–206. DOI: 10.1016/j.jcjd.2018.09.007	**Purpose:** Body mass index (BMI) is used to assess adiposity worldwide. However, additional adjustment for waist circumference (WC), a surrogate marker of abdominal fat, may be capable of revealing a latent relationship between low body weight and glycated hemoglobin (A1C) concentration. Here, we investigated the relationship between A1C and BMI in young adults, adjusting for WC. **Research Question:** How does adjusting for Waist Circumference effect the predictability for how BMI is related to glycemic control?	NONE	**Design-** Cross-sectional **Site-** Saitama Prefecture **Sampling Method-** questionnaire to record lifestyle factors. BMI, WC and HbA1C were measured **Sample Size-** 27,920 apparently healthy individuals 20 to 39 years of age	**Variables and Measurement tools:** Serum triglyceride, high-density lipoprotein cholesterol, A1C and hemoglobin levels were measured by standard methods using Hitachi autoanalyzers. BMI calculated as kg/m^2. WC measured in cm to one decimal place at the level of the umbilicus	**Conclusion:** “Most continuous parameters, including A1C levels and the prevalence of most categorical findings, increased with increasing BMI in both age groups… After additional adjustment for WC, the association between BMI ≥27.0 kg/m2 and A1C levels disappeared.” (p.203). “This study has demonstrated that people in their 20s with LBW are more likely to have higher A1C levels than subjects with normal or slightly high BMIs, especially when WC is taken into consideration” (p. 204).	**Limitations:** Cross-sectional study study population consisted of mostly nonobese individuals who were not in treatment for diabetes

10 Sisodia, R.K., & Chouhan, M. (2019). The study of correlation between Body Mass Index and glycemic control HbA1c in diabetes type 2 patients. *International Journal of Advances in Medicine*, 6(6), 1788-1791. http://dx.doi.org/10.18203/2349-3933.ijam20195228	Research question: what is the correlation between body mass index and glycemic control in type 2 diabetic patients?	None	**Design-** cross sectional **Sample-** 100 T2DM patients 62 male and 38 female 58 overweight 30 normal 12 obese **Site**- department of medicine GRMC Gwalior. Admitted and attend Medicine PD in J.A. Group of Hospital over a period of 1 year **Sampling method-** height and weight for BMI and HbA1C was obtained	FPG =126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for at least 8 h. 2-h post load glucose >200 mg/dl (11.1 mmol/l) during an OGTT. The test should be performed as described by WHO, using a glucose load containing the equivalent of 75 gm anhydrous glucose dissolved in water. HbA1C> 6.5 % Underweight <18.5 Healthy weight 18.5-24.9 Overweight 25.0-29.9 Obesity 30.0-34.9 Obesity 35.0-39.9 Extreme Obesity >40	Positive correlation between BMI and poor glycemic control	Small sample size Did not specify any ethnic or racial variety

Note. This table is a breakdown of all the research journals used as references for the topic of this research project.

Appendix B

Figure 3.

Consent form

Participant ID: ______________

Tech: ______________

Date: ______________

FABU Quarterly Report Data Consent and Results Form

CONSENT AND RELEASE: The undersigned, hereby consents to participate in this biometric screening which may include the drawing of a blood sample as well as any of the parameters listed below. No guarantee has been made regarding the results of these tests. I understand that the results of these tests are preliminary and do not constitute diagnosis of any health conditions or diseases such as, but not limited to, hypercholesterolemia, diabetes and hypertension. I also understand that the responsibility for initiating follow-up examination to confirm the results of these tests or obtaining professional medical assistance is mine alone. I release the Finding A Better U Grant and its subsidiaries and affiliates associated with this biometric from any and all liability arising from or in connection with the services provided.

AUTHORIZATION FOR RELEASE OF INFORMATION: FABU Grant, conducting this screening/testing, may disclose my results to any person which may be liable for all or part of Finding A Better U Grant charges, including but not limited to participants doctor on file with medical clearance, hospital or medical service companies, utilization or professional standards review companies, or any other person who assists in administering a contract or program under which benefits are claimed by or on behalf of patient. Finding A Better U Grant may also disclose such information to its agents, including external legal counsel, engaged to assist Finding A Better U providing services to patient, in securing payment for services. Further such persons may re-disclose these records within legal limits. Finding A Better U Grant may disclose such information to any other hospital or health care provider from which patient may receive services.

Please fill out this portion acknowledging that you have read and understand this information.

Print Name: ______________

Age: ______

DOB: ___/___/___

☐ **Male** ☐ **Female** ☐ **Quarter 1** ☐ **Quarter 2** ☐ **Quarter 3** ☐ **Quarter 4**

Height_____**feet**_____**inches** 1/4 1/2 3/4 Even ***BMI** ______

Weight________pounds (rounded to nearest half pound) **Waist Circumference** ______

Total Cholesterol ______ **HDL** ______ **LDL** ______ **Ratio** ______

Glucose ______ **Triglycerides** ______ **A1C** ______

Resting HR______ **Blood Pressure #1**____/____ **#2**____/____

*Measurements are not outcomes determining prizes

You are entitled to your privacy! No Staff member should be reading your numbers out loud – they may point out your results or allow you to take a picture of them, if you are interested in your Pre or Post assessment results contact your building coordinator to request a copy.

National Cholesterol Education Program, National Heart, Lung and Blood Institute. NIH Publication No. 01-3670, May 2001.

Gallagher D. et al. American Journal of Clinical Nutrition; 2000, 72:694-701. "Healthy percentage body fat ranges: An approach for developing guidelines based on body mass index."

Diabetes Care, American Diabetes Association. Volume 37
Supplement 1, January 2014

Note. This is the consent form all participants at the data collection site received and signed prior to participation