

**COMPARATIVE EFFECT OF FUNCTIONAL EXERCISE ON BLOOD  
GLUCOSE LEVEL IN OBESE AND NORMAL WEIGHT YOUNG ADULT  
INDIVIDUALS IN THE UNIVERSITY OF BENIN**

**BY**

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**APRIL, 2024.**

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**A PROJECT SUBMITTED TO THE DEPARTMENT OF PHYSIOLOGY  
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## **DEDICATION**

I dedicate this work to God Almighty who is the giver of all wisdom and inspiration, outside whom I would have been stranded and clueless during the course of this work. I want to also dedicate the work to my family who were very supportive financially and emotionally. I also dedicate this work to myself, for having the fortitude to finish the race in spite of myself.

knowledge and give warmest thanks to my supervisor who made this work possible. His experience, consistency, patience and advice carried me through all

the stages of writing my literature review. I appreciate you, sir. I wouldn't forget to express my profound gratitude to my brother and friend among others, who has really helped me profoundly this final year. KEPHAS KONYERINONYE, I love you so much and your help will not be forgotten.

Also to my fellow project students under my supervisor, I say thank you for your support, cooperation, and love during the short time we worked together. I love you all.

Once more, I would like to thank God for letting me through all the rigors. It is by your Grace I have gotten this far.

## TABLE OF CONTENT

Title page.....	i
Certification.....	ii
Dedication.....	iii
Acknowledgment,.....,	iv
Table of content .....	v
List of Figures.....	ix
Abstract.....	x

<b>CHAPTER ONE.....</b>	<b>1</b>
1.0 INTRODUCTION.....	1
1.1 Background study.....	4
1.2 Justification of study.....	4
1.3 Aim of study.....	4
1.4 Research questions.....	5
1.5 Specific objectives of study.....	5
1.6 Scope of study.....	5
<b>CHAPTER TWO.....</b>	<b>6</b>
2.0 LITERATURE REVIEW.....	6
2.1 Six minute walk test.....	6
2.1.1 History of six minute walk test.....	7
2.1.2 Physiology of six minute walk test.....	8
2.2 Understanding blood glucose levels.....	8
2.2.1 Definition and normal range of blood glucose.....	8
2.2.2 Fasting and Post Prandial levels.....	9
2.2.3 Fasting blood glucose levels in normal weight individuals.....	9
2.2.4 Fasting blood glucose levels in Obese individuals.....	9
2.2.5 Post pandrial blood glucose levels in normal weight individuals.....	10
2.2.6 Post pandrial blood glucose levels in Obese individuals.....	11

2.3 Hyperglycemia and its causes.....	11
2.4 Hypoglycemia and its causes.....	14
2.5 Blood glucose level regulation in the body .....	17
2.6 Blood glucose level and exercise.....	19
2.6.1 The role of Glucose in energy production during exercise.....	19
2.7 Glycolysis and energy pathway.....	20
2.7.1 Key phases of Glycolysis.....	21
2.7.2 Steps in glycolysis.....	21
2.7.3 Energy production in glycolysis.....	22
2.7.4 Regulation of Glycolysis.....	23
2.8 Effect of Functional exercise on Glucose levels in normal weight and obese individuals.....	25
2.8.1 Glucose metabolism during exercise.....	25
2.8.2 Adaptation to Exercise.....	26
2.8.3 Role of Diet.....	26
2.8.4 Health Outcomes.....	27
2.8.5 Factors influencing Glucose response.....	28
2.8.6 Clinical implications and considerations.....	28
2.9 The effects of hypoglycemia on functional exercise capacity in Obese and Normal weight individuals.....	29

2.10 Effects of hyperglycemia on functional exercise capacity on Obese and Normal individuals.....	32
2.11 The relationship between exercise and blood glucose levels.....	34
2.12 Relationship between 6MWT and blood glucose levels in Obese and And normal weight.....	36
<b>CHAPTER THREE .....</b>	<b>39</b>
3.1 Materials.....	39
3.2 Subjects and study area.....	39
3.3 Study population and study area.....	39
3.4 Inclusion criteria.....	40
3.5 Exclusion criteria.....	40
3.6 Ethical consideration.....	40
3.7 Methodology.....	40
3.7.1 Participant preparation.....	40
3.7.2 The six minute walk test.....	41
3.8 Measurement parameters.....	42
3.9 Statistical analysis.....	43
<b>CHAPTER FOUR.....</b>	<b>44</b>
<b>RESULT OF STATISTICAL ANALYSIS.....</b>	<b>44</b>
<b>CHAPTER FIVE .....</b>	<b>47</b>

<b>5.1 DISCUSSION.....</b>	<b>47</b>
<b>5.2 CONCLUSION.....</b>	<b>49</b>
<b>REFERENCES.....</b>	<b>50</b>
<b>APPENDIX.....</b>	<b>69</b>

### **LIST OF FIGURES**

Figure I: Maintenance of blood glucose levels by glucagon and insulin

Figure II: Schematic representation of glycolytic pathway

Figure III: The effect of 6mwt on blood glucose level in healthy normal weight young adult individuals

Figure IV: The effect of 6MWT on blood glucose level in healthy obese young individuals

FIGURE V: The effect of 6MWT on blood glucose level in healthy normal weight and obese young adult individuals

## **ABSTRACT**

The six-minute walk test is an easy and affordable method used to measure functional capacity. It uses the distance walked in six minutes, or the six-minute walk distance (6MWD), at their normal pace on a hard surface, like a 30-meter hallway. This study was

aimed at evaluating the effect of functional exercise (six minute walk test–6MWT) on blood glucose level in obese and normal weight young adult individuals. Measured parameters included body mass index (BMI), Blood glucose level, and distance covered (m) during the 6-minute walk test. The design required the subjects to walk back and forth on a 30-meter hallway at their normal pace for six minutes. Measurements were taken of the subjects blood glucose level before and after the six-minute walk test. The total number of meters walked was calculated by multiplying the counted and recorded number of laps traveled by 60 meters. The statistical analysis was performed with Graph Pad Prism Version 8.1. The standard error of mean (SEM) was used in graphs to display the results. The dependent and independent variable means were compared using the student t-test.  $P < 0.05$  was accepted as significant. The result revealed no significant change in blood glucose level in post 6MWT compared to pre 6MWT among obese and normal weight young adult individuals. But, There was a significant decrease in obese compared with normal weight post-6MWT, although there was no significant change in the pre-6MWT in obese compared with normal weight. It was observed that the 6MWT had more effect in obese individuals than in normal weight adult individuals.

## CHAPTER ONE

### 1.1 BACKGROUND OF STUDY

Functional exercises are forms of physical activities that aim to improve your overall physical fitness. This means enhancing the ease and efficiency with which you carry out everyday tasks and activities. This entails improving the simplicity and effectiveness with which these exercises are made to work several muscle groups simultaneously, encouraging a multifaceted approach to fitness (Doe, 2022). They focus on muscle groups and movements that we use on a regular basis in real life situations such as walking, lifting, Pulling, pushing, raising, bending and twisting. The overall importance of these exercises is to increase your strength, balance, flexibility and coordination in order to make you more efficient in your daily life (Jones, 2021). The most popular clinical exercise tests are stair climbing, 6MWT, a shuttle-walk test and a cardiac stress test. For this research, the functional exercise of choice is the six minutes walk test– 6MWT on a 30 meters Hallway.

One well-established measure of functional ability and quality of life is the ability to walk (Cazzoletti *et al.*, 2022). The Six-Minute Walk Test (6MWT) is a simple sub-maximal exercise test, It was first applied to evaluate patients with chronic

obstructive lung disease and healthy individuals' capacity for functional exercise (Ubuane *et al.*, 2018). But as time went on, and various clinical expertise and standardization with specific guidelines began to emerge, it became one of the simplest type of functional exercise for accessing functional exercise capacity of patients with other diseases like, musculoskeletal, neuromuscular, metabolic and endocrine diseases (Barestels *et al.*, 2013). The 6MWT is a useful tool in accessing a patient's functional status, especially when they have severe complications, such as chronic obstructive pulmonary diseases (COPD), heart failure and cystic fibrosis, that makes them unable to complete more complex exercise tests (Gianisti *et al.*, 2019).

6MWT Calculates the distance traveled by a subject within six minutes (Jones, 2021). In this test, the patient is asked to walk on a 30 meter walk way, as far as possible, for 6 minutes. This is to arrive at a primary outcome measure known as six minutes work distance (6MWD) (American thoracic society, 2002).

6MWT is a submaximal test because it is designed to measure exercise capacity without requiring participants to reach maximal exertion or peak intensity (Holland *et al.*, 2013). The intensity of the 6MWT is determined by the pace at which the participant walks. Unlike maximal tests, which often involve graded exercise protocols leading to maximal heart rate or oxygen consumption, the 6MWT allows

participants to self-regulate their speed, leading to varying intensity levels (Crapo, 2002).

The 6MWT has several advantages. It is easy to perform, reproducible and inexpensive. The 6MWT has been found to be useful in stating the severity of diseases, provision of important information on efficacy of treatment, and prediction of morbidity and mortality in congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), pulmonary arterial hypertension (PAH), and idiopathic pulmonary fibrosis (IPF) (Gaustavo *et al.*, 2024). Compared to other exercise testing methods, 6MWT is the most used. This is because it is more tolerated by subjects, it is faster and more convenient and it requires less equipment and expertise (Jenifer *et al.*, 2007).

The 6MWD may be impacted by a variety of factors, including the standardization of the 6MWT, depressive symptoms, muscle strength, true leg length and deterioration in health-related quality of life (Oliveira *et al.*, 2013).

Blood glucose, which is the primary source of energy for the body's cells, plays a crucial role in determining how effectively an individual can perform physical activities and recover afterward (Broadman, 2019). In functional exercise, which focuses on training the body for real-life movements and tasks, the balance of glucose is key to maintaining optimal performance and overall health (Lippincott and Wilkins, 2006). Low blood glucose levels (hypoglycemia) can lead to

symptoms like weakness, fatigue, dizziness, and confusion, which can significantly impact the ability to perform the 6MWT. In a study of diabetic individuals, hypoglycemia was associated with reduced exercise capacity and increased risks during physical activity (Brahimaj *et al.*, 2016).

On the other hand, exercise tolerance may also be impacted by hyperglycemia, or elevated blood glucose levels. Although hyperglycemia may result in high blood glucose levels, it can also cause dehydration (caused by the passing of an excessive volume of urine through a process called osmotic diuresis), increased blood viscosity, and oxidative stress, all of which can impair one's ability to exercise and endurance (Kilpatrick *et al.*, 2015).

## **1.2 JUSTIFICATION OF STUDY**

It is crucial to research the effects of functional exercise, such as the Six Minutes Walk Test (6MWT), on blood glucose levels in young adults who are obese or normal weight in order to optimize health interventions and improve exercise recommendations. Numerous studies have been conducted on 6-minute walk tests and blood glucose levels, however most of them focus on illnesses including diabetes, asthma, and COPD. Therefore, this study compares the effects of the 6-minute walk test on young adults who are obese and those who are normal on their blood glucose levels.

### **1.3 AIM OF STUDY**

The study is aimed at analyzing and comparing the effect of functional exercise on blood glucose level in healthy obese and normal weight young adult individuals.

### **1.4 RESEARCH QUESTIONS**

- Is there any significant difference in the measure of glucose level before and after the Six minutes walk test?
- Is there any significant Increase or decrease in the blood glucose level between normal and obese young adult individuals?

### **1.5 SPECIFIC OBJECTIVE OF STUDY**

The specific objectives of this study are to

- Conduct a six minutes walk test on both obese and normal weight young adult individuals, recording data on distance covered and glucose level of subjects, before and after the test.
- Analyze and compare the immediate post-6-minutes walk test glucose level between obese and normal weight participants.

### **1.6 SCOPE OF STUDY**

The scope of this review on the effect of blood glucose level on subjects undergoing functional exercise (six minutes walk test–6mwt) will involve a comprehensive review of existing literature and original research. This study will focus on the following areas:

- Blood glucose level before and after functional exercise
- Impact of functional exercise on blood glucose level in both obese and normal weight young adult participants
- BMI related differences in blood glucose level

## **CHAPTER 2**

### **2.. LITERATURE REVIEW**

#### **2.1 SIX MINUTES WALK TEST**

According to Jan et al. (2018), the six-minute walk test (6MWT) is regarded as an easy-to-use and reasonably priced technique for evaluating functional tolerance of submaximal effort. A popular clinical assessment tool used to gauge functional capacity in a range of groups is the Six-Minute Walk Test (6MWT). The test has attracted a lot of interest since it was first introduced because of its ease of use, dependability, and predictive significance in determining prognosis and treatment outcomes (Herdy *et al.*, 2017). Six walk test has several clinical applications; for instance, it can be used as a prognostic indicator for accessing mortality risk in

older adults (Gemeaux *et al.*, 2018). The 6MWT's adaptability goes beyond broad demographics to target patient populations (i.e., it is population specific). Research has examined the use of this test, for example, in people with chronic obstructive pulmonary disease (COPD), where it is a useful indicator of functional exercise capacity (Spruit *et al.*, 2016). Additionally, in patients undergoing cardiac rehabilitation, the 6MWT has emerged as a valuable tool for assessing response to intervention and guiding treatment decisions (Holland *et al.*, 2017).

### **2.1.1 history on six minutes work test**

The Six-Minute Walk Test (6MWT) is a widely used measure of functional exercise capacity, especially in patients with cardiopulmonary diseases. It was first introduced by Enright and Sherrill in 1998 as a simple, practical, and reproducible test for evaluating functional exercise capacity in patients with chronic obstructive pulmonary disease (COPD) (Enright and sherrill, 1998). Since then, it has been adopted in various clinical settings and populations to assess functional status, prognosis, and response to interventions.

Numerous studies conducted throughout time have confirmed the validity, responsiveness, and reliability of the 6MWT in a variety of patient populations, including patients with pulmonary hypertension, heart failure, and neuromuscular

disorders (Miyamoto *et al.*, 2002). Its simplicity and ease of administration make it a valuable tool for clinicians and researchers alike.

The 6MWT has been incorporated into clinical trials as a primary or secondary outcome measure to assess the efficacy of interventions, such as pulmonary rehabilitation, pharmacotherapy, and surgical procedures (Casanova *et al.*, 2011). Its ability to detect changes in functional capacity over time has made it a valuable endpoint in clinical research.

The Six-Minute Walk Test has a long history that began when Enright and Sherrill introduced it in 1998. Since then, countless research have shown its validity, reliability, and usefulness, making it a mainstay in the evaluation of functional exercise capacity in a range of clinical populations.

### **2.1.2 physiology of six minutes work test**

The Six-Minute Walk Test (6MWT) is a simple and widely used assessment tool for measuring the functional exercise capacity of individuals. It involves walking at a self-selected pace for six minutes, with the total distance covered serving as the main outcome measure.

During the 6MWT, the person's heart rate and oxygen saturation levels are typically monitored to assess their cardiovascular fitness. The test also measures

the person's breathing rate and respiratory effort, which can provide information on their lung function and respiratory system (Martins, 2021).

Walking causes the heart rate to rise in response to the muscles' increased oxygen requirement. To sustain blood flow, the heart pumps harder and dilates blood arteries. To eliminate carbon dioxide from the circulation and add more oxygen to it, breathing depth and rate increase. Breathing difficulties or dyspnea may be experienced by people with respiratory disorders. The muscles in the legs, hips, and lower back are the main ones used when walking. These muscles need to be able to work continuously for half an hour (Martins, 2021).

The interactions between the heart and lungs during exercise are the main physiological processes that are significant to the test (Casano and Annum, 2023).

## **2.2 UNDERSTANDING BLOOD GLUCOSE LEVELS**

### **2.2.1 Definition and normal range of blood glucose**

Blood glucose levels refer to the amount of glucose present in the blood. Glucose, a simple sugar, is the primary source of energy for the body's cells. The body's ability to regulate blood glucose levels is critical for maintaining overall health. Various factors, such as food intake, physical activity, and underlying health conditions, can affect blood glucose levels (Evert, *et al.*, 2019).

Blood glucose levels are typically measured in milligrams per deciliter (mg/dL) or millimoles per liter (mmol/L). Normal fasting blood glucose levels for both normal and obese individuals range from 70 to 100 mg/dL (3.9 to 5.6 mmol/L) (American Diabetes Association [ADA], 2021). After eating, these levels typically rise but should return to the normal range within a couple of hours.

### **2.2.2 Fasting and postprandial levels**

Fasting and postprandial blood glucose levels are two key measurements used to assess glucose metabolism and monitor diabetes management. These measurements offer valuable information about how the body regulates blood sugar in response to different conditions.

### **2.2.3 Fasting blood glucose in normal weight individuals**

Blood glucose levels are typically measured in milligrams per deciliter (mg/dL)moles per liter (mmol/L). Normal fasting blood glucose levels range from 70 to 100 mg/dL (3.9 to 5.6 mmol/L) (American Diabetes Association [ADA], 2021). After eating, these levels typically rise but should return to the normal range within a couple of hours.

### **2.2.4 Fasting Blood Glucose in obese individuals**

Obesity is a disorder of body weight regulatory systems characterized by an accumulation of excess body fat (Alkter *et al.*, 2017). In obese individuals, fasting blood glucose levels can vary widely, but typically, levels above 100 mg/dL are considered elevated and indicative of impaired glucose metabolism (Smith *et al.*, 2019).

### **2.2.5 Postprandial Blood Glucose level in normal weight individuals**

Postprandial blood glucose, also known as post-meal blood glucose, measures glucose levels after eating. A normal postprandial blood glucose level should be less than 140 mg/dL (7.8 mmol/L) (ADA, 2021). Levels between 140 and 199 mg/dL (7.8 to 11.0 mmol/L) indicate impaired glucose tolerance, which suggests prediabetes, while levels of 200 mg/dL (11.1 mmol/L) or higher suggest diabetes (ADA, 2021).

### **2.2.6 Postprandial blood glucose level in obese individuals**

Research suggests that postprandial blood glucose levels in obese individuals tend to be higher compared to non-obese individuals (Jones *et al.*, 2020). Obese individuals often exhibit elevated postprandial blood glucose levels. For example, a study by Abdul-Ghani *et al.*, found that obese subjects had higher postprandial glucose excursions compared to non-obese individuals, indicating impaired glucose metabolism (Abdul-Ghani *et al.*, 2019). Similarly, research by Vilsbøll *et*

*al.*, showed that obesity was associated with increased postprandial glucose levels (Vilsbøll *et al.*, 2020). The postprandial blood glucose level can vary among obese people depending on factors such as age, health status, and the specific time frame after eating. However, generally speaking, a postprandial blood glucose level of less than 140 mg/dL (7.8 mmol/L) is considered normal for most individuals, including obese individuals (ADA, 2021).

### 2.3 HYPERGLYCEMIA AND ITS CAUSES

Hyperglycemia is a condition characterized by elevated levels of blood glucose. According to the American Diabetes Association (2021), hyperglycemia is defined as fasting blood glucose levels above 126 mg/dL (7.0 mmol/L) or random blood glucose levels above 200 mg/dL (11.1 mmol/L)

Several factors lead to hyperglycemia, some of these factors include;

- **Diet:** Consuming meals high in refined carbohydrates, sugars, and fats can lead to spikes in blood glucose levels, even in individuals with normal weight (Christiane de Oliveira *et al.*, 2011)
- **Sedentary lifestyle:** A sedentary lifestyle can contribute to hyperglycemia by reducing insulin sensitivity and increasing insulin resistance, which can

lead to elevated blood sugar levels. Regular physical activity helps control blood sugar levels by improving insulin sensitivity and promoting glucose uptake by muscles (Cynthia *et al.*, 2015).

- **Genetics:** Genetics can contribute to hyperglycemia through various mechanisms, such as impaired insulin secretion or action (Khan, 2004). For example, mutations in genes involved in pancreatic beta-cell function or insulin signaling pathways can lead to dysfunctional glucose metabolism (Dean and McEntyre, 2004). For instance, the onset of type 1 diabetes is attributed to both an inherited risk and external triggers, such as diet or an infection (Dean *et al.*, 2004). The role of genetics in hyperglycemia is best explained in the context of diabetes risk based on family history. Diabetes doesn't seem to be inherited in a simple pattern. Still, some people are born more likely to develop hyperglycemia (ADA, 2021).
  
- **Stress:** Stress causes the release of stress hormones such as adrenaline and cortisol, which in turn causes the liver to create more glucose, raising blood sugar levels. Hyperglycemia may result from this, particularly in diabetics who may have compromised insulin activity. Stress-induced hyperglycemia is the term used to describe the rise in blood sugar levels that occurs when

under stress. (Mifsud *et al.*, 2018). It can occur in people with or without diabetes but is more pronounced in those with diabetes due to their impaired insulin response.

- **Medications:** Numerous methods exist for how drugs might cause hyperglycemia, such as changes in insulin sensitivity and secretion, direct cytotoxic effects on pancreatic cells, and increases in glucose synthesis. Different ways exist for how medications might cause hyperglycemia. Blood sugar levels can rise as a direct result of some drugs interfering directly with insulin activity, such as corticosteroids and some diuretics. Some medications, such as certain antipsychotics and antidepressants, have the potential to cause weight gain, which can worsen insulin resistance and raise blood sugar levels. Furthermore, certain drugs may cause the liver to release glucose or interfere with the body's capacity to control blood sugar, which can lead to hyperglycemia. (Fathalla *et al.*, 2015).

## 2.4 HYPOGLYCEMIA AND ITS CAUSES

Hypoglycemia is a condition characterized by abnormally low levels of glucose in the blood, typically below 70 milligrams per deciliter (mg/dL) (ADA, 2022). It commonly occurs in individuals with diabetes who take insulin or certain other medications to manage their blood sugar levels, but it can also occur in people without diabetes, symptoms of hypoglycemia can vary but often include sweating, trembling, confusion, dizziness, hunger, and in severe cases, loss of consciousness (Schene, 2015).

Hypoglycemia can be caused by several factors, including:

- **Medications:** Taking too much insulin or other glucose-lowering medications can lower blood sugar levels excessively. Medications like insulin and sulfonylureas stimulate the release of insulin from the pancreas, leading to a decrease in blood sugar levels. If the dose is too high or if food intake is inadequate, this can result in hypoglycemia (Cruz, 2020).
- **Delayed or skipped meals:** Not eating on time or skipping meals can lead to a drop in blood sugar levels, especially in individuals with diabetes who are taking medications that lower blood sugar. Skipping meals can cause hypoglycemia because when you don't eat, your body doesn't have a fresh supply of glucose from food to maintain blood sugar levels. This can lead to a drop in blood sugar, causing symptoms like shakiness, weakness, and

confusion. Your body relies on a steady intake of food to keep blood sugar stable, so skipping meals disrupts this balance (GhavamiNejad *et al.*, 2022).

- **Excessive physical activity:** Intense exercise can increase the body's demand for glucose, leading to hypoglycemia, particularly if insulin or other blood sugar-lowering medications are not adjusted accordingly. Excessive physical activity can cause hypoglycemia because it increases the rate at which your body uses glucose for energy. When glucose is used up faster than it's replenished, blood sugar levels can drop, leading to hypoglycemia. This is especially true if someone with diabetes engages in intense exercise without adjusting their insulin or carbohydrate intake accordingly (Galassetti and Riddell, 2013).
- **Alcohol consumption:** Alcohol can interfere with the liver's ability to release stored glucose into the bloodstream, leading to hypoglycemia, especially if consumed without food. Alcohol consumption can cause hypoglycemia because it can interfere with the body's ability to maintain stable blood sugar levels. Alcohol can inhibit the liver's ability to release stored glucose into the bloodstream, leading to a drop in blood sugar levels. Additionally, alcohol can mask the symptoms of hypoglycemia, making it difficult for individuals to recognize and address low blood sugar levels. This combination of factors can increase the risk of hypoglycemia,

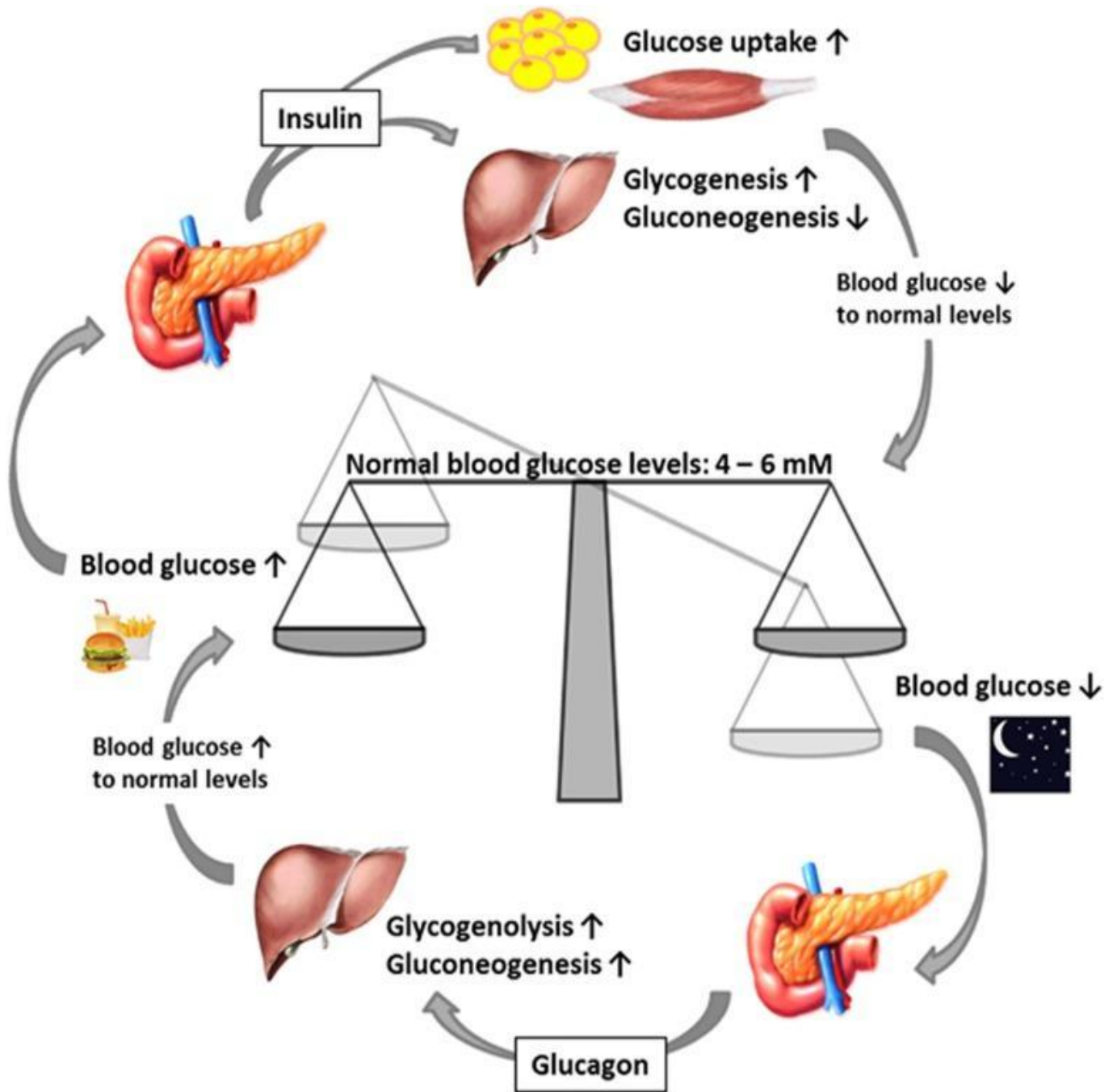
especially in people with diabetes who may already have impaired glucose regulation (Tourkmani *et al.*, 2018).

- **Insulinoma:** This is a rare tumor of the pancreas that produces excessive amounts of insulin, leading to recurrent episodes of hypoglycemia. Insulinoma is a tumor of the pancreas that produces excessive amounts of insulin. Insulin is responsible for lowering blood sugar levels by promoting the uptake of glucose into cells. When an insulinoma produces too much insulin, it leads to a rapid decrease in blood sugar levels, causing hypoglycemia. Essentially, the body receives an excess of insulin relative to the amount of glucose present, resulting in an imbalance that leads to hypoglycemia (Palani *et al.*, 2023).
  
- **Dumping syndrome:** Dumping syndrome is a condition that occurs when food, especially sugar-rich foods, moves too quickly from the stomach to the small intestine. This rapid transit can lead to a range of symptoms, including nausea, vomiting, abdominal cramps, diarrhea, weakness, sweating, and dizziness. It commonly occurs after certain types of surgeries, such as gastric bypass surgery or surgery to remove part of the stomach. The rapid influx of undigested food into the small intestine causes a surge in blood sugar levels,

followed by a rapid drop, leading to the symptoms of dumping syndrome. Management often involves dietary modifications, such as eating smaller, more frequent meals and avoiding sugary foods (Della *et al.*, 2022).

## **2.5 BLOOD GLUCOSE LEVEL REGULATION IN THE BODY**

In humans, blood glucose levels are tightly regulated through a complex interplay of hormones, primarily insulin and glucagon, produced by the pancreas (Wensveen *et al.*, 2021). When blood glucose levels rise, such as after a meal, beta cells in the pancreas release insulin, which facilitates the uptake of glucose by cells for energy production or storage. Conversely, when blood glucose levels drop, alpha cells in the pancreas release glucagon, which prompts the liver to convert stored glycogen into glucose and release it into the bloodstream (Noakes, 2022). This delicate balance ensures that cells receive a steady supply of glucose for energy while preventing excessive fluctuations in blood sugar levels. Additionally, other hormones, such as cortisol and adrenaline, also play a role in regulating blood glucose levels, particularly during times of stress or physical exertion (Cupka, 2023). Overall, this intricate system helps maintain blood glucose homeostasis, essential for overall health and proper functioning of the body.



Source: Röder *et al.*, 2016

**FIG 1: MAINTENANCE OF BLOOD GLUCOSE LEVELS BY GLUCAGON AND INSULIN**

## 2.6 BLOOD GLUCOSE LEVELS AND EXERCISE

### 2.6.1 The role of glucose in energy production during exercise:

1. **Primary Source Of Fuel:** Glucose serves as the primary source of fuel for muscles during exercise (Herrera *et al.*, 2015) . Glucose serves as the primary source of energy for the body's cells, especially for the brain and muscles. When consumed, it's broken down through a series of chemical reactions in a process called glycolysis, producing ATP (adenosine triphosphate), which is the cell's energy currency (Wu and Bai, 2023).. Without adequate glucose, cells would struggle to function optimally, leading to fatigue and potential health issues (Cupka and sedliak, 2023)

2. **Glycolysis:** During exercise, glucose serves as a crucial fuel for energy production through glycolysis (Cupka and Sedliak, 2023). Glycolysis is the metabolic pathway that breaks down glucose into pyruvate, generating ATP (adenosine triphosphate) in the process (Schurr and Passarella, 2022). ATP is the primary energy currency of cells, used to power various cellular processes, including muscle contraction during exercise(Attwaters and Hughes, 2022). So, glucose is essential for providing the necessary energy for muscle function during physical activity.

3. **Glycogen stores:** During exercise, muscles rely on glucose for energy and as glucose levels decrease, the body turns to glycogen stores, breaking them down

into glucose to fuel activity(Katz, 2022). After exercise, when glucose levels are high, excess glucose is stored as glycogen through a process called glycogenesis, replenishing glycogen stores for future use (Coqueiro *et al.*, 2019) . So, glucose plays a crucial role in both fueling exercise and replenishing glycogen stores afterward. Glucose stored in the form of glycogen in muscles and the liver is utilized to sustain energy levels, especially during prolonged exercise (Lacombe *et al.*, 2006).

## **2.7 GLYCOLYSIS AND ENERGY PATHWAY.**

Glycolysis is a central metabolic pathway involved in the breakdown of glucose to extract energy for cellular processes (cupka and sedliak, 2023). It occurs in the cytoplasm of cells and is the first step in both aerobic and anaerobic respiration (peek *et al.*, 2017). Glycolysis is a fundamental energy pathway that plays a key role in cellular metabolism by breaking down glucose into pyruvate and generating ATP and NADH, glycolysis provides the necessary energy for a variety of cellular processes (Peek *et al.*, 2017). Its regulation ensures that energy production aligns with cellular demands, making it a central and versatile metabolic pathway (poole *et al.*, 2021).

Glycolysis involves a sequence of ten enzyme-catalyzed reactions that convert glucose, a six-carbon sugar, into two molecules of pyruvate, a three-carbon

compound. This pathway is found in almost all living organisms, reflecting its fundamental role in metabolism. Glycolysis can operate in the presence or absence of oxygen, serving as the initial stage of cellular respiration ( Fuller *et al.* , 2021).

### **2.7.1. Key Phases of Glycolysis**

Glycolysis can be divided into two main phases:

1. Investment Phase: The first five reactions involve an investment of energy. Here, glucose is phosphorylated and converted into fructose-1,6-bisphosphate, which is then split into two three-carbon molecules. This phase uses two ATP molecules.
2. Payoff Phase. The last five reactions produce energy. The three-carbon molecules are further metabolized, resulting in the production of four ATP molecules, two NADH (reduced nicotinamide adenine dinucleotide), and two pyruvate molecules (Shiroshita *et al.*, 2023)

### **2.7.2. Steps in Glycolysis**

According to Chaudhry and Varacallo (2023), the following steps outline the glycolysis pathway:

- Hexokinase: Phosphorylates glucose to form glucose-6-phosphate, using one ATP molecule.

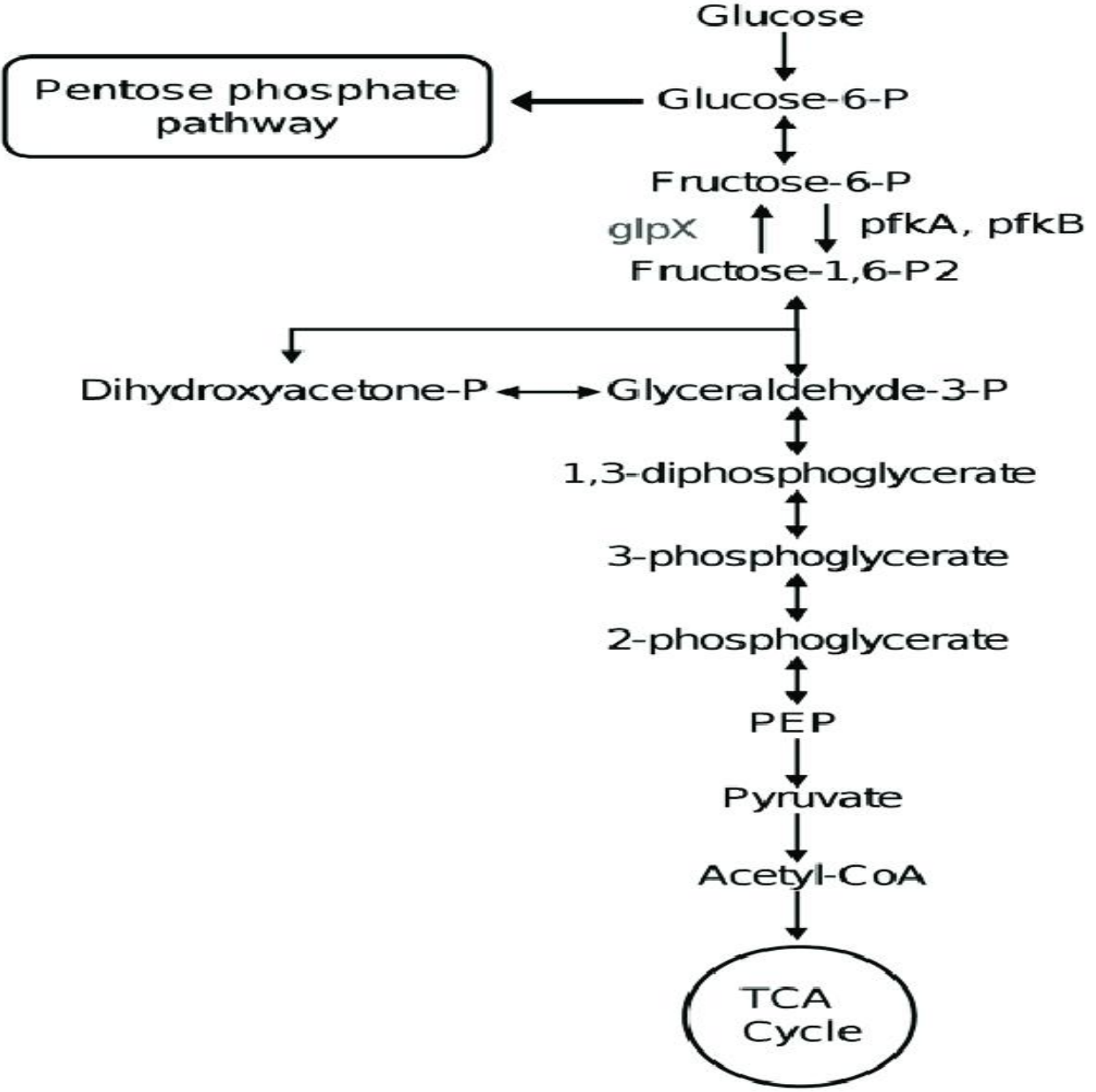
- Phosphoglucose Isomerase: Converts glucose-6-phosphate to fructose-6-phosphate.
- Phosphofructokinase-1 (PFK-1): Phosphorylates fructose-6-phosphate to fructose-1,6-bisphosphate, using another ATP molecule.
- Aldolase: Cleaves fructose-1,6-bisphosphate into two three-carbon molecules: dihydroxyacetone phosphate (DHAP) and glyceraldehyde-3-phosphate (G3P).
- Triose Phosphate Isomerase: Converts DHAP into G3P, resulting in two G3P molecules from one glucose molecule.
- Glyceraldehyde-3-Phosphate Dehydrogenase: Converts G3P to 1,3-bisphosphoglycerate, generating NADH in the process.
- Phosphoglycerate Kinase: Transfers a phosphate group from 1,3-bisphosphoglycerate to ADP, forming ATP and 3-phosphoglycerate.
- Phosphoglycerate Mutase: Converts 3-phosphoglycerate to 2-phosphoglycerate.
- Enolase: Dehydrates 2-phosphoglycerate to form phosphoenolpyruvate (PEP).
- Pyruvate Kinase: Transfers a phosphate group from PEP to ADP, forming ATP and pyruvate.

### **2.7.3. Energy Production in Glycolysis**

The net energy yield from glycolysis is two ATP molecules (four produced, two used) and two NADH molecules (Hertz *et al.*, 2006). This process is crucial for providing energy quickly in anaerobic conditions or as the initial stage of aerobic respiration (Hui *et al.*, 2017). If oxygen is available, pyruvate can enter the mitochondria for further energy extraction through the citric acid cycle and oxidative phosphorylation. In anaerobic conditions, pyruvate can be converted into lactate or ethanol through fermentation, depending on the organism (wenes *et al.*, 2022).

### **2.7.4. Regulation of Glycolysis**

Glycolysis is tightly regulated to meet cellular energy demands. The key regulatory enzyme is phosphofructokinase-1 (PFK-1), which is inhibited by high levels of ATP and citrate and activated by AMP and fructose-2,6-bisphosphate (Mor *et al.*, 2011). Hexokinase and pyruvate kinase are also regulated by various feedback mechanisms to ensure glycolysis proceeds according to cellular needs (Israelson and Vander, 2015).



Source: Phong *et al.*, 2013

## **FIG 2: SCHEMATIC REPRESENTATION OF GLYCOLYTIC PATHWAY**

### **2.8 THE EFFECT OF FUNCTIONAL EXERCISE ON GLUCOSE LEVEL IN NORMAL WEIGHT AND OBESE INDIVIDUALS**

#### **2.8.1 Glucose Metabolism During Exercise:**

During exercise, muscles rely on glucose as a primary fuel source, especially during high-intensity activities (Han *et al.*, 2021). Exercise stimulates glucose uptake by muscle cells through insulin-independent mechanisms, such as contraction-induced glucose transporter translocation (e.g., GLUT4). Glucose is also mobilized from glycogen stores in the liver and muscles to maintain blood glucose levels during prolonged exercise (Richter *et al.*, 2021).

In normal Weight Individuals, they typically experience a decrease in blood glucose levels due to increased glucose uptake by active muscles. This decrease in blood glucose may be more pronounced after intense or prolonged exercise sessions. Normal-weight individuals often have better insulin sensitivity, allowing for efficient glucose uptake by muscles and a quicker return to baseline glucose levels post-exercise (Koh *et al.*, 2021).

Normal weight individuals possess an effective ability to replenish glycogen

stores in muscles and liver after exercise thus, helping to stabilize blood glucose levels (Ying *et al.*, 2017).

Obese individuals may exhibit slight differences in glucose metabolism compared to normal-weight individuals, including insulin resistance, impaired glucose tolerance, and altered hormonal regulation (Hilton *et al.*, 2023).

### **2.8.2 Adaptations to Exercise:**

Over time, regular exercise can lead to adaptations in glucose metabolism, including improved insulin sensitivity, enhanced glucose uptake by muscles, and more efficient glycogen storage and utilization (Paola *et al.*, 2016). These adaptations may occur in both normal-weight and obese individuals, although the rate and extent of improvement may vary depending on factors such as exercise intensity, duration, and adherence.

Obese individuals may experience greater improvements in insulin sensitivity and glucose metabolism with structured functional exercise programs (Jeremy *et al.*, 2013).

### **2.8.3 Role of Diet:**

pre- and post-exercise meals play a crucial role in modulating glucose responses to exercise (Jenna *et al.*, 2013).

Consuming carbohydrates before and/or after exercise can help replenish glycogen

stores and stabilize blood glucose levels, particularly in individuals with higher energy demands or prolonged exercise sessions (Bob and Christine, 2018).

Dietary composition, such as the ratio of carbohydrates to protein and fat, can also influence post-exercise glycemic control and metabolic responses, some evidence suggest that low-carbohydrate diets can alter glucose metabolism differently in normal-weight versus obese individuals (Jenna *et al.*, 2021).

#### **2.8.4. Health Outcomes:**

Improving glucose management through exercise can have significant implications for overall health outcomes, including reduced risk of type 2 diabetes, cardiovascular disease, and metabolic syndrome (Neil and will, 2006)

Normal-weight individuals engaging in regular exercise may experience benefits such as improved insulin sensitivity, better glycemic control, and enhanced cardiovascular health (YoonMyung and HaNui, 2013).

For obese individuals, exercise can be a cornerstone of obesity management, contributing to weight loss, metabolic improvements, and reductions in obesity-related comorbidities (Stephan *et al.*, 2017).

After exercise, obese individuals may still experience a decrease in blood glucose levels, but the response can vary depending on factors such as exercise intensity, duration, and individual metabolic health (Conor *et al.*, 2009). Insulin

resistance in obese individuals can impair glucose uptake by muscles during exercise, leading to higher blood glucose levels during and after exercise compared to normal-weight counterparts (Bulbul *et al.*, 2021). Obese individuals may have a delayed return to baseline glucose levels post-exercise due to impaired insulin sensitivity and slower glycogen replenishment kinetics (Geraldine *et al.*, 2009).

### **2.8.5 Factors Influencing Glucose Response:**

#### **1. Exercise Intensity and Duration:**

Higher intensity and longer duration of exercise sessions typically result in greater glucose utilization and a more significant decrease in blood glucose levels in both normal-weight and obese individuals (Peter, 2013).

#### **2. Body Composition:**

Differences in muscle mass, fat distribution, and metabolic health between normal-weight and obese individuals can influence glucose metabolism during and after exercise (John and Audrey, 2020).

#### **3. Insulin Sensitivity:**

Normal-weight individuals generally have higher insulin sensitivity, facilitating glucose uptake by muscles, whereas obese individuals may exhibit insulin resistance, affecting glucose clearance and post-exercise glucose levels (Alice *et al.*, 2019).

### **2.8.6 Clinical Implications and Considerations:**

**Monitoring:** Continuous glucose monitoring may be beneficial for both normal-weight and obese individuals to understand individual responses to exercise and adjust dietary and exercise interventions accordingly (viral *et al.*, 2019).

**Health Risks:** Individuals with obesity and related metabolic conditions should be aware of potential risks associated with exercise-induced fluctuations in blood glucose levels (Joséphine *et al.*, 2021) and consult healthcare professionals for personalized guidance.

While Functional exercise generally leads to decreased blood glucose levels in both normal-weight and obese individuals, differences in metabolic health, insulin sensitivity, and body composition can result in distinct glucose responses. Understanding these differences is crucial for designing effective exercise interventions and promoting metabolic health in diverse populations (Alice *et al.*, 2019)

## **2.9 THE EFFECTS OF HYPOGLYCEMIA ON FUNCTIONAL EXERCISE CAPACITY IN BOTH OBESE AND NORMAL WEIGHT INDIVIDUALS**

### **1. Muscle Function:**

**Energy Production:** Glucose is the primary fuel source for muscle contraction during exercise both in obese and in normal weight individuals. Hypoglycemia leads to decreased glucose availability, compromising the muscles' ability to produce energy efficiently (Philip and polonsky, 2008).

**Strength and Endurance:** Low blood sugar levels can result in reduced muscle strength and endurance. Without an adequate supply of glucose, muscles may fatigue more quickly, limiting the intensity and duration of exercise (Hwi *et al.*, 2010).

### **2. Cardiovascular Response:**

**Heart Rate;** Hypoglycemia can cause tachycardia, an increased heart rate, as the body attempts to compensate for the decreased energy supply. This can lead to an elevated heart rate during exercise, potentially impacting exercise tolerance (Sitara and Mohamed, 2017).

**Cardiac Output:** Reduced cardiac output may occur during hypoglycemia, impairing the heart's ability to pump an adequate amount of blood to the muscles during exercise. This can result in decreased exercise capacity and

performance(shei–wei *et al.*, 2016).

### 3. Metabolic Changes:

**Glycogen Depletion:** Hypoglycemia can accelerate glycogen depletion in the muscles and liver. Glycogen is a stored form of glucose used during prolonged exercise. Depleted glycogen stores can lead to premature fatigue and decreased exercise capacity (Neils *et al.*, 2013).

**Muscle Wasting:** Prolonged hypoglycemia may contribute to muscle wasting or loss of muscle mass over time, further impairing functional exercise capacity (Joerg *et al.*, 2020).

### 4. Neurological Impact:

**Cognitive Function:** Low blood sugar levels can impair cognitive function, affecting concentration, coordination, and decision-making abilities during exercise. This can increase the risk of accidents or injuries and decrease exercise efficiency (Shan *et al.*, 2023).

**Central Fatigue:** Hypoglycemia can contribute to central fatigue, a phenomenon involving the brain's perception of effort during exercise. This may result in a reduced willingness to exert maximal effort, further limiting exercise capacity (Takashi *et al.*, 2019).

## 5. Hormonal Response:

Counterregulatory Hormones: During hypoglycemia, the body releases counterregulatory hormones such as glucagon, epinephrine, and cortisol to increase blood sugar levels (Jennifer and Ana, 2011). While these hormones help raise blood glucose, they can also have side effects such as increased heart rate and impaired glucose utilization, affecting exercise capacity (Francesco *et al.*, 2013).

## **2.10 EFFECT OF HYPERGLYCEMIA ON FUNCTIONAL EXERCISE CAPACITY OF BOTH NORMAL AND OBESE INDIVIDUALS**

Hyperglycemia, characterized by abnormally high blood sugar levels, can have profound effects on the functional exercise capacity of both normal-weight and obese individuals (Jermin, 2023). While exercise is a cornerstone of diabetes management, elevated blood glucose levels can impact various physiological systems, compromising performance and increasing the risk of complications during physical activity (Peter, 2013).

Normal-weight individuals typically rely on a tightly regulated system of glucose metabolism to fuel their exercise endeavors. During physical activity, muscles utilize glucose as a primary energy source, facilitated by insulin-mediated glucose uptake. However, in the presence of hyperglycemia, insulin resistance or inadequate insulin production can impair glucose uptake by skeletal muscle cells, leading to reduced energy availability and compromised exercise capacity (Karla and Debbie, 2011). Furthermore, hyperglycemia can exacerbate dehydration and electrolyte imbalances, increasing the risk of heat-related illness and exertional rhabdomyolysis, a condition characterized by muscle breakdown and release of toxic byproducts into the bloodstream (This, 2017).

In obese individuals, the effects of hyperglycemia on exercise capacity may be more pronounced due to underlying metabolic dysfunction and comorbidities associated with excess adiposity (Michael and Dana, 2019). Obesity is often accompanied by insulin resistance, systemic inflammation, and dyslipidemia, which can further impair glucose metabolism and cardiovascular function, limiting exercise tolerance and performance. Moreover, obesity-related factors such as reduced mobility, joint pain, and respiratory limitations can exacerbate the impact of hyperglycemia on functional capacity, making it challenging to engage in physical activity effectively (Stephan *et al.*, 2017).

One of the primary mechanisms through which hyperglycemia impairs exercise capacity is the disruption of energy metabolism and substrate utilization (Paolo, 2016). Elevated blood sugar levels can inhibit fat oxidation and promote reliance on carbohydrates as a fuel source during exercise, leading to premature glycogen depletion and fatigue (Lawrence, 2014). This phenomenon is particularly problematic during prolonged or high-intensity exercise bouts, where the demand for energy exceeds the body's capacity to utilize glucose efficiently. As a result, individuals may experience decreased endurance, increased perceived exertion, and diminished exercise performance (Salwa *et al.*, 2023)

Hyperglycemia can impair cardiovascular function, compromising the heart's ability to meet the increased oxygen demand during exercise (Anne *et al.*, 2015). Chronic exposure to elevated blood sugar levels can lead to endothelial dysfunction, arterial stiffness, and microvascular damage, increasing the risk of cardiovascular complications such as coronary artery disease, peripheral artery disease, and autonomic neuropathy (William and Eugene, 2021). These conditions can manifest as reduced exercise tolerance, impaired heart rate recovery, and exercise-induced ischemia, limiting the intensity and duration of physical activity.

Hyperglycemia can have adverse effects on thermoregulation and fluid balance

during exercise, predisposing individuals to heat-related illnesses such as heat exhaustion and heat stroke (Ryosuke and Kazunobu, 2018). Insulin deficiency or resistance can impair sweat gland function and hinder heat dissipation, exacerbating the risk of hyperthermia and dehydration, particularly in hot and humid environments (Matthew *et al.*, 2022). Moreover, hyperglycemia-induced osmotic diuresis can lead to excessive fluid loss and electrolyte depletion, further compromising exercise performance and increasing the likelihood of heat-related complications (Lindsay and Asker, 2011).

## **2.11. THE RELATIONSHIP BETWEEN EXERCISE AND BLOOD GLUCOSE LEVELS**

Exercise can directly impact blood glucose levels through its effects on insulin sensitivity (Stephen and John, 2017). Insulin sensitivity refers to the ability of cells to respond to insulin and take up glucose from the bloodstream (Gisela, 2005).

Regular functional exercise has been shown to increase insulin sensitivity in both healthy individuals and those with insulin resistance or type 2 diabetes (Geirsdottir *et al.*, 2012). This occurs through several mechanisms, including increased muscle glucose uptake during exercise and enhanced insulin signaling pathways within muscle cells.

Exercise can lead to improvements in body composition, particularly an increase in

lean muscle mass and a decrease in body fat percentage (Clint *et al.*, 2013). Lean muscle tissue is highly metabolically active and plays a crucial role in glucose metabolism. As muscle mass increases, so does the capacity for glucose uptake and utilization, leading to better blood glucose control.

Another important aspect of the relationship between functional exercise and blood glucose levels is its acute effects on glucose metabolism during and after exercise. During exercise, muscles require a constant supply of energy, which is provided by both glucose and fatty acids. As a result, blood glucose levels may decrease temporarily during exercise as glucose is taken up by muscle cells for energy (Ana *et al.*, 2020). Additionally, exercise can stimulate glucose uptake into muscle cells independently of insulin, thereby promoting glucose clearance from the bloodstream (Lykke *et al.*, 2017).

Exercise can have long-term effects on blood glucose regulation through its impact on overall health and lifestyle factors. Regular participation in functional exercise is associated with improvements in cardiovascular health, lipid profiles, and stress management (Kelsy *et al.*, 2019), all of which can indirectly influence blood glucose levels. For example, reduced levels of stress hormones such as cortisol can help to improve insulin sensitivity and glycemic control (Tanja *et al.*, 2010).

The relationship between functional exercise and blood glucose levels is not one-size-fits-all and can vary depending on individual factors such as age, fitness level, and underlying health conditions (Derek *et al.*, 2019)

The intensity, duration, and frequency of exercise can all influence its effects on blood glucose regulation (Matthew *et al.*, 2020).

## **2.12 RELATIONSHIP BETWEEN 6MWT AND BLOOD GLUCOSE LEVEL IN OBESE AND NORMAL WEIGHT**

### **Obesity and the 6MWT:**

In obese individuals, excess body weight can significantly impact physical function and mobility, potentially affecting performance on the 6MWT (Jeannie *et al.*, 2019). Several studies have demonstrated that obese individuals tend to have lower exercise capacity and endurance compared to their normal-weight counterparts (Ya-Tzu, *et al.*, 2020). The additional weight carried by obese individuals requires greater energy expenditure and may lead to premature fatigue during physical activity, including walking tests like the 6MWT.

### **Blood Glucose Levels in Obesity:**

Obesity is closely linked to insulin resistance, a condition in which cells fail to respond effectively to insulin, leading to elevated blood glucose levels (Dilek and

Havva, 2017). Chronic elevation of blood glucose levels, especially in the fasting state and after meals, is a hallmark of type 2 diabetes mellitus, which is highly prevalent in obese individuals (Federica *et al.*, 2015). Insulin resistance and hyperglycemia can impair endothelial function, promote inflammation, and contribute to the development of cardiovascular disease, further exacerbating functional limitations observed in obese individuals (Valeska *et al.*, 2018).

### **Relationship Between 6MWT and Blood Glucose Levels:**

The relationship between the 6MWT and blood glucose levels in obese and normal-weight individuals is multifaceted. In obese individuals with poorly controlled blood glucose levels, impaired glucose metabolism can compromise aerobic capacity and endurance, leading to reduced performance on the 6MWT (Alice *et al.*, 2024). Conversely, improvements in glycemic control through lifestyle modifications or pharmacotherapy may enhance exercise tolerance and functional capacity in obese individuals, potentially resulting in better performance on the 6MWT (Sherif *et al.*, 2019). The relationship between the 6-Minute Walk Test (6MWT) and blood glucose levels in obese and normal-weight individuals underscores the intricate interplay between physical fitness, metabolic health, and functional capacity (Neeti *et al.* , 2012). Obesity, characterized by excessive adiposity and insulin resistance, can impair exercise tolerance and performance on the 6MWT (Alice *et al.*, 2024). Conversely, improvements in glycemic control and

physical fitness through lifestyle interventions have the potential to enhance functional capacity and overall health outcomes in both obese and normal-weight individuals (Yuri *et al.*, 2019).

## **CHAPTER THREE**

### **3.1 MATERIALS**

- Two small cones to mark the start and end point
- Countdown timer
- A measuring tape
- Worksheet
- Borg scale
- Glucometer
- A lancet
- A chair that can be easily moved along the walking course
- A chair for subject to seat while using the glucometer

### **3.2 Subject and study area**

The study involved equal number of obese and normal weight participants from the University of Benin: 34 normal weight and 34 obese subjects

### **3.3 Study population and study area**

A total of 68 young adults were recruited for this study. The subjects were selected randomly amongst students of University of Benin within the age range 18–27 years.

The study was conducted in the college of basic medical sciences, University of

Benin.

### **3.4 Inclusion criteria**

Students of the University of Benin between the age of 18 years and 27 years.

- Both male and female

### **3.5 Exclusion criteria**

- Subjects who had surgery recently (within the space of 6 months or less prior to the commencement of this study)
- Subjects who experience frequent shortness of breath.
- Subjects who were unable to complete the test.

### **3.6 Ethical consideration**

Approval and clearance for this study was sought and obtained from the Health Research Ethics Committee, College of Medical Sciences, University of Benin, Benin City, Edo State with approval number (HM. 1208/88)

### **3.7 Methodology**

#### **3.7.1 participant preparation**

- Subjects were asked to walk at their normal walk pace for six minutes, walking back and forth on a 30m hall way. Six minutes is a long time to walk, hence, subjects were permitted to slow down, stop and rest when necessary. They may lean against the wall while resting, but resume walking as soon as they are able to do so.
- Subjects were advised to wear comfortable clothing and appropriate walking shoes. Subjects were allowed to use their usual walking aids for the test (e.g a cane, walker, etc.).
- Subject were advise not to eat heavy meals at least two(2) hours before the test, although they were allowed to take light meals
- Subjects were advised not to exercise vigorously within two(2) hours before beginning the test.
- Subjects were instructed to walk at their normal pace for six(6) minutes, running or jogging was discouraged
- Subjects were permitted to quit whenever they wanted

### 3.7.2 The 6-minute walk Test

- The subjects were asked to rest for at least 15 minutes before the test
- The subject's baseline borg scale and oxygen saturation were measured
- The subject's blood glucose level was taken before the walk starts
- The subjects walked back and forth the two cones on the 30m hallway
- Standard motivational cues were spoken at the appointed time to the subject within the period of the walk
- The number of laps walked was counted and recorded
- The total number of laps walked was multiplied by 60 meter to get the total number of distance covered, within six minutes (six minutes work distance(6MWD)), in meters
- The subject's Borg scale ,oxygen saturation and blood glucose level were measured again at the end of the test
- The subjects were congratulated and their on their good effort and offered a drink of water and snack

## 3.8 Measurement Parameters

### 3.8.1 Distance covered in the 6MWT

At the end of the 6MWT, the distance covered by the subjects was measured in meters. The total number of laps walked was multiplied by 60 meters to get the total number of meters walked

### 3.8.2 Body mass index (BMI)

- Weight

Weight was measured in kilogram(Kg) using a weighing scale, subjects were made to put off their footwear or any piece of items or object in their possession. Thereafter they were made to mount the scale and their weight was read off the scale

- Height

Height was measured in cm using a standard stadiometer and thereafter it was converted to meters

Body mass index (BMI) was calculated using the formula

$$\text{BMI} = \text{Weight (Kg)} / \text{height}^2(\text{m}^2)$$

### 3.8.3 Blood glucose level

Blood glucose level was measured in mg/dl using a standard glucometer.

## 3.9 Statistical Analysis

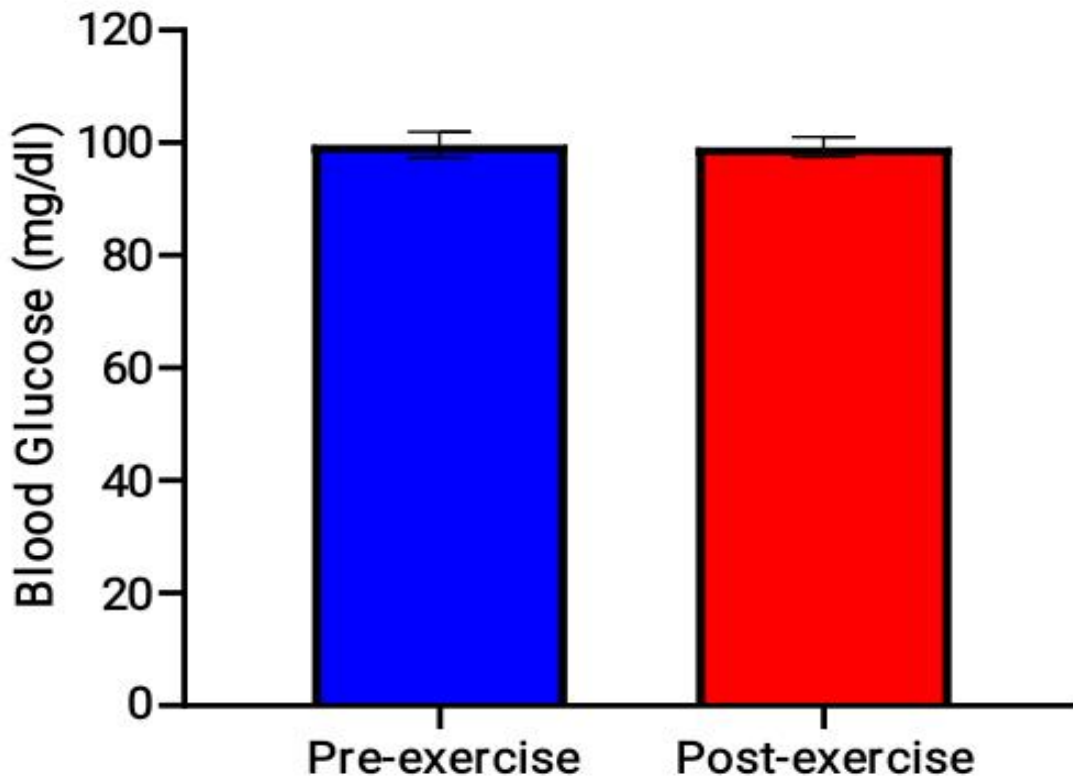
Graph pad prism version 8.1 statistical software was used. Result was presented as Mean SEM (Standard error mean) in tables and graph.

Student t-test was used to compare means between the dependent

against the independent variable.  $P \leq 0.05$  was accepted as statistically significant.

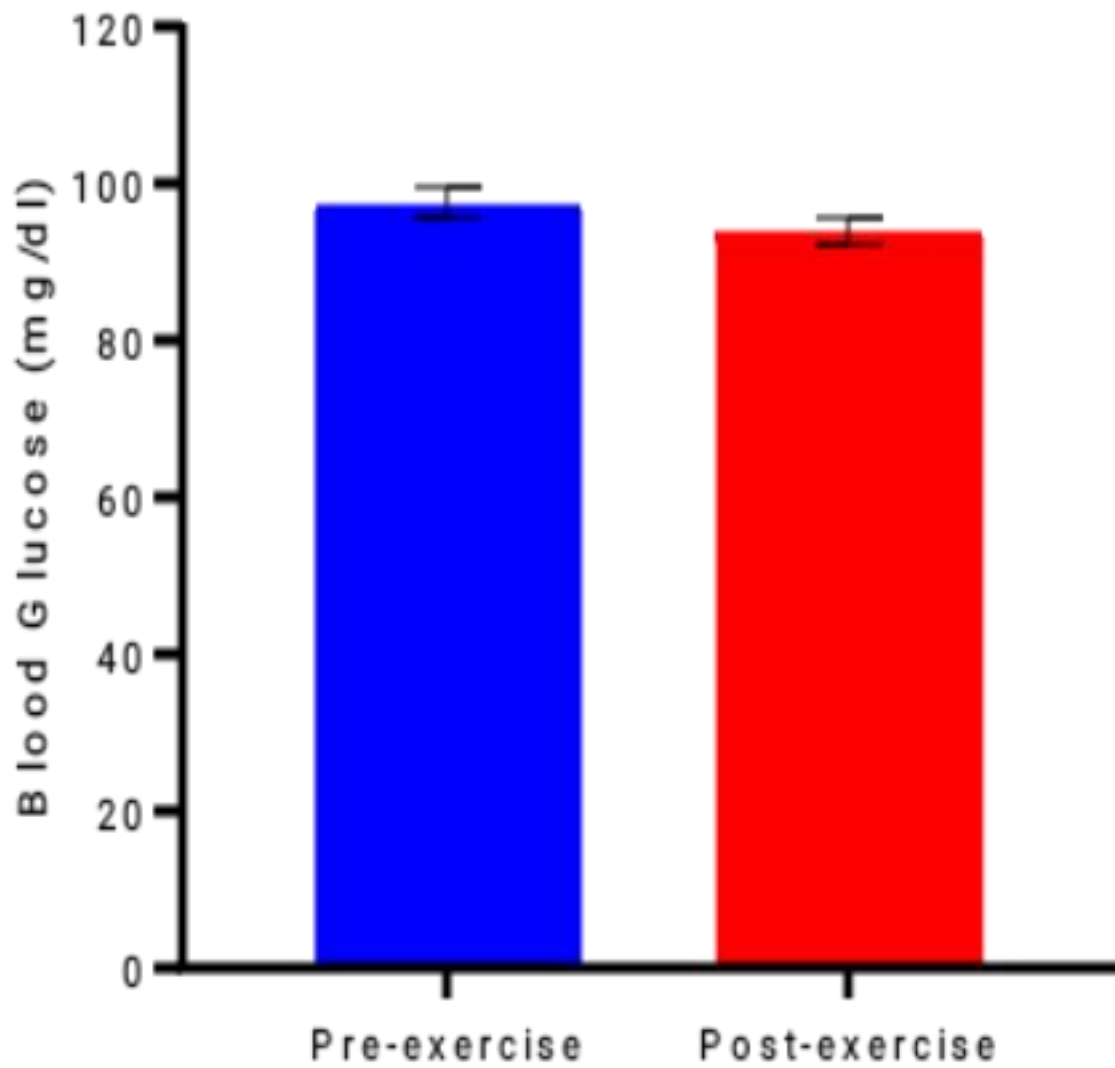
#### **4.0 CHAPTER FOUR**

**Fig III: The effect of 6MWT on blood glucose level in healthy normal weight young adult individuals**



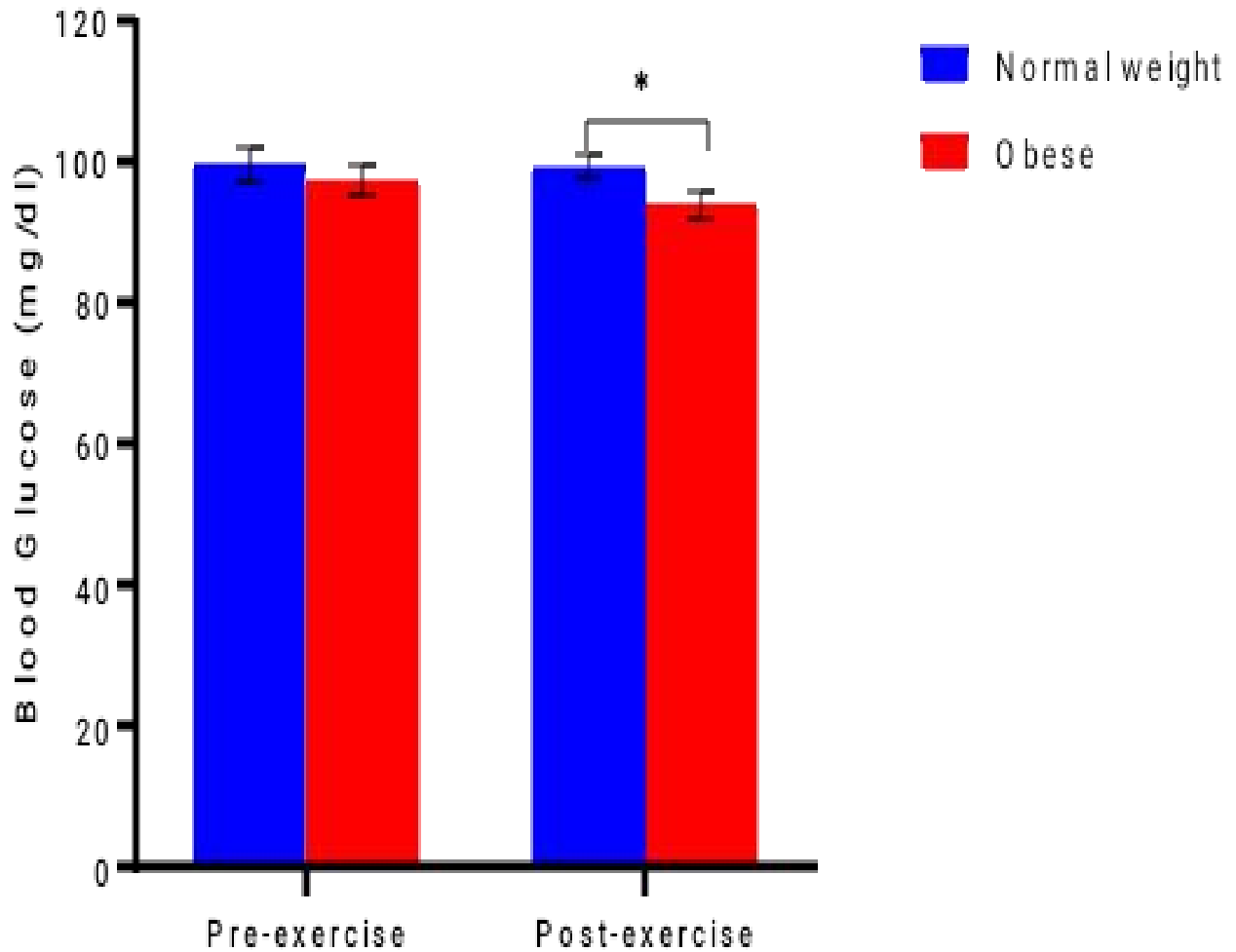
There was no significant change in post 6MWT compared to pre 6MWT.

**Fig IV: The effect of 6MWT on blood glucose level in healthy obese young adult individuals**



There was no significant change in post 6MWT compared with pre 6MWT

**Fig V: The effect of 6MWT on blood glucose level in healthy normal weight and obese young adult individuals**



There was a significant decrease in the blood glucose levels of obese compared with normal weight post-6MWT, although there was no significant change in the blood glucose level pre-6MWT in obese compared with normal weight.

## CHAPTER FIVE

### 5 DISCUSSION AND CONCLUSION

## 5.1 DISCUSSION

The findings of this study indicate a statistically significant decrease in the blood glucose levels of obese compared with normal weight post-6MWT, although there was no significant change in the blood glucose level pre-6MWT in obese compared with normal weight. This suggests that the exercise from the test may have a greater impact on blood glucose levels in obese individuals than in their normal weight counterparts. This result raises several important considerations regarding the varying impact of functional exercise on the blood glucose level of individuals of different body mass index (BMI) and underscores the need for a comprehensive understanding of underlying factors contributing to this disparity. There are a number of possible explanations for the difference in blood glucose level post-6MWT observed between obese and normal young adult individuals. According to Gerald (2008) in his work published by Endocrinology and metabolism clinics of North America, there is a higher level of insulin resistance in obese than in normal weight individuals. This means that their bodies have a harder time using insulin effectively to regulate blood sugar levels. Additionally, excess adipose tissue (body fat) can interfere with glucose metabolism according to the work done by Michele (2019) published by the International journal of molecular sciences. Physical activities like walking can enhance insulin sensitivity, allowing cells to better absorb glucose from the bloodstream (Sheri, 2008).

Therefore, the same amount of exercise might have a more significant effect on improving insulin sensitivity and glucose uptake in obese individuals compared to those with normal weight. The study by Adeniyi *et al.*, (2010) published by the African Journal of Physiotherapy and Rehabilitation Sciences, Indicated a more pronounced enhancement in insulin sensitivity among obese participants compared to normal-weight participants following 6-minute walk tests (6MWTs). This could be the reason why there was a statistically significant decrease in the blood glucose levels of obese compared with normal weight post-6MWT. Also in obese individuals, excessive weight bearing might strain joints and increase the metabolic demand, potentially affecting glucose levels. This is in accordance with the work done by Robert and Michael (2009). According to the data analysis there was no significant change in Glucose level Post-6MWT compared with Pre-6MWT in both normal and obese young adult individuals. It is possible that their baseline levels of insulin sensitivity and glucose metabolism were already optimal, leading to less room for improvement after the exercise test. Additionally, factors such as diet, lifestyle, and genetic predispositions may influence how individuals respond to exercise and its impact on blood glucose levels. Further research could explore these factors in more detail to better understand the lack of significant changes observed in these groups.

## **5.2 CONCLUSION**

In conclusion, with the result obtained from this study it was observed that the 6-minute walk test has more effect on obese than in normal weight young adult individuals. And this could be due to BMI related differences like differences in insulin Sensitivity, increased weight bearing, higher energy expenditure, and potentially greater cardiovascular stress.

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Subject	Age	Sex	DOB	Height (cm)	Weight (kg)	BMI	Category	Blood Glucose	Blood Glucose
A1	22	Female	3/2/2002	166.37	92	33.2	Obese	79	78
A2	27	Female	28/6/1996	172.5	115	38.6	Obese	96	102
A3	19	Female	16/1/2005	162	123.5	47.1	Obese	111	104
A4	25	Female	29/8/1999	162	83	31.6	Obese	115	111
A5	22	Female	19/1/2002	167.25	99	35.4	Obese	119	104
A6	21	Female	5/9/2003	178	99	31.2	Obese	92	90
A7	22	Female	16/9/2001	180	112	34.6	Obese	91	89
A8	17	Female	30/4/2006	170	100	34.6	Obese	99	102
A10	22	Female	21/5/2001	168	94	33.5	Obese	76	87
A13	20	Female	21.02.2004	160.25	93.5	36.4	Obese	95	91
A14	21	Female	17/3/2003	171	110	37.6	Obese	90	87
A15	22	Female	27/8.2002	168.5	90.5	31.9	Obese	96	102
A16	53	Female	6-May	158.5	80.5	32	Obese	87	91
A17	21	Female	20/12/2002	166.5	104.5	37.7	Obese	89	91
A18	17	Female	3/1/2007	174.8	93.5	30.7	Obese	104	95
A19	22	Female	6/6/2001	158.75	105.5	41.9	Obese	112	101
A20	17	Female	20/2/2007	169	87	30.5	Obese	93	92
A21	22	Female	13/12/2002	150	86	38.2	Obese	84	82
A22	18	Female	28/9/2005	174	111.5	36.8	Obese	59	124
A23	18	Female	6/10/2005	174	179	42.6	Obese	103	92
A24	17	Female	17/6/2006	170	115.5	40	Obese	114	93
A25	19	Female	19/8/2004	174.6	123.5	40.5	Obese	101	93
A26	23	Female	4/3/2001	169.1	96.5	33.7	Obese	110	91
A27	25	Female	8/3/1999	160.8	88	34	Obese	92	83
A28	23	Female	13/11/2000	163.1	93	35	Obese	95	87
A29	25	Female	5/2/1999	160	118.5	46.3	Obese	106	94
A30	17	Female	16/10/2006	184.15	114.5	33.8	Obese	111	77
A31	18	Female	3/2/2006	157.2	108	43.7	Obese	107	114
A32	21	Female	3/12/2002	176.5	108	34.7	Obese	83	83
A33	21	Female	17/9/2002	168.1	113	40	Obese	91	85
A34	22	Female	29/10/2002	176	110.5	35.7	Obese	92	92
B1	24	Male	15/02/2000	171.5	57	19.4	Healthy	93	97
B2	20	Male	12/6/2003	174.5	67.5	22.2	Healthy	87	90
B3	25	Male	6/8/1999	181.3	67	20.4	Healthy	103	98
B4	23	Male	12/2/2000	178	60.5	19.1	Healthy	133	109
B5	22	Male	28/2/2002	179.5	64	19.9	Healthy	95	86
B6	24	Male	17/1/2000	175.9	65.5	21.2	Healthy	97	111
B7	23	Male	19/4/2001	173.6	62.25	20.7	Healthy	85	85
B8	19	Male	29/9/2004	176.53	61.5	19.7	Healthy	144	107
B9	21	Male	19/11/2002	183.25	66	19.7	Healthy	88	97
B10	24	Male	5/1/2000	168.75	66.5	23.4	Healthy	92	94
B11	24	Male	7/4/2000	169.4	57	19.9	Healthy	82	93
B12	24	Male	16/2/2000	178.9	72	22.5	Healthy	97	93
B13	20	Male	20/11/2003	165.75	59.5	21.7	Healthy	94	96
B14	19	Male	22/6/2004	182.88	73.5	22	Healthy	92	93
B15	24	Male	22/11/1999	172.72	58.5	19.6	Healthy	109	104
B16	25	Male	2/12/1998	185	73	21.3	Healthy	86	104
B17	22	Male	24/2/2002	172	66.5	22.2	Healthy	81	85
B18	25	Male	9/2/1999	180.5	63.5	19.5	Healthy	95	92
B19	23	Male	19/10/2000	172	71	24	Healthy	108	95
B20	22	Male	22/10/2001	172.7	57	19.1	Healthy	109	98
B21	18	Male	2/4/2006	175.8	60.5	19.6	Healthy	97	104
B22	21	Male	6/8/2002	177.25	66.5	21.2	Healthy	100	113
B23	28	Male	26/8/1995	183.8	70.5	20.9	Healthy	116	109
B24	24	Male	8/12/1999	175.6	57.5	18.6	Healthy	136	133
B25	23	Male	23/3/2001	178.25	74	23.3	Healthy	99	101
B26	21	Male	10/7/2002	189	77	21.6	Healthy	99	105
B27	18	Male	26/12/2005	176.75	74.75	23.9	Healthy	93	101
B28	23	Male	30/4/2000	181.61	74	22.4	Healthy	126	113
B29	26	Male	21/1/1998	191.25	81	22.1	Healthy	101	98
B30	25	Male	16/5/1998	170.18	59.5	20.5	Healthy	106	107
B31	26	Male	5/8/1997	174.4	61.25	20.1	Healthy	102	112
B32	25	Male	12/5/1998	166.37	53	19.1	Healthy	93	86
B33	23	Male	11/1/2001	176	59.5	19.2	Healthy	94	113
B34	22	Male	9/12/2001	177.5	61	19.4	Healthy	86	75

## APPENDIX

