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ASSOCIATION OF GLYCATED HAEMOGLOBIN (HbA1c) LEVELS WITH SERUM CREATITINE AND UREA IN RENAL PATIENTS THAT ATTENDED PARIRENYATWA HOSPITAL, HARARE IN 2023

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR IN MEDICAL LABORATORY SCIENCES HONOURS IN THE COLLEGE OF HEALTH, AGRICULTURE AND NATURAL RESOURCES.

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Abstract

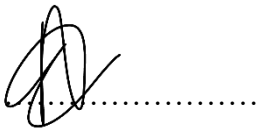
Diabetes mellitus poses a significant global health burden, and chronic kidney disease stands as a major and concerning complication. This study investigated the potential association between glycemic control, as measured by hemoglobin A1c (HbA1c), and the functional state of the kidneys in diabetic patients admitted to the renal ward of Parirenyatwa Hospital, Zimbabwe. Employing a retrospective cross-sectional design, the study analyzed data from 106 diabetic patients admitted between January and December 2023. A stratified random sampling technique ensured participant representativeness by selecting individuals across three distinct age groups (18-30 years, 30-50 years, and 50+ years). Data included the HbA1c levels, which serve as a crucial indicator of long-term blood sugar control. Additionally, serum creatinine and urea levels were retrieved, as these markers provide valuable insights into kidney function. By analyzing these parameters, the study aimed to identify any potential correlations that might exist between glycemic control and renal health. The mean HbA1c results for the strata from youngest to oldest were 7.2%, 7.5% and 8.1% respectively. For serum creatinine the mean was 442 µmol/L, 534 µmol/L and 621 µmol/L respectively whilst the mean urea results are 2.86 mmol/L, 3.39 mmol/L and 4.01 mmol/L respectively. These statistical tests revealed a positive correlation between HbA1c levels and both serum creatinine and urea levels. The results indicated that patients with higher HbA1c, signifying poorer glycemic control, tended to have higher levels of creatinine and urea in their blood, suggesting compromised kidney function. Analysis revealed that the oldest age group (50+ years) displayed significantly higher HbA1c and creatinine levels compared to younger diabetic patients. This suggests that older individuals with diabetes might be at a greater risk for experiencing both poor glycemic control and impaired kidney function. The retrospective nature of the design relies on existing data within medical records, potentially introducing unforeseen biases. Additionally, the sample size of 106 participants might limit the generalizability of the findings to the entire population of diabetic patients in Zimbabwe. Despite these limitations, the study offers valuable preliminary data on the observed positive correlation between HbA1c and renal function markers in Zimbabwean diabetics. The results highlight the importance of effective glycemic control strategies in managing diabetes to potentially reduce the risk of developing CKD. Further research utilizing a larger, prospective cohort design is recommended to establish causal relationships and explore additional contributing factors influencing CKD development in this specific population.

Keywords: diabetic kidney disease, kidney function test, glycemic control

Declaration

I declare that this research proposal is my original work, except where sources have been cited and acknowledged. This work has never been, nor will it be submitted to another university for the award of a degree.

ANESU R CHIKOMBERO

……..…….. 

Student's name Student's signature

PROF. CHRISTIAN C. EZEALA

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Supervisor's name **Supervisor's signature**

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I would like to acknowledge and thank my parents for their constant support both financially and morally in order to finish my degree. I would also want to thank every lecturer and mentor I have had during my university time. Also I would like to thank my supervisor Prof. Christian Ezeala for taking is time to help me with my project. Last but not least, I would want to thank my Heavenly Father. Without His strength and power, I would not be here today.

Dedication

This dissertation is dedicated to my grandmothers Mrs Charlotte Chigwedere and the late Mrs Emily Chikombero. They have both been a consistent image of strong hardworking women to me and without their advice, prayer and consistent encouragement in my life, I would not be the woman I am today.

List of abbreviation and acronyms

CKD – Chronic Kidney Disease

HbA1c - glycated haemoglobin

ESRD – End Stage Renal Disease

BUN – Blood Urea Nitrogen

sCr – Serum Creatinine

Hb – Haemoglobin

DM – Diabetes Mellitus

GFR – Glomerular Filtration Rate

CVD – Cardiovascular Disease

DKD – Diabetic Kidney Dieases

Table of Contents

Abstract i

Declaration ii

Copyright iii

Acknowledgements iv

Dedication v

List of abbreviation and acronyms vi

Chapter 1 1

1.0 Introduction 1
1.1 Background of the Study 3
1.2 Statement of the problem 4
1.3 Research Objectives 5
1.4 Research Questions 5
1.5 Significance of the Study 5
1.6 Delimitation of the study 6
1.7 Summary 6

Chapter 2: Literature Review 7

2.0 Introduction 7
2.1 Theoretical Framework 7
2.2 Conceptual Framework 8
2.3 Study by Chutani and Pande (2017) 9
2.4 Study by Subramanyam et al. (2018) 10
2.5 Study by Jung (2021) 11
2.6 Conclusion 12

Chapter 3: Research Methodology 13

3.0 Introduction 13
3.1 Research Design 13

3.2 Study Population 13
3.3 Inclusion Criteria 13
3.4 Exclusion Criteria 13
3.5 Sample size 14
3.6 Sampling Procedure 15
3.7 Study Setting 15
3.8 Data Analysis 16
3.9 Ethical Considerations 16
3.10 Summary 16
CHAPTER 4: DATA PRESENTATION 17
4.1 Introduction 17
4.2 Description of Study Participants 17
4.3 Data Presentation 18
4.3.1 Tables of Laboratory Findings 18
Table 1: HbA1c Results 18
Table 2: Serum Creatinine Result 19
Table 3: Urea Result 19
4.3.2 Pearson correlation graphs 20
CHAPTER 5: DISCUSSION, RECOMMENDATIONS & CONCLUSIONS 22
5.1 Introduction 22
5.2 HbA1c levels for the patients in the renal ward 22
5.3 Serum creatinine levels for patients in the renal ward 24
5.4 Urea levels for patients in the renal ward 25
5.5 The correlation between HbA1c, serum creatinine and urea 26
5.6 Implications of study findings to public health 27
5.7 Study Limitations 28
5.8 Conclusion 28
5.9 Recommendations 28
5.10 Dissemination of Data 29
References 31
Appendices 34

Appendix 1: APPLICATION LETTER TO PARIRENYATWA GENERAL HOSPITAL 34
Appendix 2: RESEARCH PROJECT BUDGET 35
Appendix 3: RESEARCH TIMETABLE/GANTT CHART 36
Appendix 4: DATA COLLECTION TOOL 37
Appendix 5: STUDY SITE APPROVAL LETTER 38
Appendix 6: AUREC APPROVAL LETTER 39

Chapter 1

1.0 Introduction

When a sickness or ailment affects kidney function, kidney damage declines over a period of months or years, leading to chronic kidney disease. Some of the illnesses and ailments can that result in chronic kidney disease are: diabetes mellitus type 1 and type 2, elevated blood pressure (hypertension), an inflammation of the kidney's filtration units (the glomeruli) known as glomerulonephritis, an inflammation of the kidney's tubules and surrounding structures known as interstitial nephritis, renal illnesses that are hereditary, such as polycystic kidney disease, prolonged blockage of the urinary tract caused by diseases such kidney stones, enlarged prostates, and some malignancies causing the illness known as vesicoureteral reflux, which results in urine reflux into the kidneys and pyelonephritis, another name for recurrent kidney infection.

When the kidneys are unable to perform all of their vital functions due to damage over an extended period of time (at least three months), it is known as chronic kidney disease (CKD) (*Facts About Chronic Kidney Disease*, 2023). It involves a progressive decline in renal function. Urine is the result of your kidneys filtering wastes and extra fluid from your blood. Your body may accumulate hazardous amounts of fluid, electrolytes, and waste products if you have advanced chronic renal disease. If kidney damage advances slowly, signs and symptoms of chronic renal disease appear gradually. Electrolyte imbalances, bodily waste accumulation, and fluid accumulation can all result from renal failure. Kidney disease symptoms and signs are frequently ambiguous. This implies that other ailments may possibly be the cause of them. Your kidneys can compensate for reduced function, so you may not experience symptoms until permanent damage has taken place.

Nearly every aspect of your body might become complicated by chronic kidney disease. This includes: fluid retention which may result in elevated blood pressure, oedoema (swelling of the limbs and legs), or fluid accumulation in the lungs (pulmonary oedema), an abrupt increase in potassium levels in the blood (hyperkalemia), which could be fatal and affect heart function, anaemia, heart conditions, an elevated risk of bone fractures and weak bones, diminished desire

for sexual activity, impotence, or lower fertility, harm to the central nervous system, which may result in seizures, trouble focusing, or personality changes, reduced immunological response, increasing your susceptibility to infection, an inflammation of the sac-like membrane that surrounds your heart is called pericarditis (pericardium) (Ammirati, 2020). It could cause problems during pregnancy that pose a risk to the developing foetus and the mother. End-stage renal disease (ESRD) causes irreversible damage to the kidneys, eventually necessitating dialysis or a kidney transplant to survive (Chronic Kidney Disease - Symptoms and Causes - Mayo Clinic, 2023).

One of the main risk factors for chronic kidney disease and end-stage renal failure is diabetes mellitus. Insulin resistance and reduced insulin breakdown in severe renal failure are linked to chronic renal failure (Diabetes - a Major Risk Factor for Kidney Disease, 2023). In diabetes, there are problems with the insulin in the body. There are 2 main types of diabetes, Type 1 and Type 2. Type 1 diabetes is when the islets of Langerhans beta cells in the pancreas are destroyed by an autoimmune reaction which means that very little or no insulin is produced and secreted into the blood. In type 2 diabetes, the person goes through a phenomenon called insulin resistance. This is when the cells become less sensitive to the action of insulin and don't easily take up glucose from the blood. This means that the beta cells have to make more insulin to get the same effect. This carries on until the pancreas cannot keep up. Both of these conditions end up with the person having glucose levels that are chronically high which leads to diabetes. Since type 1 is caused by an autoimmune reaction, genetics is a very big factor if a person gets it and it used to be called juvenile diabetes because most people develop it as either children, teenage or as young adults. Type 2 is also called lifestyle related diabetes or adult diabetes because there are other lifestyle factors that influence whether a person gets this type of diabetes besides genetics. This includes obesity, too much glucose in the liver or metabolic syndrome.

In most high-income countries, diabetes mellitus is the fourth greatest cause of death, while 80% of current cases are found in low- and middle-income nations, such as Zimbabwe (Amod et al., 2012). According to Chirombe et al. (2018), the WHO reported that Zimbabwe's prevalence of diabetes mellitus increased from 0.04% reported before 1980 to 4.6% in 2016. The International Diabetes Federation (IDF) projected that three-quarters of diabetes-related deaths among individuals under 60 years of age occurred in Africa in 2013. (Mutowo et al., 2014). The burden

of chronic diabetic complications is expected to rise further globally as the diabetes epidemic accelerates in the developing countries. This study intends to see if there is a significant association between chronic hyperglycemia, which is a phenomenon mostly found in diabetic patients and kidney damage in Zimbabwe.

1.1 Background of the Study

Urea and creatinine are nitrogenous end products of metabolism. The main metabolite obtained from the metabolism of tissue and dietary protein is urea. The byproduct of muscle creatine catabolism is creatinine. Both are relatively small molecules that are found throughout the body's fluids. In contrast to the United States, where just the nitrogen component of urea—blood or serum urea nitrogen, or BUN is evaluated, Europe assays the entire urea molecule. Therefore, the BUN is approximately half of the blood urea.

The liver is where over 99% of urea production takes place. Dietary protein is its main source. Over 90% of the peptides and amino acids that are created during the conversion of protein in the gut are absorbed and transported to the liver. Amino acids undergo both transamination and deamination within the hepatocyte. The surplus nitrogen that is produced as a result enters the urea cycle and is combined with urea. The gut flora, primarily in the colon, transforms recycled urea and protein moieties that are not absorbed by the small intestine into ammonia. Through the portal circulation, ammonia diffuses into the liver and enters the urea cycle. Less than 0.5 g/day are typically lost through the skin, lungs, and gastrointestinal tract; but, during physical activity, a significant portion may be expelled through perspiration. The kidneys eliminate the majority of the urea, which is roughly 10 gm every day.

Transamination of arginine to glycine results in glycocyamine, which is the first step in the production of creatinine. The kidneys are the main organs affected by this reaction, however the pancreas and small intestinal mucosa are also affected. Once in the liver, the GAA is methylated to become creatine. 90% of the creatine that enters the bloodstream is absorbed and stored by muscular tissue. The majority of this muscular creatine is converted to creatine phosphate by phosphorylation. Approximately 2% of these reserves are irreversibly and nonenzymatically transformed to creatinine each day.

In contrast to urea, creatinine is largely unaffected by fever, steroids, and gastrointestinal haemorrhage. However, because cooking turns the creatine in meat into creatinine, consuming cooked meat can increase serum creatinine levels (BUN and Creatinine, 1990).

Renal function screening is done with the BUN and sCr assays. They essentially reflect GFR since they are predominantly managed by glomerular filtration, with little to no renal regulation or adaptation along the course of diminishing renal function. Their values remain within the normal range until more than 50% of renal function is lost (Hosten, 1990).

Type 2 diabetes is the most common type of diabetes mellitus. It is diagnosed by detecting glucose in urine and testing for fasting and 2 hours' postprandial glucose levels. Long term glycemic control is assessed by the HbA1c blood test. It is used to track how effectively diabetics regulate their blood sugar. HbA1c is an acronym that stands for glycated haemoglobin. The protein in red blood cells called haemoglobin (Hb) is responsible for carrying oxygen throughout your body. The term HbA1c describes the combination of glucose and haemoglobin. The amount of glucose in your blood directly affects how much HbA1c is produced. Given that red blood cells have an average lifespan of 120 days, HbA1c provides a measure of the amount of sugar that has been in your blood over the previous several months (Healthdirect Australia, 2023).

1.2 Statement of the problem

According to Sivasubramanian et al. (2019), nephropathy affects between 20% to 30% of persons with type 1 or type 2 diabetes and the likelihood of developing nephropathy rises with the length of diabetes. Throughout the world, diabetes is a leading cause of morbidity and death; this is particularly concerning in developing nations. One of the main causes of kidney failure is diabetes, hence screening for diabetes-related kidney disease early on can save money and be done in developing nations. Chronic hyperglycemia is the cause of microvascular problems such as nephropathy, retinopathy, and neuropathy. The International Diabetes Federation (IDF) estimates that 382 million people worldwide had diabetes in 2013, with type 2 accounting for over 90% of cases. This translates to 8.3% of adult population, with rates equal for men and women. Over 80% of diabetic patient fatalities occur in low- and middle-income nations. It is projected that by 2035, there would be 592 million diabetic groups (Aguiree et al., 2013).

The WHO reported that the prevalence of diabetes mellitus in Zimbabwe was 4.6% in 2016, showing an increase from the 0.04% reported before 1980. The International Diabetes Federation (IDF) estimated that three-quarters of diabetes deaths among people under 60 years of age occurred in Africa in 2013 (International Diabetes Federation, 2013). The prevalence of diabetes is estimated to be 10 per 100 individuals in Zimbabwe, and the disease now accounts for more than 100 000 visits or consultations at outpatient facilities annually (Ministry of Health and Child Care - Ministry of Health and Child Care, n.d.). Though we have all this information, there is yet to be a study that assesses Zimbabwean diabetic people's risk for cardiovascular disease by assessing their lipid panels which is what this study seeks to achieve.

1.3 Research Objectives

The main purpose of this study is to highlight if there is a relationship between HbA1c levels and serum creatinine and urea. This would therefore show if there is a relationship between diabetes and kidney disease. This main objective is broken down into these specific objectives:

1. To identify the serum creatinine levels of patients in the renal ward
2. To identify the serum urea levels of patients in the renal ward
3. To identify the HbA1c levels of patients who are in the renal ward
4. To identify if there is a relationship between serum creatinine, urea and HbA1c levels

1.4 Research Questions

1. What are the serum creatinine levels of patients in the renal ward?
2. What are the serum urea levels of patients in the renal ward?
3. What are the HbA1c levels of patients who are in the renal ward?
4. What is the correlation between HbA1c, serum creatinine and urea levels in the renal patients?

1.5 Significance of the Study

This study makes an important contribution to the Zimbabwean scientific field. This is because it will help bring a greater understanding to the correlation between high HbA1c levels and kidney

disease. It will help health care professionals and the Ministry of Health to be able to make changes if need be to the care and monitoring of diabetic patients and help to reduce the progression of their disease, hence helping to reduce the mortality of diabetics in Zimbabwe and improving their quality of life.

1.6 Delimitation of the study

Due to the short timeframe, the study was conducted at Parirenyatwa Hospital, one of the largest hospitals in Zimbabwe. Additionally, due to the lack of financial resources it was difficult to collect data from other hospitals in Harare. The study included adults who are both male and female who are over the age of 18 years who are currently admitted to the renal ward at the hospital.

1.7 Summary

The rising cases of complications of both diabetes and kidney disease has become a problem in our society. One of the main causes of kidney disease according to research has been diabetes and this study aims to assess whether or not there is an association between HbA1c levels and the two most common tests used for the kidney function test: urea and serum creatinine. This would be able to help to guide healthcare professionals in how best to treat patients to help increase their chances of recovery.

Chapter 2: Literature Review

2.0 Introduction

The Ministry of Health and Childcare estimates that 10 out of every 100 persons in Zimbabwe have diabetes, and at this time, diabetes statistics account for more than 100 000 visits or consultations at outpatient departments each year (Ministry of Health and Child Care - Ministry of Health and Child Care, n.d.). This presents significant obstacles to the delivery of care and the avoidance of crippling co-morbidities in an already underfunded healthcare system. Among the most populated African nations, Zimbabwe is thought to have the greatest prevalence of diabetes. According to projections, Zimbabwe might have more than 1.2 million diabetic patients by 2035 (Guariguata et al., 2014). This means that by 2035 more of the population will be suffering of the effects of kidney disease that is caused by diabetes. It is crucial, therefore, to be able to diagnose it earlier so that they can be treated before there have worsened.

In this literature review, we will be looking at journal articles that looked at glycated haemoglobin and its relationship with serum creatinine and urea with the hope that they will be able to educate health care professionals on the importance early diagnosis and treatment as well as certain factors that may increase the risk of someone getting further illness like cardiovascular disease.

2.1 Theoretical Framework

This study used the theoretical framework that kidney disease can improve with better glycemic management, if it has not yet reached chronic stage. One of the most important strategies for preventing renal vascular injury in diabetic individuals is strict glucose control. According to Greco and Hall (2023), it has been proven that dysregulated glucose and kidney disease, as well as disease biomarkers, are directly linked pathophysiologically. In particular, most people agree that advanced glycosylation end products (AGEs), which are created when surplus glucose is covalently linked to serum proteins and fats without the use of enzymes, have a detrimental effect. Patients with diabetes who experience chronic hyperglycemia are more likely to develop AGEs, which increases the risk of end organ damage linked to AGEs.

2.2 Conceptual Framework

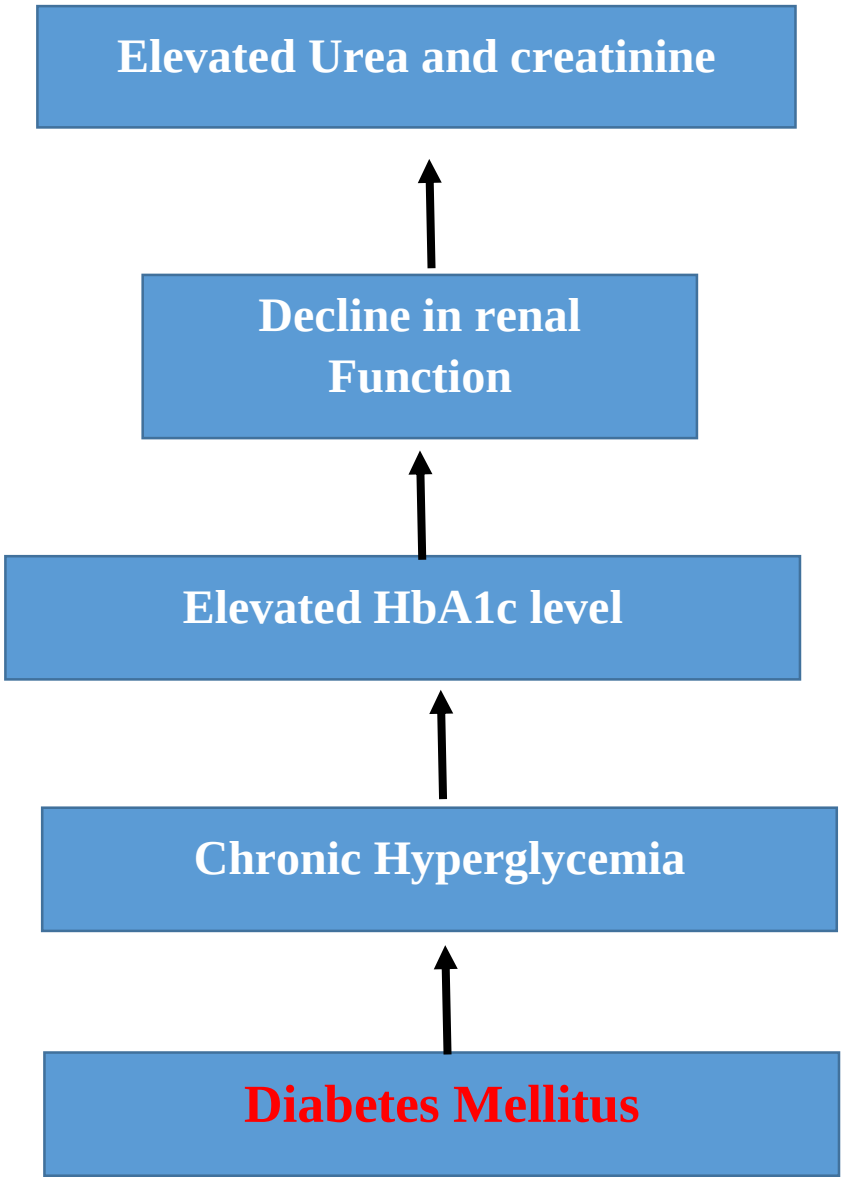

Figure 1: Connection between Diabetes Mellitus and Kidney Function

The diagram shows how different things like high urea and creatinine levels, kidney problems, high HbA1c levels, long-term high blood sugar, and diabetes are all connected. When urea and creatinine levels are high, it often means the kidneys aren't working well. As kidney function worsens, it affects how the body handles sugar, leading to high HbA1c levels and chronic high blood sugar, which are common in diabetes. This diagram helps us see how kidney problems and sugar issues are linked in diabetes, giving us a clearer picture of how diabetes affects the kidneys and overall health.

2.3 Study by Chutani and Pande (2017)

The study conducted by Arun Chutani and Sonali Pande aimed to compare the levels of serum urea and creatinine in Type 1 and Type 2 diabetic subjects with those in non-diabetic subjects, while also exploring the correlation between these levels and the duration of diabetes and glycated hemoglobin (HbA1c) levels. The researchers collected blood samples from diabetic subjects attending a diabetic clinic and non-diabetic subjects in a tertiary hospital. The analysis revealed a significant increase in serum urea and creatinine levels in both Type 1 and Type 2 diabetic subjects compared to non-diabetic subjects (Chutani & Pande, 2017).

They noted that about one-third of dialysis patients in India have chronic renal failure due to nephropathy, which is the primary cause of renal failure globally. Therefore, it could be beneficial for prompt intervention to target glycemic control in particular if early detection of diabetic nephropathy could be achieved with low-tech testing. Patients with diabetes who have low socioeconomic status would especially benefit from simple biomarker testing like blood creatinine and urea combined with HbA1c estimate (Chutani & Pande, 2017).

Chutani and Pande (2017) found that when compared to healthy controls, there was an increase in the fasting, post-meal blood glucose, and HbA1c levels in both Type 1 and Type 2 diabetic patients. The Type 1 diabetic study group had greater levels than the Type 2 diabetic study group. For Type 1 and Type 2 diabetics, the duration of diabetes was 7.32 ± 1.52 and 2.47 ± 1.82 years, respectively. Compared to Type 2 diabetics, Type 1 diabetic individuals had longer diabetes durations and higher HbA1c levels.

In their study, they also found that there was an association between serum creatinine and urea levels and HbA1c levels and the length of diabetes, as measured by Pearson's correlation coefficient. However, this correlation was not observed in the Type 2 diabetics group. In Type 2 diabetics, there was no relationship between the duration of diabetes and serum creatinine or urea levels. This could be because Type 2 diabetes had a shorter illness duration than Type 1 diabetes mellitus. Also hyperglycemia, which also occurs in Type 1 diabetes, is a condition marked by an acute insulin shortage that begins in early childhood and is thought to be the primary cause of nephropathy. On the other hand, in Type 2, hyperglycemia typically begins after the age of forty, at which point the kidneys have already experienced the long-term effects of ageing and other factors that can contribute to chronic renal impairment, such as obesity, dyslipidemia, and

arterial hypertension. While it does not correlate with the length of diabetes in Type 2 diabetes mellitus, they think that this may be the reason of elevated serum creatinine and urea levels in diabetics (Chutani & Pande, 2017).

Chutani and Pande (2017) conclude that in individuals with type 1 diabetes, a linear connection between serum creatinine and urea level and elevated HbA1c levels was found. They strongly advised to estimate blood urea and creatinine levels in addition to HbA1c levels in order to monitor diabetic patients. They say that serum urea and creatinine are straightforward and practical indicators that can be used as predictive assays to evaluate kidney function (nephropathy) in individuals with diabetes.

2.4 Study by Subramanyam et al. (2018)

Subramanyam et al. (2018) conducted a study aimed to determine how glycated haemoglobin related to type II diabetes mellitus by establishing a relationship between glycated haemoglobin and serum creatinine and calculated Glomerular Filtration Rate (GFR). 60 CKD patients were recruited for the study over the course of a year in this retrospective case-control investigation. eGFR calculation was used to diagnose CKD following the acquisition of clinical and pathological data and the patient's history. Patients visiting the OPD had their blood samples taken as well as Day 1 and Day 2 of admission for inpatients and dialysis units. The following parameters were examined: Blood urea, serum creatinine, serum albumin, fasting blood sugar, and electrolytes (Na, K, Cl). In plasma samples, haemoglobin (Hb) and glycated haemoglobin (HbA1c) were measured.

The researchers noted that measuring HbA1c in CKD is important since it allows for the monitoring and control of the disease's course in addition to assessing glycaemic control. Furthermore, the results are predictable, particularly in cases when diabetes mellitus is the underlying cause. Other studies have demonstrated that eGFR decreased even in cases when fasting blood glucose levels were normal and HbA1c was changed (>5.7% but <6.5%), suggesting the necessity of using HbA1c to avoid CKD early on (Subramanyam et al., 2018).

The investigators found that the results demonstrated a correlation between poor glycaemic control and an increasing prevalence of renal injury by showing that HbA1c values increased with decreased eGFR. The data, which also showed that HbA1c levels rise in response to rising

serum creatinine levels, corroborate this. Additionally, the research demonstrated that, among CKD cases, each subgroup's median HbA1c value rises in proportion to the disease's severity (or staging). This emphasises how important it is to accurately test and manage HbA1c at regular intervals in patients with chronic kidney disease (CKD) with diabetic aetiology for their clinical evaluation and staging (Subramanyam et al., 2018).

2.5 Study by Jung (2021)

Jung (2021) conducted a study to find out what the optimal glycemic target is to slow down the progression of diabetic kidney disease in Korea. Retrospective cohorts from the National Health Information Database, a publicly accessible database for the whole Korean population kept up to date by the National Health Insurance Service (NHIS), were used for this investigation. When serum creatinine was initially detected in the nationwide health screening survey in 2009 or 2010, participants aged 40 to 74 years were recognised as patients with chronic kidney disease (CKD). In general, participants had health examinations every two years. Fasting blood glucose level was determined during the examination using samples taken from subjects who had fasted for eight to twelve hours.

The researcher found that the fasting blood glucose level with the lowest risk was higher in patients with albuminuria or a reduced eGFR than in patients without CKD. The curve of on-treatment FBG level HRs for creatinine doubling and renal failure was J shaped. Additionally, compared to acute albuminuria, the FBG level with the lowest HR for progressive renal impairment was significantly higher. These results provide epidemiologic support for the theory of a final common pathway to end-stage kidney disease (ESKD) and suggest that the ideal on-treatment glucose level to slow the progression of DKD is higher than the level to prevent DKD from developing. The study found that patients with albuminuria had a higher FBG level with the nadir HR for all-cause mortality, but not patients with decreased eGFR. Cardiovascular and mortality HRs were lowest among most patients at an FBG level of 110 mg/dL to less than 140 mg/dL (Jung, 2021).

The study highlights the challenge of determining the optimal blood glucose targets for patients with DKD. While intensive glucose control has been shown to reduce the incidence of DKD, its effectiveness in slowing progressive kidney dysfunction is less clear. This underscores the need

for individualized treatment approaches tailored to patients' specific risk profiles and disease stages. According to Jung (2021), despite the importance of glycemic control in DKD management, there remains uncertainty regarding its impact on long-term outcomes. While lowering blood glucose levels is a key therapeutic goal, aggressive glucose lowering may not always translate to improved DKD outcomes, particularly in patients with advanced kidney disease.

The study underscores the importance of individualizing treatment approaches based on patients' baseline kidney function and albuminuria status. Jung (2021) says clinicians must carefully weigh the potential benefits and risks of intensive glucose control in patients with DKD, taking into account factors such as age, comorbidities, and treatment goals. The insights from the study have important implications for clinical practice. The researcher suggests that clinicians must adopt a nuanced approach to glycemic control in patients with DKD, balancing the benefits of lowering blood glucose levels with the potential risks of hypoglycemia and other adverse effects. Close monitoring of kidney function and regular assessment of blood glucose levels are essential components of DKD management.

2.6 Conclusion

In conclusion, the above studies emphasize the importance of regularly monitoring the glycemic control of diabetic patients before they can get kidney damage. This is done by regularly conducting kidney function tests on the patients. Larger sample numbers and longer follow-up times are required for longitudinal research in order to fully comprehend the intricate link between blood glucose levels and the advancement of DKD. These investigations ought to clarify the fundamental processes that connect glycemic control to DKD consequences and pinpoint new therapeutic targets for intervention.

Chapter 3: Research Methodology

3.0 Introduction

The design of the study, location, participant selection, data collecting and analysis techniques, ethical issues, and study restrictions are all described in this portion of the quantitative research study. This chapter's discussion of research design, target population, research tools, and study area is crucial. All of them will be crucial to the study's findings and their production.

3.1 Research Design

This study used a retrospective cross sectional quantitative study design. This is because this study observed the trends between the patients' HbA1c, urea and serum creatinine levels. Since the study was carried out during a short period of time, it was the most appropriate to provide the most reliable result that period of time. It is also very effective in studying a large number of subjects. The study includes results from March 2023 to March 2024.

3.2 Study Population

The population under study comprises all patients with kidney disease. This study targeted patients who were admitted to the renal ward of the hospital between January and December 2023 and who were 18 years and older. Both men and women were needed of different age ranges to be able to give a good representation of different ages of people.

3.3 Inclusion Criteria

Patients who were 18 years or above were included in the study. They had to be diagnosed with kidney disease as they will have been in the renal ward and have had their samples tested for HbA1c and kidney function tests. Both men and women were equally considered for the study.

3.4 Exclusion Criteria

Patients under the age of 8 were excluded from the study.

3.5 Sample size

In this study, the first step to calculate the sample size was done as the following:

$$n = \frac{z^2 p(1-p)}{w^2}$$

Where:

n = the desired sample size when the population is greater than 10 000

z = the standard normal deviate at 95% confidence level

p = the estimated proportion in the target population who kidney disease. In this study 30% will be used according to Stanifer et al. (2014)

w = the desired level of precision

Therefore,

$$n = \frac{1.96^2 0.1(1-0.3)}{0.05^2}$$

$$= 107.56$$

To find the sample size for a finite population, the following equation was used:

$$nf = \frac{n}{1 + \frac{n}{N}}$$

Where:

nf = the desired sample size when the population is less than 10 000

n = the sample size when the population is more than 10 000

N = the estimated population of diabetic patients attending Parirenyatwa General Hospital which was calculated as 100 000 patients in a year divided by 12 months

Therefore,

$$nf = \frac{107.56}{1 + \frac{107.56}{8333.3}}$$

= 106

3.6 Sampling Procedure

In this study, stratified random sampling was used since, being a public health facility, its expenses are subsidized by the government, making it inexpensive and accessible to the vast majority of the local community. In order to have equal representation of male and female study subjects, they were separated into 53 males and 53 females. Then from there, 3 strata were made with the subjects' various age ranges: 18-29 years, 30-49 years, and 50+ years. In each stratum for males and females the participants people were then chosen by the lottery method to be included in the study.

3.7 Study Setting

The study was carried out at Parirenyatwa General Hospital, which is located in Harare, the country's capital. It rests on 400000 square meters and is located at an elevation of 1531 meters (5026 feet) above sea level. The hospital, which is two kilometers from the Harare Central Business District, has 5000 beds and can provide weekly care for 645,713 patients. It is operational 24 hours a day. Being the largest hospital in Zimbabwe and the hub of the healthcare community, Parirenyatwa General Hospital draws patients from all over the country and receives referrals from other medical facilities, giving it a larger sample size than hospitals that only accept patients from Harare.

Figure 2: Location of Parirenyatwa Hospital

3.8 Data Analysis

The statistical package for the social sciences (SPSS) software version 21 and Microsoft Excel was used to display the data in tables, graphs, and as percentages for the most important numerical information. The correlations between the research variables were examined using Pearson's correlation.

3.9 Ethical Considerations

Only after receiving approval from the Africa University Research Ethics Committee was the study be carried out. The research was carried out in accordance with the AUREC-approved protocols. The Chief Scientist and the Clinical Director of the Parirenyatwa Group of Hospital laboratory were contacted to request permission to conduct the research and review patients' records. The research only took place after the approval of the hospital's ethical board. The only use for which the clinical data was gathered is for research. Research data was stored securely on the computer's hard disk. To protect patient privacy and confidentiality, laboratory numbers rather than real patients' names were used for identification.

3.10 Summary

The research design, study environment, nature of the study population, sample size, and sampling methodologies that were employed in the search for solutions and empirical evidence were all outlined in this chapter, which served as the foundation for the research report. The research design that was used is retrospective cross sectional and the sample was obtained using the stratified sampling technique from renal patients. This chapter also looked at how data was represented on paper for analysis, and it went into great detail about the ethical issues involved in such a health-related undertaking.

CHAPTER 4: DATA PRESENTATION

4.1 Introduction

This chapter demonstrates the research findings of study by exploring the sociodemographic information of the study such as their age and gender just to mention a few. Tables, charts and graphs are used to illustrate the correlation between serum creatinine, glycated haemoglobin and creatinine that was found.

4.2 Description of Study Participants

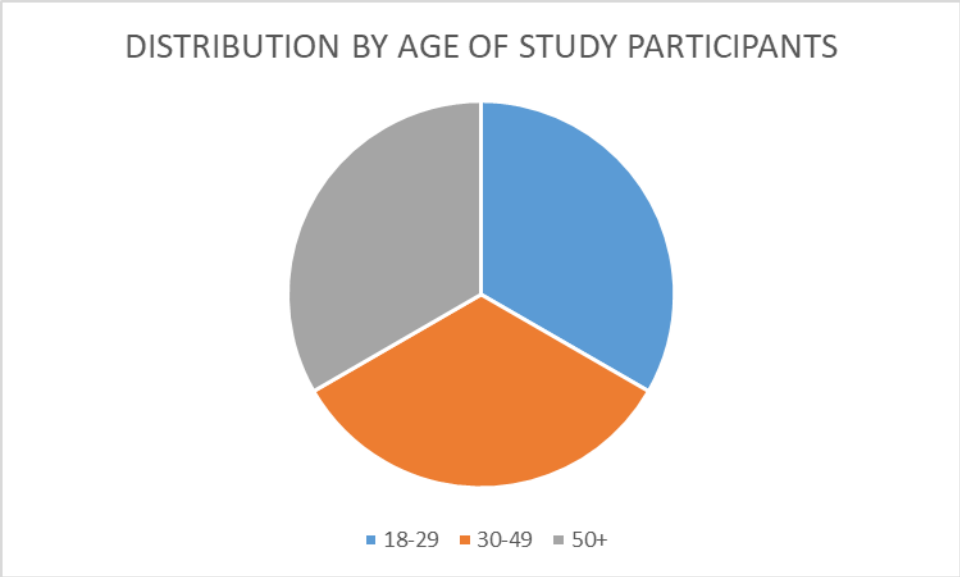

Figure 3: Distribution of study participants according to age

The patients were separated into three strata with 34 patients each. These patients were then equally divided into an equal number of males and females. That means that 33.3% of the study participants were between 18-29 years old, 33.3% of the participants were between 30-49 years old and 33.3% of the participants were 50 years and above

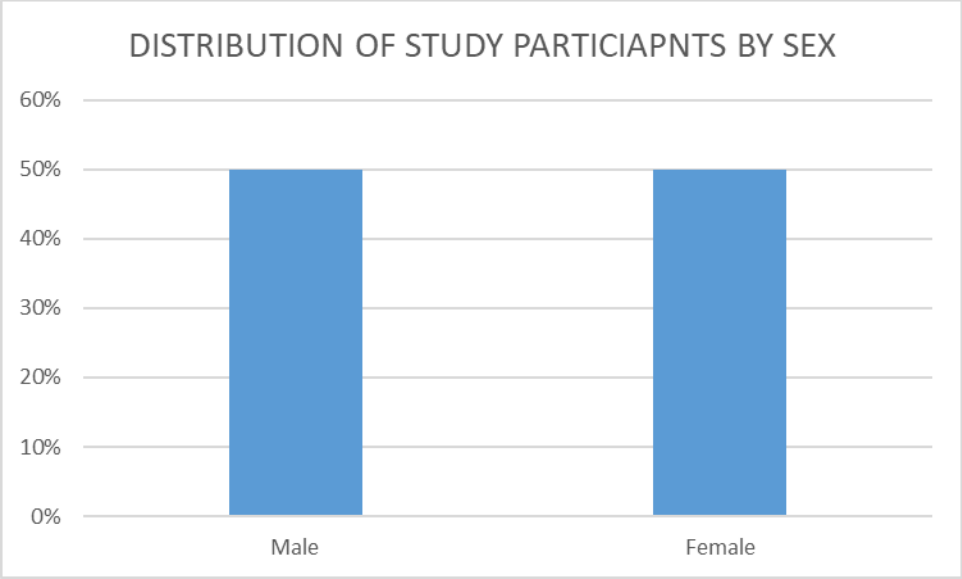

Figure 4: Distribution of study participants by sex

As stated above, there was an equal number of males and females included in the study. Of the 106 participants, 50% were female and 50% were male.

4.3 Data Presentation

4.3.1 Tables of Laboratory Findings

Table 1: HbA1c Results

Age Group (years)	Mean ± SD(%)	Median HbA1c Result (%)	Range (%)
18-29	7.2 ± 0.53	6.6	5.8-7.9
30-49	7.5 ± 0.57	6.7	5.5-7.8
50+	8.1 ± 0.75	7.5	6.2-9.2

Table 2: Serum Creatinine Result

Age Group (years)	Mean ± SD (µmol/L)	Median (µmol/L)	Range (µmol/L)
18-29	442 ± 124	431	139-631
30-49	534 ± 94	537	210-598
50+	621 ± 164	611	207-855

Table 3: Urea Result

Age Group (years)	Mean ± SD (mmol/L)	Median (mmol/L)	Range (mmol/L)
18-29	2.86 ± 0.40	2.71	1.90-3.50
30-49	3.39 ± 0.41	2.99	2.10-3.74
50+	4.01 ± 0.77	3.63	2.67-5.76

The above tables are the results that were found in the laboratory. The first table is the HbA1c results. In the first stratum, the mean, median and range for the results are 7.2 ± 0.53, 6.6 and 5.8-7.9 correspondingly. The second stratum had the results of 7.5 ± 0.57, 6.7 and5.5-7.8 respectively while the third stratum had 8.1 ± 0.75, 7.5 and6.2-9.2 respectively. The standard deviation was relatively small which shows that the data values were not spaced too far off from the mean.

The second table showed the results that were found with the serum creatinine of the participants. The mean values for the three strata from youngest to oldest are 442 ± 124, 534 ± 94, and 621 ± 164 respectively. The median results are 431, 537 and 611 respectively whilst the respective ranges are 139-631, 210-598 and 207-855 respectively.

The third table had the mean results of 2.86 ± 0.40, 3.39 ± 0.41 and 4.01 ± 0.77 from the youngest stratum to the oldest. The median urea results were 2.71, 2.99 and 3.63 respectively whereas the ranges were 1.90-3.50, 2.10-3.74 and 2.67-5.76 respectively. On all of the above tables, there is a rather symmetrical distribution which is indicated by the median values which were marginally lower than the mean.

4.3.2 Pearson correlation graphs

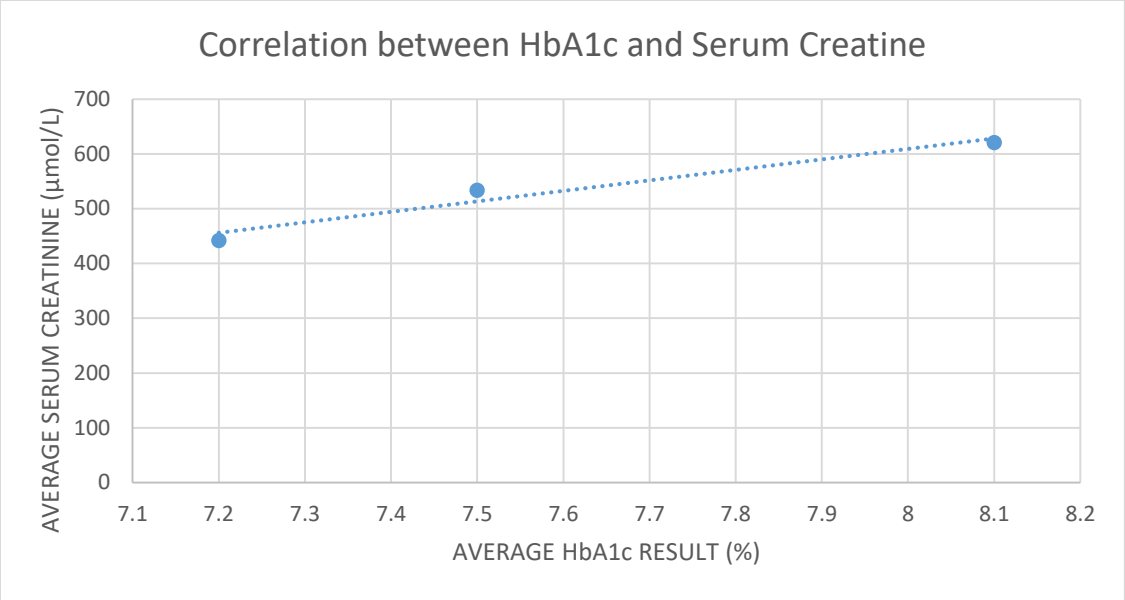

Figure 5: The correlation between the mean HbA1c results and the mean serum creatinine results of the three strata in the patients. The Pearson's correlation coefficient is 0.9788. This shows that there is a positive correlation, meaning that as the HbA1c raises, the average serum creatinine also rises in a linear fashion.

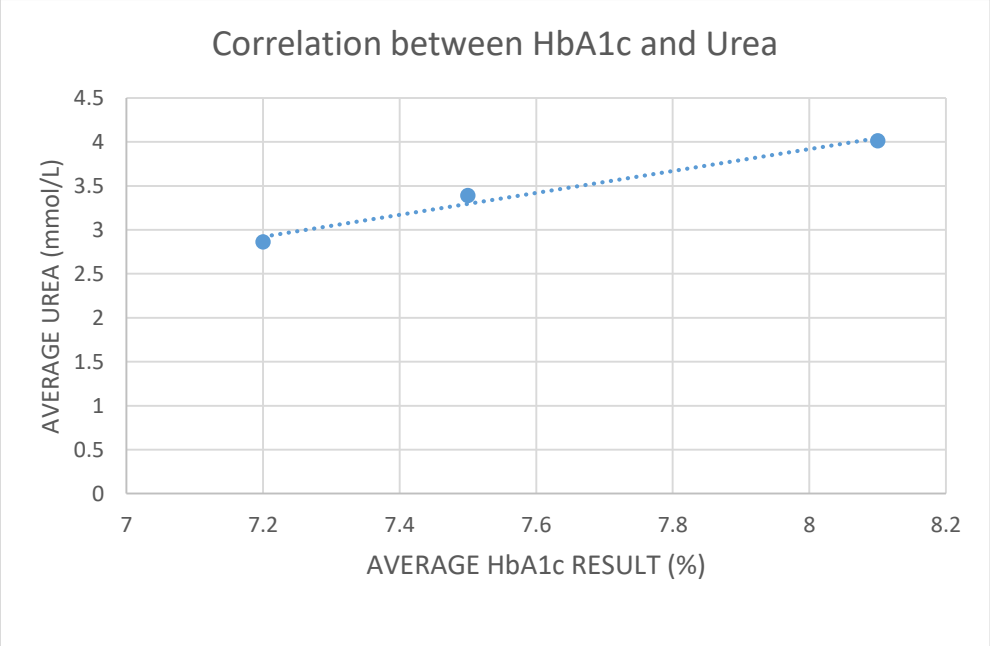

Figure 6: The correlation between the mean HbA1c results and the mean urea result for the three strata of the patients. The Pearson's correlation coefficient is 0.9896. This shows that there is a

positive correlation, meaning that as the HbA1c raises, the average urea also rises in a linear fashion.

CHAPTER 5: DISCUSSION, RECOMMENDATIONS & CONCLUSIONS

5.1 Introduction

Using the objectives, research questions, and the examined relevant literature, this chapter delivers discussions based on significant research findings. This chapter also emphasises a critical analysis and discussion of the findings mentioned in the preceding chapter. The results would be contrasted and compared with earlier research to highlight significant and pertinent study findings. Finally, conclusions are reached based on the research findings, limitations, and suggestions; they are established through debates and conclusions.

This study's primary goal was to determine whether blood creatinine and urea levels and HbA1c levels are related. Thus, this would demonstrate whether diabetes and renal illness are related. The specific research questions that were addressed include what the serum creatinine, urea and HbA1c levels were for the patients that were admitted in the renal ward and to assess if there was a correlation between those three findings. The results indicated that there was a significant increase in both the HbA1c and serum creatinine levels in all the three strata of the patients that were assessed. However, the patients all had normal urea levels when they were assessed.

5.2 HbA1c levels for the patients in the renal ward

A person can be diagnosed with diabetes if their HbA1c is 6.5% or higher, but prediabetes is defined as anyone with a value between 5.7% and 6.4% (*Hemoglobin A1C*, 2024). The average HbA1c results for all three strata from the above results are all above 6.5%. This suggests that the patients included in this study were all diabetic. This is in line with the study that was done by Subramanyam et al. (2018), where they found that there was a relationship between poor glycemic control, and an increasing prevalence of renal injury. This may be due to the fact having high blood sugar may damage the nephrons on the kidney causing overall damage to the kidney. High blood pressure, which is one of the hallmarks of type 2 diabetes also causes damage to the nephrons.

Another interesting finding from this research is that the range of the HbA1c levels for all the age strata is from 5.8% to 9.2%. This shows that all of the study participants were either in the pre-diabetic or diabetic range. This is an indication that the majority of the patients in the

hospital that are undergoing dialysis was caused by diabetes or it was one of the factors that influenced them to get to that stage. This makes diabetes a major culprit that causes kidney damage to people. This realization also puts into perspective the burden that diabetes has given the healthcare system in Zimbabwe. If the healthcare workers and school system manages to educate the population of diabetes and its effects, and the number of diabetics decreases in the country, it would also decrease the burden the healthcare system currently has to provide dialysis for. It can also be an indication of how poorly the hospital staff are doing to manage their patients' blood glucose level. More information about how long they have been admitted to the hospital will be needed to draw a more definite conclusion.

The study by Jung (2021) aimed to find out the optimal glycemic target to slow down the progression of DKD in Korea. The researcher found that although reducing blood glucose levels is an important therapeutic objective, severe glucose lowering may not necessarily result in better outcomes for individuals with diabetic kidney disease, especially when the illness is advanced. This may show that even though all of the patients that were included in the study all required better glycemic control, this does not necessarily mean that it will translate to them having a better prognosis.

It was also noted that the oldest stratum had a significant higher glycemic result that the younger ones. One of the many factors that can make older people have worse glycemic control than younger people is decreased pancreatic function. The pancreas, which produces insulin, may become less efficient with age, resulting in decreased insulin production, leading to higher blood sugar levels. Changes in body composition is also a factor because older individuals may experience changes in body composition, including increased fat mass and decreased muscle mass. Since muscle tissue plays a significant role in glucose uptake, so a decline in muscle mass can contribute to poorer glucose control. Another factor can be medication use since older adults often have multiple chronic conditions and may take medications that can affect blood sugar levels, such as corticosteroids or certain blood pressure medications. These medications can interfere with glucose metabolism and contribute to higher HbA1c levels.

5.3 Serum creatinine levels for patients in the renal ward

The results show that there is a great increase in the creatinine levels in all the three strata as the range for creatinine is 61.9 to 114.9 µmol/l for men and 53 to 97.2 µmol/l for women (Creatinine - Serum, 2023). This is expected since the study population are all patients that are undergoing treatment for kidney disease and creatinine is an important marker of renal function. Elevations in blood creatinine are frequently linked to clinical signs of chronic kidney disease (CKD), including uremia and electrolyte abnormalities. By monitoring serum creatinine levels, medical professionals can spot CKD issues and take quick action to stop the kidneys from getting worse.

In the study conducted by Chutani and Pande (2017), they found that one third of the Indian dialysis patients have chronic renal failure due to nephropathy, which is defined as the deterioration of kidney function. This means that if people are able to detect early that an individual has poor glycemic control, they will be able to solve it and significantly reduce the number of patients that progress to needing dialysis. In this study, it was found that all of there was a positive relationship between serum creatinine and HbA1c. meaning that in most cases, we can predict the HbA1c result when we look at the serum creatinine. As previously stated, having a high serum creatinine result was not surprising since the study population were patients that were undergoing dialysis. This means that they already had a deteriorated kidney function therefore, we expect that the serum creatinine result will be high.

Also like the HbA1c results, there was an interesting trend of the older the strata, the higher the mean serum creatinine levels were, being significantly the highest in the third strata. This means that the older people who are undergoing dialysis have significantly worse renal function than the younger people. Even in the absence of chronic kidney disease (CKD), kidney function naturally declines with age. This age-related decrease in kidney function may make the impairment associated with chronic kidney disease worse. For this reason, compared to younger people with the same degree of renal disease, older people with CKD may see a faster reduction in kidney function.

There are also other reasons why this is the case. Many older persons have several complications, and in order to manage these problems, they may be taking medication. Certain drugs may have an impact on renal function and raise creatinine levels. For instance, a number of pharmaceuticals can damage or impair kidney function, which raises creatinine levels. Diabetes

and hypertension are two common medical disorders in older persons that can worsen chronic kidney disease (CKD) and cause kidney damage. A higher creatinine level might result from these comorbidities in addition to the symptoms of chronic kidney disease.

5.4 Urea levels for patients in the renal ward

The normal range for urea is 1.8 to 7.1 mmol/L. This means that all the strata are well in the normal range. This result was unexpected because since both urea and creatinine are both used to test for kidney function, having an extremely high creatinine level and normal levels of urea was unusual. However, after further reading, there are many reasons that this may be the case. The metabolism of proteins in the liver results in the production of urea. Increased production of urea may result from a higher protein intake. Individuals suffering from chronic kidney disease may adhere to dietary guidelines that restrict their protein consumption, which can lower the synthesis of urea and maintain normal urea levels. Urea can be made from the breakdown of muscles. Patients with chronic kidney disease, especially those in more advanced stages of the condition, may see a loss of muscle mass as a result of things like malnourishment and reduced physical activity. Even with compromised kidney function, reduced muscle mass contributes to normal urea levels by reducing protein turnover and urea generation. Urea is removed from the blood by the kidneys and left behind as urine. However, glomerular filtration rate (GFR) decreases and renal tubular function is compromised when kidney function diminishes in chronic kidney disease. In spite of diminished kidney function, this may result in lower urea excretion and higher urea reabsorption back into the bloodstream, maintaining normal urea levels.

Despite that, there is a trend where the urea result increases as we go up the strata. This is because as we mentioned above, kidney function tends to get worse as the individual gets older naturally. However, this puts into question on whether or not urea is a good indicator of kidney function if both the creatinine and the HbA1c level of a patient that is undergoing dialysis can be very high, but they would have normal urea levels. Chutani and Pande (2017) say that serum urea and creatinine are straightforward indicators that can be used as predictive assays to evaluate kidney function. It should be noted then that these tests should be used in conjunction with each other in order to get a clearer picture of what is going on. This is because if the clinician only relies on using the urea result, they may get a false reassurance that the patient is unaffected by CKD when they actually would be.

5.5 The correlation between HbA1c, serum creatinine and urea

The findings in this study suggest that there is a positive correlation between HbA1c, serum creatinine and urea as there was a positive correlation coefficient for both cases using Pearson's correlation. This is because the results show that as HbA1c increases, serum creatinine and urea also increase. There are many possible reasons why this is the case. Unchecked hyperglycemia can cause serious harm to the kidneys' glomerular filtration units over time (National Kidney Foundation, 2023). The glomeruli are essential for the removal of waste materials and extra fluid from the bloodstream. They accomplish this by keeping waste materials in reserve for later excretion via urine and only permitting necessary elements, like as proteins and blood cells, to pass through. On the other hand, persistent exposure to high blood sugar levels damages these fragile glomeruli in the setting of poorly managed diabetes. A series of harmful consequences, such as the thickening of the glomerular basement membrane, the constriction of the blood arteries that supply the glomeruli, and the progressive scarring of the glomerular units themselves, may arise from this exposure over time. These anatomical and functional changes lead to a reduction in the effectiveness of glomerular filtration, which causes waste materials and extra fluid to build up in the blood rather than be eliminated through urine.

Creatinine and urea are normal waste products from the body's metabolism. When these compounds are filtered out of the bloodstream by healthy kidneys, the serum concentrations of these substances stay within a specific physiological range. However, creatinine and urea levels start to rise in the blood as kidney function declines as a result of damage caused by diabetes (National Institute of Diabetes and Digestive and Kidney Diseases, 2023). Elevated levels of urea and creatinine in the serum are indicative of this accumulation and are important indicators of impaired kidney function.

This opposes the results that were found by Lee et al. (2018) where they found that the patients with diabetes who had higher HbA1c fluctuation and were in stages 3–4 of CKD were less likely to go on to dialysis whereas patients with a lower HbA1c (<7%) or those with stage 5 CKD did not show this connection. Subgroup analysis showed that patients with higher HbA1c variability had better renal outcomes for patients with a decreasing HbA1c trend. According to the authors, patients with high baseline HbA1c may require rigorous diabetes management, which could result in higher variations in HbA1c but ultimately contribute to improved kidney function.

A study that was done by Hernández et al. (2013) found that even in people without diabetes, higher HbA1c levels were substantially linked to an elevated risk of both CVD (cardiovascular disease) and CKD. Even after taking into consideration conventional risk variables, there was still a substantial correlation between HbA1c and these illnesses. They concluded that regardless of the presence of diabetes, a lower HbA1c cut-off point (around 5.5%) may be helpful in identifying people who are at high risk for CVD or CKD. The study raises the possibility that endothelial dysfunction, oxidative stress, inflammation, and persistent hyperglycemia are the processes by which CKD and CVD occur. In this study, all of the study participants had HbA1c levels that were above 5.5%. This means that, according to the study conducted by Hernández et al. (2013), all of the patients will have a higher risk of CVD. More research would need to be done if there is a correlation between a person having CVD and CKD.

In the study by Chutani and Pande (2017), they found that there was a linear correlation between serum creatinine and urea levels with elevated HbA1c in patients that had type 1 diabetes but not in patients that had type 2 diabetes. In this study, there was no separation of whether the patient had type 1 or type 2 diabetes. However, it did show that there was a positive and linear correlation. This then may show that the majority of the patients that were admitted to the hospital were type two diabetics since they go with the above trend. However, more in-depth research needs to be done on that topic.

Subramanyam et al. (2018) also noted the importance of measuring HbA1c when studying CKD because it allows the monitoring and control of the course of the disease, especially if the cause of the CKD is diabetes. This agrees with this paper's data where the researcher found that there is a positive correlation between all the three variables. This means that it would then be important to find the underlying cause of the CKD and act accordingly.

5.6 Implications of study findings to public health

Based to the findings of this study, HbA1c may be a useful biomarker for determining who is at risk for chronic kidney disease and that renal health may benefit from lower HbA1c levels. The findings of the paper also highlight the importance of correctly managing the blood glucose levels of a diabetic patient. This is because as shown by the data, there is a positive correlation between glycemic control and kidney function. That means that we can predict how bad a

person’s kidney function is according to their HbA1c is, especially if the underlying reason for dialysis is diabetes mellitus. This is because doing an HbA1c test is cheaper to the patient than going for a full kidney function test. Also, making sure the population is properly educated about diabetes and glycemic control will reduce the burden the hospitals currently have of the patients that are undergoing dialysis reducing costs for buying new equipment to service more patients. This study also shows the importance of clinicians properly taking care of their patients’ blood sugar levels. This is because we found here that the glycated blood sugar levels are proportional to the kidney function. This can be either by increasing funds to hospitals or ensuring that the clinicians are doing their due diligence in helping their patients. Further investigation is necessary to validate these results and examine the underlying mechanisms.

5.7 Study Limitations

Since the study was conducted in a hospital, it cannot be applied to the broader population. Because it was a retrospective study, it was difficult to get the comprehensive data needed to fully characterise a patient. The study's small sample size may also have hampered the results by making it difficult to draw precise conclusions about how patients' renal function and glycaemic management compare. Also, because of the lack of technological advancements in the hospital, the data was collected from hard copy laboratory reports. This increased the chance of errors during data collection and made the process time consuming.

5.8 Conclusion

There is a positive correlation between HbA1c, urea and serum creatinine. Increased chances of getting kidney damage from high glucose concentration in the blood is a possible cause of the increasing renal failure. It is therefore important to monitor the glycaemic control of diabetic patients to reduce the chance of them getting chronic kidney disease.

5.9 Recommendations

Regular monitoring of blood sugar levels, renal function (as measured by creatinine and urea levels), and other vital signs is necessary to evaluate the efficacy of treatment and make any modifications. Patients receiving dialysis must comprehend the illness and how to treat it. Patients can take an active role in their own care by using educational materials and support

groups. More financial resources also have to be allocated to the hospitals to be able to efficiently care for the patients with better machines, more advanced medication and to motivate the clinicians to give proper care to their patients. More research also would need to be done on the correlation of HbA1c in kidney function for type 1 or type 2 diabetes. Also more research would also need to be done on their effects with CVD.

5.10 Dissemination of Data

A copy of the research findings was submitted to City of Harare health director. Another copy was submitted to the Parirenyatwa Group of Hospitals Clinical Director, and finally another copy was submitted to Africa University, College of Health Science Agriculture and Natural Resources under the Department of Biomedical and Laboratory Science.

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Appendices

Appendix 1: APPLICATION LETTER TO PARIRENYATWA GENERAL HOSPITAL

P.O Box 1320
Fairview Road Mutare
Zimbabwe
27 February 2024

The Laboratory Manager
Parirenyatwa General Hospital
P.O Box CY 198 Causeway
Harare
Zimbabwe

REF: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT PARIRENYATWA GENERAL HOSPITAL IN HARARE.

I, Anesu Chikombero do hereby seek for permission to conduct research on "Association of glycated haemoglobin levels with serum creatinine and urea in kidney disease patients at Parirenyatwa Hospital in Harare" as a requirement for my undergraduate degree at Africa University. This research study is to be supervised by Professor C Ezeala.

I have provided you with the copy of my research proposal together with the letter from my supervisor. Upon completion of the study, l will provide the department of health with a bound copy of the full report.

Looking forward to your consideration.

Yours Sincerely

Anesu Chikombero

Appendix 2: RESEARCH PROJECT BUDGET

PROJECT EXPENSES	**QUANTITY**	**EXPENDITURE ($)**	**TOTAL ($)**
Transport	-	100	100
Printing	-	200	200
Total			$300

Appendix 3: RESEARCH TIMETABLE/GANTT CHART

Title: Assessing the Prevalence of Dyslipidaemia in Type 2 Diabetes Patients at Parirenyatwa Hospital

Begins: March 2024

	February	**March**	**April**	**May**
Research Initiation/ letters of permission				
Data collection phase				
Data presentation and analysis				
Final report				

Appendix 4: DATA COLLECTION TOOL

KEY

S1 = 18-30 YEARS OLD

S2 = 30-50 YEARS OLD

S3 = 50+ YEARS OLD

LABORATROY NUMBER	SEX (M/F)	AGE RANGE (S1/S2/S3)	HbA1c RESULT (%)	UREA RESULT (mmol/L)	SERUM CREATINE RESULT (mmol/L)

Appendix 5: STUDY SITE APPROVAL LETTER

All communications should be addressed to
"CLINICAL DIRECTORS OFFICE"
Telephone: 701502-7/4
Fax: 702227
Website:www.parihosp.org

PARIRENYATWA GROUP OF HOSPITALS
P.O Box CY 198
Causeway
Zimbabwe

22 January 2024

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH STUDY AT PARIRENYATWA GROUP OF HOSPITALS: ANESU RUTENDO CHIKOMBERO

The above matter refers

The Parirenyatwa Group of Hospitals hereby grants you permission to conduct research on: -

ASSOCIATION OF GLYCATED HAEMOGLOBIN (HBA1C) LEVELS WITH SERUM CREATINE AND UREA IN RENAL PATIENTS THAT ATTENDED PARIRENYATWA HOSPITAL, HARARE IN 2023

The permission is granted subject to the following conditions: -

1. The researcher will provide all sundries necessary for sample collections.
2. The researcher sponsors all payments for the tests involved.
3. The hospital incurs no cost in the course of the research.
4. All relevant departments are notified in advance and the Head of section/ward signs acknowledgement of such notification.
5. The conduct of the research does not interfere or interrupt the daily service provision by the hospital.
6. Formal written feedback on research outcomes must be given to the Director of Clinical Services.
7. Permission for publication of research must be obtained from the Director of Clinical Services.

PARIRENYATWA GROUP OF HOSPITALS
CLINICAL DIRECTOR
22 JAN 2024
P O BOX 198 CAUSEWAY
HARARE ZIMBABWE

DR M. MHLANGA
ACTING CLINICAL DIRECTOR

Appendix 6: AUREC APPROVAL LETTER

Investing in Africa's future

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 Website: www.africau.edu

Ref: AU3200/24

20 March, 2024

ANESU RUTENDO CHIKOMBERO
C/O Africa University
Box 1320
MUTARE

RE: **ASSOCIATION OF GLYCATED HAEMOGLOBIN (HbA1c) LEVELS WITH SERUM CREATINE AND UREA IN RENAL PATIENTS THAT ATTENDED PARIRENYATWA HOSPITAL, HARARE IN 2023**

Thank you for the above-titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved
your application to conduct the above research.

The approval is based on the following.

a) Research proposal

- **APPROVAL NUMBER** AUREC3200/24
  This number should be used on all correspondences, consent forms, and appropriate documents.
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** March 20, 2024
- **EXPIRATION DATE** March 20, 2025
- **TYPE OF MEETING**: Expedited
  After the expiration date, this research may only continue upon renewal. A progress report on a standard AUREC form should be submitted a month before the expiration date for renewal purposes.
- **SERIOUS ADVERSE EVENTS** All serious problems concerning subject safety must be reported to AUREC within 3 working days on the standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC) APPROVED P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU
ASSISTANT RESEARCH OFFICER: FOR CHAIRPERSON
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE