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CAPSTONE FINAL REPORT

Assessment of Nutrition Status of Dialysis Patients in Rwanda

By

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DECLARATION

I, Marcella Canelo, hereby declare that the practicum capstone thesis has been written by me without any external unauthorized help, that it has been neither presented to any institution for evaluation nor previously published in its entirety or in parts. Any parts, words, or ideas in the thesis, however limited, that are quoted from or based on other sources, have been acknowledged as such without exception.

Signature:  _____

Date: 04/05/2018

DEDICATION

This report is dedicated to all those individuals who are affected by Chronic Kidney Disease and are unable to access treatment. I hope that treatment can be made more universally available and the future can be brighter for these individuals.

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ABSTRACT

Introduction: Chronic Kidney Disease is a condition that affects individuals worldwide and Rwanda is no exception. Malnutrition is a significant issue among dialysis patients and dramatically increases risk of morbidity and mortality. Dialysis patients also often have abnormal potassium, phosphorus, calcium and albumin laboratory values. The problem is that the overall nutritional status of stage 5 chronic kidney disease patients on dialysis in Rwanda is unknown and the objective of this study was to determine the nutrition status of a cohort of patients on dialysis with Stage 5 CKD at select facilities in Kigali and Gisenyi.

Methods: In this cross-sectional study, adults who had been on hemodialysis for more than 30 days were recruited from dialysis centers in Kigali and Gisenyi. Nutrition status was measured by performing a physical exam and interview known as the Subjective Global Assessment (SGA), calculating body mass index (BMI), and collecting laboratory values for potassium, phosphorus, calcium and albumin. SGA scores categorized participants into A (nourished), B (moderately malnourished) or C (severely malnourished). BMI was categorized as underweight ($<22 \text{ kg/m}^2$), normal/overweight ($22\text{-}29.9 \text{ kg/m}^2$), and obese ($>30. \text{ kg/m}^2$). Laboratory values were categorized as high, normal or low.

Results: 34 patients were assessed 19 (59.4%) of whom were males and 13 (40.6%) were females. Mean age for all was 52.4 years. 28% of participants were classified as moderately malnourished (SGA B) and 62.4% of participants were underweight (BMI $<22 \text{ kg/m}^2$). There was a correlation ($p = 0.0117$) between moderate malnutrition and underweight. 69% of participants presented with high potassium ($> 5.10 \text{ meq/l}$, mean value 5.49 mEq/L), while the majority of participants were normal for phosphorus, calcium and albumin. There was no association between low albumin and moderate malnutrition ($p=0.0687$) and low albumin and underweight ($p=0.6834$).

Conclusion: Malnutrition is prevalent among hemodialysis patients in Rwanda and there may be an increased risk of morbidity and mortality among patients due to low BMI scores. When creating nutrition recommendations for hemodialysis patients, potassium restriction should be emphasized. Additional research could help to draw further conclusions around malnutrition, laboratory values and dialysis in the region.

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CHAPTER 1. INTRODUCTION

Background

Chronic Kidney Disease (CKD) is an issue that affects people worldwide, and Rwanda is no exception. While earlier stages of CKD, stages 1 to 4, can be managed without dialysis, most often, CKD stage 5, or end-stage renal disease (ESRD) requires hemodialysis or peritoneal dialysis. While dialysis is a lifesaving intervention, it has its own set of implications for nutrition, and patients on dialysis are particularly susceptible to protein-energy malnutrition (PEM), due to the loss of protein during dialysis and increased dietary protein needs (Nelms and Lacey 2016). Potassium, phosphorus, sodium, and fluids need to be limited in patients with CKD due to the inability of the kidneys to function correctly, and many of the most commonly eaten foods in Rwanda are high in micronutrients that patients with ESRD need to avoid (Nelms and Lacey 2016). For example, potatoes and matoke are very high in potassium, while beans and groundnuts are high in phosphorus. Dairy products are high in calcium, phosphorus, and potassium. Meat and other animal products (excluding milk) are encouraged for their highly bioavailable protein content, and calcium supplements are often prescribed in order to protect bone integrity (Langman and Cannata-andía 2010). But these products are usually more expensive and can pose monetary strain on many Rwandans. This unfortunately leaves patients with insufficient dietary choices and frustration surrounding food. This leads to the question of whether or not the standard diet of Rwandans meets the nutritional requirements of individuals on hemodialysis.

The consequences of a patient not adhering to a prescribed diet can be high and can result in frequent hospitalization and even death. Patients can be subject to hyperkalemia, hyperphosphatemia, and fluid overload, among other issues. Estimated energy (kcal) and

protein requirements are also higher than for individuals not on dialysis as adequate energy is needed to prevent catabolism (Nelms and Lacey 2016). Wasting and PEM are common in maintenance dialysis patients, and these are risk factors for poor clinical outcomes including decreased productivity, quality of life and mortality (Kovesdy and Kalantar-Zadeh 2012). Patients' quality of life and overall health outcomes improve if they adhere to dietary recommendations. Recommendations are best when personalized for each, but general guidelines can also be implemented. While educational offerings have been developed for other contexts, the educational resources explicitly tailored to East Africa are insufficient, and the number of research studies done in this setting are limited. If the gaps in evidence-based nutrition education for hemodialysis patients are left unaddressed, these barriers will undermine the care for dialysis patients allowing morbidity and mortality will remain high and outcomes will not be as favorable as they could be.

Problem Statement

The overall nutrition status of stage 5 chronic kidney disease patients on dialysis in Rwanda was unknown.

Objective

Determine the nutrition status of a cohort of patients on dialysis with Stage 5 CKD at select facilities in Kigali and Gisenyi by March of 2018.

Justification

This research was conducted at three different dialysis centers. Two are private centers operated by Africa Healthcare Network (AHN) in Kigali and Gisenyi. These two centers have approximately 30 patients currently on dialysis. The third center is located at King Faisal Hospital in Kigali. King Faisal has approximately 40-50 patients in their dialysis unit at a given time. All of these centers serve patients with both Chronic Kidney Disease and Acute Kidney Injury. Beneficiaries were all patients at these centers whether they chose to participate or not as the education materials will be distributed to all individuals at the centers, as well as other dialysis centers within Rwanda. This information could also benefit doctors and nurses within Rwanda as they can use the information to answer questions and better inform the patients under their care. In addition, the information was shared with the nutritionists at King Faisal hospital so they can potentially use the information to improve dietary counseling and make diet plans or recommendations.

Layout of capstone

The capstone will be organized into the following chapters:

Chapter 1: Introduction

The introduction describes the background and rationale of the project and the problem statement. It also introduces the problem statement and justification of the project.

Chapter 2: Literature Review

The literature review summarizes the current literature on the topic of dialysis in Sub-Saharan Africa and introduces important information regarding nutrition assessment and dialysis.

Chapter 3: Methodology

The methodology section will describe the research settings, design, sampling procedures, measure(s), and data collection tools. The methodology also includes interventions and data collection procedures as well as ethical considerations and standards for research project are outlined in this section.

Chapter 4: Results

The results that have been collected thus far are outlined and presented.

Chapter 5: Discussion

In the discussion, the results are interpreted. This section also discusses challenges and limitations in the study, and how these limitations impacted the results of the study.

Chapter 6: Conclusion

The conclusion summarizes the project and makes recommendations for the future.

CHAPTER 2: LITERATURE REVIEW

1. Introduction

Chronic Kidney Disease is “a syndrome of progressive and irreversible loss of the excretory, endocrine, and metabolic functions of the kidney secondary to kidney damage” (Nelms and Lacey 2016). Renal replacement therapy, or dialysis, is a lifesaving intervention for patients with End Stage Renal Disease (ESRD) when their kidneys no longer function on their own. Renal replacement therapy, however, has negative health implications, such as protein-energy malnutrition (PEM) and micronutrient imbalances (Nelms and Lacey 2016) .

Understanding the nutritional status of dialysis patients can assist to make more informed decisions regarding the health of patients. Assessment of nutritional status includes anthropometric measurements, biochemical measurements, clinical assessment and dietary intake assessment (Knox et al. 2003). Nutrition therapy is vital to ensuring the long-term health and well-being of dialysis patients; it can reduce morbidity and mortality, PEM and improve outcomes in dialysis patients. Currently there is little-published research on the parameters and adequacy of dialysis in Africa and the developing world in general (Sarala Naicker 2002). In Rwanda, the overall nutrition status of patients has not been determined and there is a need for nutrition assessment among dialysis patients.

1.1 Magnitude

Chronic Kidney Disease (CKD) affects millions of people worldwide and it is estimated that the prevalence is between 11 to 13% (Hill, Fatoba, Oke, et al., 2016). Of those individuals with CKD, it is estimated that about 2 million receive dialysis treatment, also called renal replacement therapy (National Kidney Foundation 2015). CKD not only affects the individuals, but society as a whole due to the high cost of treatment and a loss of productivity. The

progression of CKD can be minimized and loss of productivity can be lessened by ensuring that CKD is managed efficiently (Weiner 2009). Understanding and maintaining nutrition status among CKD patients is a piece of that puzzle.

1.2 Dialysis in East Africa

It is difficult to fully discuss and understand CKD and ESRD in Sub-Saharan Africa because there is a lack of published research on this topic. There is also minimal specific information on nutrition status or nutrition interventions for dialysis patients in Africa. It is estimated that the burden of CKD in Africa is high due to the high HIV prevalence. While the prevalence rate in Rwanda is comparatively lower than other African countries at 2.9%, HIV could also be a contributing factor to the burden of CKD (UNAIDS 2015). Another contributing factor to renal failure is malaria. *Plasmodium falciparum* is the cause of the most severe form of malaria and is associated with acute kidney injury (AKI), but other forms of malaria can also affect renal function. Of those patients with AKI, approximately 64% regain complete renal function after *P. falciparum* and *P. vivax* infection (Maria, Farias, and Daher 2017).

In general, the lack of reliable measures of kidney function is a major limitation when reviewing the literature on the prevalence of kidney disease in sub-Saharan Africa. This, however, draws attention to the large gap in reliable and validated estimates of kidney function and the need for more information on CKD in general (Stanifer et al. 2014). It is particularly important that African countries address cardiovascular disease and diabetes, as integrated management of CKD and its risk factors is necessary in order to reduce and mitigate the burden of ESRD (Saraladevi Naicker 2013).

While it is vital to follow the Kidney Disease Outcomes Quality Initiative (K/DOQI) guidelines, all materials developed need to be adapted for the Rwandan context.

2. Risk Factors for CKD

The primary causes of CKD are often directly related to diabetes mellitus and hypertension, but other disease can lead to CKD. Other risk factors for the development of CKD include ethnicity, family history, hereditary factors such as polycystic kidney disease, and prolonged consumption of over-the-counter painkillers (Nelms and Lacey 2016). While the prevalence is higher in developed countries such as the US, is becoming more common in less developed countries (Hill et al. 2016). As the world becomes more accustomed to consuming a Western style diet, the prevalence of these diseases will continue to grow, and so will the burden of CKD (Nelms and Lacey 2016). As such, affluence is a dominant risk factor for CKD development (Abd ElHafeez et al. 2015). In addition, communicable diseases, such as post-infectious glomerulonephritis, schistosomiasis, leishmaniasis, malaria and HIV infection, are common in Africa and can also contribute to the development of CKD (Stanifer et al. 2014).

2.1 CKD and Dialysis

Earlier stages of CKD, stages 1 to 4, can be managed through dietary interventions and management of comorbid conditions, but most often, CKD stage 5, or end-stage renal disease (ESRD) requires dialysis. Without dialysis, ESRD is fatal (Stanifer et al. 2014). Dialysis acts as a replacement for the kidneys by removing toxic by-products of metabolism. While this function will sustain life, it does not replace many of endocrine and metabolic functions of the kidneys (Nelms and Lacey 2016). Dialysis is usually conducted two to three times per week depending on residual kidney function.

3. Nutrition Implications for Dialysis

While dialysis is a lifesaving intervention, it has it's own set of implications for nutrition and it is important that nutrition related conditions not be overlooked. A study in Brazil found

that nutrition status was most often influenced by age, income and depression (G. T. Oliveira et al. 2012). Intake of Potassium, phosphorus, sodium, and fluids often need to be limited or controlled in patients with CKD due to the inability of the kidneys to function properly, and many of the most commonly eaten foods in Rwanda are high in micronutrients that patients with ESRD need to limit (Nelms and Lacey 2016). Calcium supplements are sometimes necessary (Langman and Cannata-andía 2010). Medications and medical nutrition therapy play a huge part in ensuring that patients stay as healthy as possible and nutrition interventions are effective in improving outcomes (Weiner, Kapoian, and Johnson 2015).

It is important that these dietary guidelines be adequately communicated so that patients can make informed food choices. Cardiovascular disease (CVD), bone and mineral disorders, diabetes mellitus and anemia are also common complications that need to be managed through nutrition (Nelms and Lacey 2016). CVD, diabetes, age, and nutrition appear to be the most significant predictors of outcome for the ESRD patients and CVD, diabetic management, and nutritional status are potentially modifiable (Eiam-Ong and Sitprija 2002). Nutrition therapy plays a vital and integral role in these modifications and can help diabetic patients gain control of these conditions.

Patients not adhering to a prescribed diet can be subjected to hyperkalemia, hyperphosphatemia, hypocalcemia and fluid overload, among other issues. Recommendations are best when personalized for each individual, but general guidelines can also be put in place (Nelms and Lacey 2016). While resources have been developed for other contexts, the resources tailored specifically to East Africa are extremely limited, and the number of studies done in this setting are also few. Dietary intake should not be restricted unnecessarily.

3.1 Protein-Energy Malnutrition

Estimated energy (kcal) and protein requirements are higher than the average for individuals on dialysis and adequate energy is needed to prevent catabolism (Nelms and Lacey 2016). Patients on dialysis are particularly susceptible to wasting and protein-energy malnutrition (PEM), due to the loss of protein during dialysis and increased dietary protein needs. Disturbances in protein and energy metabolism, hormonal derangements, infections and other illnesses and reduced food intake because of anorexia, nausea and vomiting related to uremic toxicity also contribute to PEM (Kadiri, Nechba, and Oualim 2011). Often, the dietary guidance that patients do receive involves heavy restrictions on food, which further decreases intake (Mohamed and Abdullah 2014). One study in Brazil found that the prevalence of malnutrition varied between 12.1% to 94.8% (C. M. C. De Oliveira et al. 2010).

Morbidity and mortality is increased in dialysis patients with malnutrition and it is estimated that around 40% of dialysis patients suffer from PEM (Sarala Naicker 2002). A few programs that have been implemented in other developing countries have shown success in treating patients with PEM. A study done in Egypt and South Africa found significant improvement in “neurophysiologic data and decrease in muscle fatigue after optimization of dialysis dose and patients’ nutrition” and reported that “the services of a renal dietitian on an on-going basis is essential in renal and dialysis clinics” (Sarala Naicker 2002). While it may not be practical to have a renal dietitian at every clinic in Rwanda, understanding the common nutrition issues that dialysis patients share can help practitioners to better advise patients on how to improve their nutrition status.

4. Nutrition Assessment

There is no standardized method to assess malnutrition in dialysis patients and the methods of assessing nutrition status can be a combination of subjective and objective (C. M. C. De Oliveira et al. 2010). According to Kovesdy, “the lack of either a well-defined formal test or a gold standard test for PEM makes formal assessment of diagnostic accuracy impossible. Using a combination of criteria that encompass various different aspects of PEM makes an accurate diagnosis of this condition more likely (Kovesdy and Kalantar-Zadeh 2012)”. It is common that patients present with multiple nutrition diagnoses (Nelms and Lacey 2016). In order to achieve a comprehensive picture, nutrition assessment involves looking at anthropometric measurements, laboratory values and dietary intake (C. M. C. De Oliveira et al. 2010).

4.1 Physical Assessment and Anthropometrics

Malnutrition or mineral imbalance often present with physical signs and symptoms. Physical assessment includes height and weight (used to calculate BMI), subjective global assessment (SGA) and physical signs/symptoms of nutrient deficiencies (Nelms and Lacey 2016).

Anthropometric measurements are useful to assess body mass and are common methods of nutritional assessment and are easily used in a clinical setting, however, alterations in fluid status can commonly cause errors. Height, body weight, percent of standard body weight, body mass index (BMI), skinfold thickness, arm circumference (AC), and arm muscle area (AMA) are also useful measurements that can be used to obtain a comprehensive picture.

Anthropometrics are easily reproducible and have a sensitivity rate of 90% (C. M. C. De Oliveira et al. 2010). However, there is a lack of data that considers variations in sex, age and ethnicity, which calls the accuracy of the anthropometric data into question. Skinfold thickness also is

very subject to examiner-dependent error, and is particularly not recommended (C. M. C. De Oliveira et al. 2010).

The SGA is a low-cost, easy to use tool to assess physical status and has been found relatively accurate in detecting long term mortality risk (Mutsert et al. 2009). There are multiple SGA techniques available, and it is recommended that conventional SGA be used for screening and following up dialysis patients. It can be followed by PG-SGA to make a nutrition diagnosis (C. M. C. De Oliveira et al. 2010). SGA, however, “needs greater validation regarding sensitivity, specificity, accuracy, intra- and inter-observer variability. It correlates with other nutritional measures” (C. M. C. De Oliveira et al. 2010). Nonetheless, it has overall been found reliable and valid in assessing PEM and is commonly used in dialysis settings (Mutsert et al. 2009) so it will be used for the assessment of participants for this study.

BMI, in particular, is very easy to use in a clinical setting. The World Health Organization recommends that 18.5 kg/m² be used for lower cutoff (<18.5 kg/m² is classified as underweight) in the general population, but a different scale is suggested to dialysis patients as some studies have found that BMI lower than 22 kg/m² is associated with an increase in mortality. Therefore, the BMI cutoff point used in dialysis patients should be different from what is used for the general population (C. M. C. De Oliveira et al. 2010). Some studies have recommended that a BMI of 23 kg/m² or higher be considered normal weight among dialysis patients, with anything <23 kg/m² being considered as underweight, and that obesity (BMI > 30 kg/m²) may prove to be a survival advantage (Feingold et al. 2015). Using SGA and BMI together can help to get a more comprehensive picture of nutrition status than using one alone.

4.2 Laboratory Values

Laboratory values that are commonly taken include albumin, as well as phosphorus, potassium and calcium. While sodium is generally not measured as a laboratory value, it is also an important micronutrient to consider because an increased sodium intake can also contribute to an increase in fluid intake, which can lead to fluid overload (Mohamed and Abdullah 2014). Albumin is a marker of visceral protein storage and levels can be a predictor of malnutrition, but should not be used alone to make a diagnosis, as other factors can affect this parameter, such as inflammation, fluid overload and infection. Over time, the kidneys become less efficient at handling phosphorus levels and very little phosphorus is removed through dialysis. Accumulation of phosphorus can cause leaching of calcium from the bones, eventually making them brittle, as well as contributing to joint pain and other health complications. Phosphate binders can help to control phosphorus levels, but dietary considerations should also be taken (Mohamed and Abdullah 2014).

Potassium is important to consider because it is necessary for heart function, nerve conduction and muscle contraction. If potassium is too low, patients will experience issues related to these functions, however, this is less common than high potassium levels. Potassium can build up between hemodialysis treatments, resulting in hyperkalemia (Mohamed and Abdullah 2014). Many patients on dialysis also take angiotensin-converting-enzyme (ACE) inhibitors, a class of drugs used to control hypertension. These drugs can sometimes have the side effect of causing potassium retention, which can also contribute to high potassium levels (Harvard Medical School 2009). Hyperkalemia in this study is defined as potassium levels being greater than 5 mEq/l. Severe, and life threatening hyperkalemia is defined as potassium levels greater than 7.0 mEq/L (Nelms and Lacey 2016). This buildup can cause fatigue, poor respiration and heart problems including cardiac arrest (Mohamed and Abdullah 2014).

Decline in kidney function can contribute to calcium abnormalities. Low calcium levels can occur if there is insufficient Vitamin D available in CKD patients. As a result, many patients receive calcium and vitamin D supplements. High calcium levels can occur if there is too much supplementation of calcium and vitamin D, or if there are high levels of parathyroid hormone (PTH) (Kidney Patients UK 2017). Calcium levels are closely tied with albumin levels as albumin is the primary carrier for calcium in the body, therefore, it is important to take this into consideration if albumin levels are low. Using the adjusted calcium (**see appendix for equation**), or ionized calcium, is a more accurate measure of the true calcium levels that are active in the body (Nelms and Lacey 2016). High serum calcium levels in combination with high serum phosphorus levels (know as Ca x P product) are especially problematic as these greatly increase the risk of morbidity and mortality (Nelms and Lacey 2016). See the appendix for more specific information related to ranges for laboratory values.

4.3 Dietary Assessment

Dietary assessment provides a picture of average dietary intake of key micronutrients, macronutrients and overall calories. Optimal energy intake is 35 kcal/kg body weights in patients <60 years, and 30 kcal/kg body weight in patients >60 years. Protein intake should be at least 1.2 g/kg body weight in order to prevent wasting, and it should ideally be of high biological value (C. M. C. De Oliveira et al. 2010). Dietary assessment can be used to estimate and compare intake to reference values and recommended intake. However, their effectiveness at measuring individual intake is limited, but can be used for dietary comparison and estimation of intake for patients within a given population. Methods for dietary assessment include 24-hour recalls, food diaries/records, and food frequency questionnaires. While these methods are

useful in this setting, accuracy of this type of data is questionable due to recall bias and translation issues, so this information will not be collected as part of this study.

5. Conclusion

In conclusion, there is a lack of information surrounding dialysis in Sub-Saharan Africa. While nutrition interventions are vital to preventing PEM and addressing comorbidities, few studies have been done on nutrition status or intervention in the context of the developing world. Due to the lack of published studies done on nutrition interventions for dialysis patients in Africa, education materials are not readily available. In order to develop nutrition education materials, dietary intake, nutrition status, or the specific nutrition-related issues that patients are struggling with must be understood. Collecting data on nutrition status can aid in the understanding of common nutrition issues and aid in designing appropriate nutrition education materials that can benefit dialysis patients.

CHAPTER 3: METHODOLOGY

Setting

This research was conducted at three different dialysis centers. Two are operated by Africa Healthcare Network (AHN) in Kigali and Gisenyi, and serve approximately 30 patients currently on dialysis. The third center is located at King Faisal Hospital in Kigali. King Faisal has approximately 40-50 patients in their dialysis unit at a given time. All of these centers serve patients with both Chronic Kidney Disease and Acute Kidney Injury.

Design

The study design is a cross-sectional study. Nutrition status was assessed for patients in three different dialysis centers between December 2017 and February 2018.

Sample

The target population was individuals who were on dialysis at either AHN or King Faisal Hospital dialysis centers. Three dialysis centers were included in order to obtain data from patients in different healthcare settings. The inclusion criteria used was individuals over the age of 18 years with Stage 5 CKD who required dialysis and have been on dialysis for more than 30 days.

Pregnant women were excluded. The size of the sample was determined by the number of patients at these facilities, but aimed at 15-20 patients from Africa Healthcare Network (split between their Kigali and Gisenyi locations) and 15-20 from King Faisal.

Data collection method

Patients were recruited from these centers by obtaining a list of all patients in each center who were 18 and above and had been diagnosed with Chronic Kidney Disease. From there, all patients from AHN were recruited and 20 from King Faisal were randomly selected from these lists. These subjects were approached for enrollment in the study when they came to the clinic for an appointment by the head researcher and/or a nurse that they are already familiar with, and who speaks Kinyarwanda. Due to the limited samples size at AHN, all patients on dialysis who met the criteria were given the opportunity to participate.

Study requirements and procedures were explained to participants and they were informed that there would be a questionnaire/interview, a physical exam, and their laboratory values were recorded, so they needed to give permission to access their patient charts. It was also explained that the purpose of the study was solely to collect information that would help to guide nutrition education programs, but that participation in the study would not provide them with a cure or any specific incentive. If after this explanation they agreed to participate, they signed a consent form. It was also explained that this study would be used to help develop materials that would guide them and other patients when it comes to nutrition and what they can eat. The consent form was translated and reviewed by the nephrologist to ensure that it was clear for participants.

Data collection tool

A data collection tool and data recording sheets were used for each participant. The Subjective Global Assessment (SGA) generates a score based on patient generated information (weight, dietary intake, GI symptoms, and functional) and a physical examination of subcutaneous fat, muscle wasting, edema and ascites. The score ranks patients as A (nourished), B (moderately

malnourished) and C (severely malnourished) (Queensland Health 2014). The SGA is a method that has been used and validated in this setting, so it did not require piloting.

For the SGA, an interview and physical exam was performed (Queensland Health 2014). This required the help of a nurse to translate if the participant didn't speak English. Only nurses or medical personnel already working in the facility were used for translation. Questions asked about weight change, dietary intake, gastrointestinal symptoms (nausea, vomiting, diarrhea, anorexia) and functional capacity. The physical exam observed subcutaneous fat under the eyes, triceps and biceps, muscle wasting on the temple, clavicle, shoulder, scapula/ribs, quadriceps, calf, knee and interosseous muscle between the thumb and forefinger, and edema and ascites related to malnutrition. This exam was performed with a nurse present if there is a need for translation, and the patient was fully briefed on what we were looking for before the exam began. The patients' weight was taken immediately following dialysis to ensure a more accurate dry weight.

Measures

SGA scores, anthropometric values (height, weight and age), and laboratory values (albumin, phosphorus, potassium and calcium), were collected and recorded on the data recording. Laboratory values were obtained from the patient charts for the individuals who had consented to participate in the study and the patient's most recent laboratory values for calcium, potassium, phosphorus and albumin were collected if available.

Data Collector(s)

Data was collected by the head researcher with the help of nurses who translated when a patient did not speak English. For the exam, a nurse or doctor was present if there was a need for translation. All translators were medical personnel already working in the facilities, so there was no need for external translators.

Data Management

All patients were assigned an ID number that allowed them to record their information without revealing their name and protecting their privacy. A list of paired participant names and codes were kept in a password protected excel sheet on the researcher's computer. All paper data was entered into a password protected excel sheet and kept at Africa Healthcare Network.

Data Analysis

Descriptive analysis was used to analyze the SGA score category, lab value, BMI. Mean, median and percentage of each variable were presented. Lab values and BMI were coded into categories of high, normal or low for each respective lab value (see table 1 for exact ranges). Fischer Exact tests were used to analyze the association between BMI, SGA and albumin. Correlations between potassium, phosphorus and sodium were not assessed as these would not be clinically related to BMI and SGA. All tests were conducted using Vasserstat, with P-value set at 0.05. The distribution of data values for potassium, phosphorus, calcium and albumin were presented using histograms. The number or times patients receive dialysis per week was noted as this may influence factors such as fluid retention and laboratory values.

Ethical Considerations

Vulnerable populations

All participants were adults over the age of 18 years and pregnant women were excluded, however, the participants in the study were undergoing dialysis and many had other health complications

Assessment of risks to participants

Risks to participants were minimal as participation in the study was similar to any sort of routine exam. Participants were recruited from dialysis centers in which they were already familiar and participation was during regular appointment time so there was low risk of additional stigmatization from going to a new location and travel cost. No extra lab work was required.

One potential risk was that patients may gain a new sense of hope and may be under the impression that a change in diet could cure them. It was communicated to all patients that neither participation in the study, nor dietary intervention, will cure them of chronic kidney disease, but may keep them healthier during their time on dialysis. Their rights as participants in the study were explained and they were informed that study participation would be to help guide education materials for them and future patients, but would not provide them with a cure. Any patient that was found to be moderately or severely malnourished during the course of the study was informed and referred to a doctor of choice or the nephrologist serving the clinic. If patients have further concerns about their specific medical conditions, they were referred to the nephrologist or other doctor on staff.

Medical or psychosocial support

At Africa Healthcare Network, all patients with identified malnutrition or concerns about their health conditions were referred to the nephrologist, Dr. Ntarindwa. At King Faisal, patients with similar issues were referred to the nephrologist in charge as well as the nutritionist on staff, in the case of malnutrition.

Information and consent process

The consent of participants was obtained by explaining the process in whichever language they were most comfortable with (English or translated into Kinyarwanda, with the assistance of a translator) and allowing them to ask questions before deciding to participate. If patients cannot read or write, this oral explanation will be of value to them and they will use their thumbprint in place of a signature. If participants wish to withdraw from the project, they will be instructed that they need to inform the nurse or myself and any data collected on the will be immediately removed. No compensation was given for participation in the study, as patients will already be at the clinic during their participation times.

Protection of privacy and confidentiality

Private information was not discussed with anyone who was directly involved with data handling. Other parties involved in handling data (nurses and medical personnel) were briefed on the importance of confidentiality. All participants were briefed on the type of information that was collection before they participated in the study and were reassured that participation is voluntary and that they will not have to answer any questions or participate in aspects that they are not comfortable with. All patients were assigned an ID number that that facilitated the recording of information without revealing their name and protecting their privacy. Paper data only contained patient codes, not names, of participants.

De-identification of data

Participants were assigned a numerical code once enrolled in the study. This code is on their SGA sheet and data collection sheet so information collected does not reveal actual patient names. A list of patients with codes were kept in a password protected excel sheet.

Safekeeping of data

Data sheets were kept separately from patient code information. Paper copies of data were uploaded to a computer and then surrendered to UGHE for safekeeping. UGHE will keep data for 10 years. Once analysis is complete and the data is no longer needed, computer files will be deleted.

CHAPTER 4: RESULTS

Data Collection Summary

SGA data was collected from 32 participants; six from AHN Gisenyi, 11 from AHN Kigali and 15 from King Faisal Hospital (KF). Laboratory values (if available) were collected for all facilities.

Analysis Results

The study sample included 19 males and 13 females with a mean age of 52.4 years. According to SGA scores, 28% of participants were classified as moderately malnourished (SGA B), while 72% can be classified as nourished (SGA A). None of the participants presented with severe malnutrition (SGA C). See Appendix 2.

Using an adjusted BMI cutoff point for underweight of 22.0 kg/m² (<22.0 was classified as underweight), 62.5% of participants were classified as underweight and 37.5% as normal/overweight, with a BMI mean of 21.66 with a confidence interval (.95 CI) of 20.38-22.94 and median of 21.17.

69% of participants presenting with high potassium (> 5.1 mEq/L), while 28% presented as normal, and one (4%) presented as low. One (3%) presented with severe hyperkalemia (>7.0 mEq/L) The mean/median for albumin was 3.70 (CI 3.49-3.91), which is within the normal range, however 38.5% of participants registered as low albumin, 61.5% had normal albumin levels. 70% of participants presented with normal phosphorus. 21% of participants had low calcium, and 62% were normal, while 17% were high. A summary of results can be found in

Table 1.

Table 1. Summary of descriptive data

Sample = 28					
	Complete data (n)	n (%)		Mean (CI)	Median
SGA	32	A- Nourished	23 (72%)	NA	NA
		B- Moderately malnourished	9 (28%)		
		C- Severely malnourished	0 (0%)		
BMI (<22.0 as adjusted cutoff point)	32	Obese (≥ 30 kg/m ²)	0 (0%)	21.66 (CI 20.38-22.94)	21.17
		Normal (22.0 – 29.9 kg/m ²)	12 (37.5%)		
		Underweight (≤ 21.9 kg/m ²)	20 (62.5%)		
Potassium	29	High (>5.1 mEq/L)	20 (69%)	5.49 (CI 5.1-5.88)	5.7
		Normal (3.5-5.0 mEq/L)	8 (28%)		
		Low (<3.5 mEq/L)	1 (3%)		
Phosphorus	24	High (>5.5 mg/dL)	1 (4%)	3.39 (CI 2.86-3.92)	3.39
		Normal (3.0-5.5 mg/dL)	14 (58%)		
		Low (<3.0 mg/dL)	9 (38%)		
Calcium	24	High (>10.2 mg/dL)	4 (17%)	9.10 (CI 8.52-9.68)	8.6
		Normal (8.4-10.2 mg/dL)	15 (62%)		
		Low (<8.4 mg/dL)	5 (21%)		
Albumin	26	High n/a	0 (0%)	3.70 (CI 3.49-3.91)	3.55
		Normal (3.4-5.0 g/dL)	16 (61.5%)		
		Low (<3.5 mg/dL)	10 (38.5%)		
# Dialysis sessions	32	3/week	30 (94%)	3	3
		Less than 3/week	2 (6%)		

Associations between SGA scores and BMI were observed, as well as associations between low BMI and low SGA. 100% of participants with a low SGA score (B) were classified as having a low BMI (<22 kg/m²), while 45% with a low BMI had a low SGA score. There is a significant association between underweight (BMI) and moderate malnutrition (SGA B) with a p-value of 0.0117 (Table 2).

Table 2. Association between SGA and BMI

		BMI underweight (low)	p-value
SGA	SGA A	11 (48%)	0.0117
	SGA B	9 (100%)	

Table 3. Association between SGA and low albumin

		Low albumin	p-value
SGA	SGA A	5 (36%)	0.0687
	SGA B	5 (71%)	

Table 4. Association between Albumin and BMI underweight

		BMI underweight (low)	p-value
Albumin	Low	7 (47%)	0.6834
	Normal	8 (53%)	

There was no significant association ($p=0.0687$) found between low albumin and SGA B (moderately malnourished), as well as no significant association ($p=0.6834$) between low BMI and low albumin.

The distribution of laboratory values can be found in the following figures:

Figure 1: Distribution of Potassium Values

The distribution of potassium data is normal and shows that 34% of participants had a laboratory value that fell between 5.4 and 5.9 mEq/dL. A visual representation of participants in the low, normal, and high ranges can be found in **figure 2**.

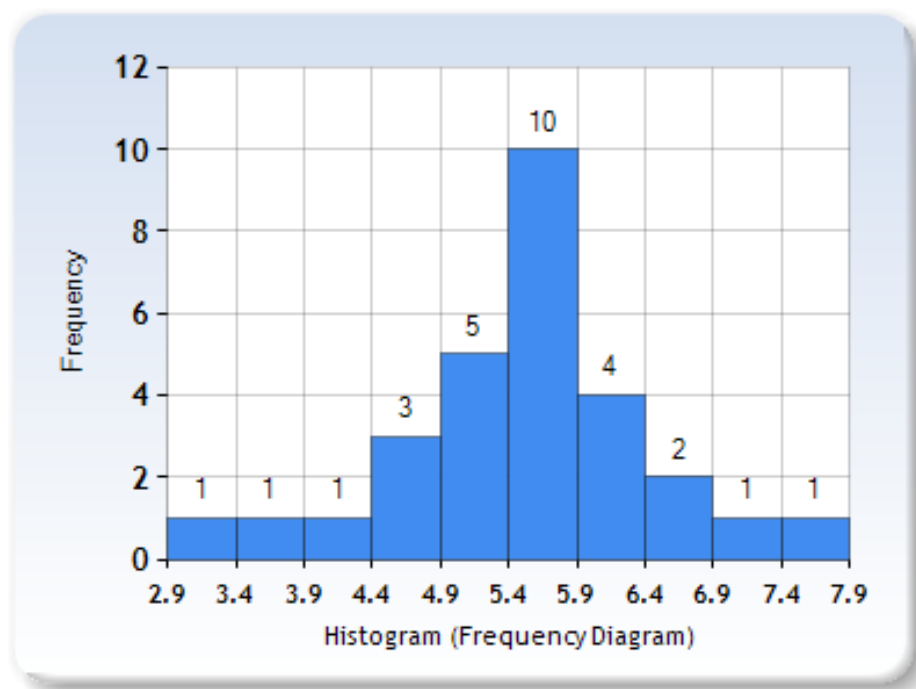


Figure 2: Number of individuals with low, normal and high potassium

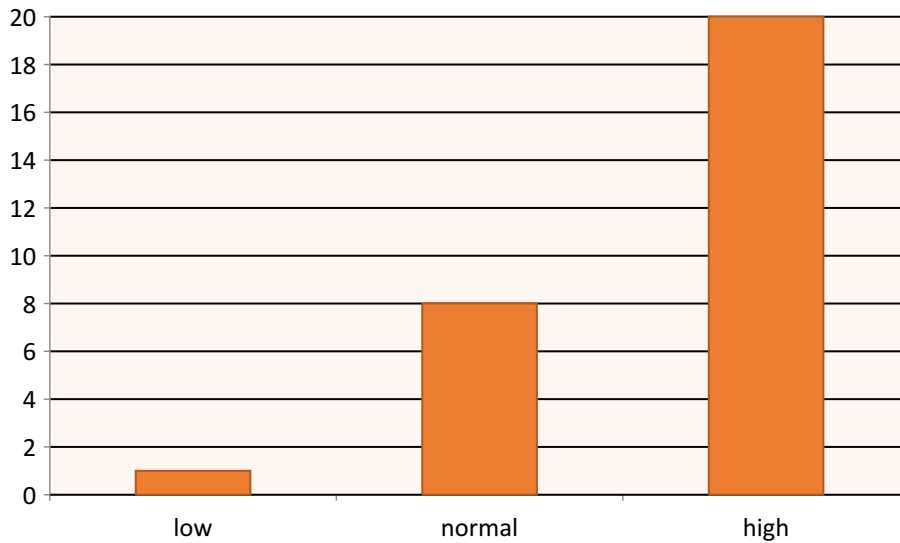


Figure 3: Distribution of Phosphorus Values

Phosphorus values vary quite a bit, with the lowest value at 1.11 mg/dL and the highest at 5.88.

The distribution pattern of values is relatively evenly distributed. A visual representation of participants in the low, normal, and high ranges can be found in **figure 4**.

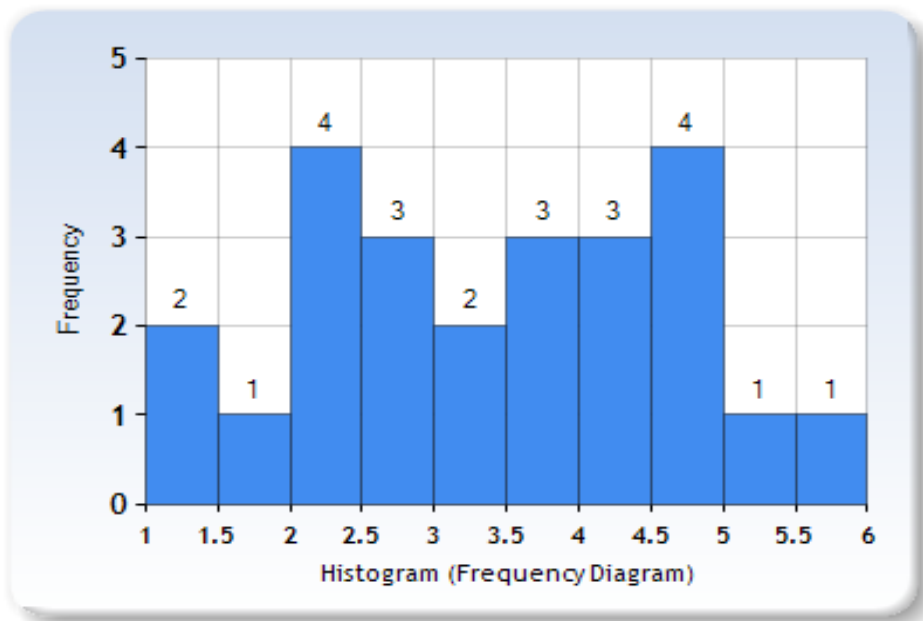


Figure 4: Number of individuals with low, normal and high phosphorus

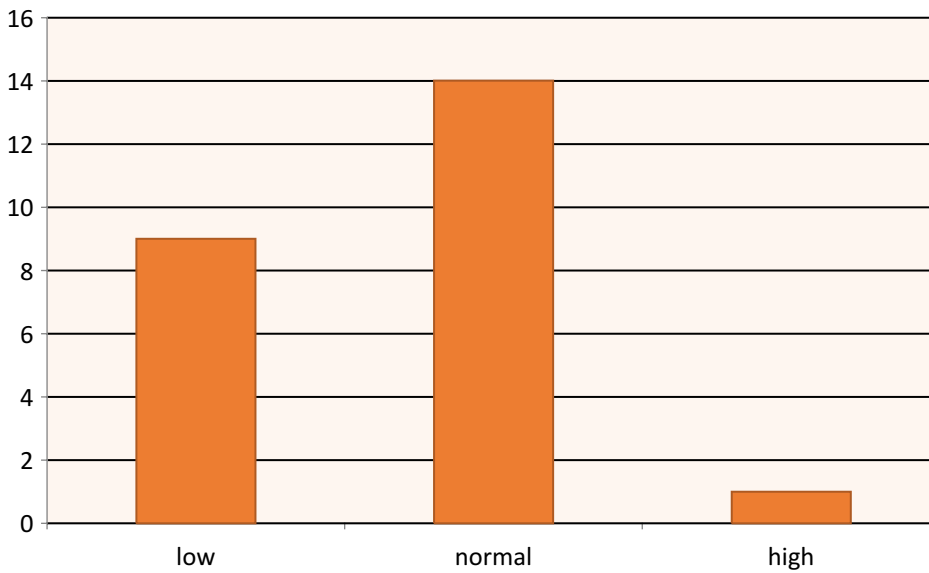


Figure 5: Distribution of Calcium Values

The values for calcium data are left skewed, indicating that the majority of values fall between 7 and 10 mg/dL, with few values falling above 10 mg/dL. A visual representation of participants in the low, normal, and high ranges can be found in **figure 6**.

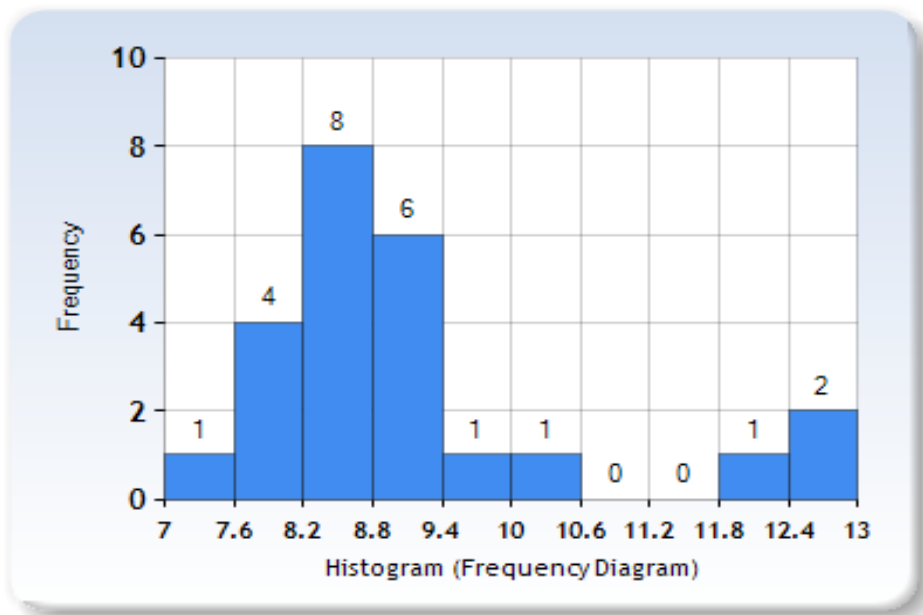


Figure 6: Number of individuals with low, normal and high calcium

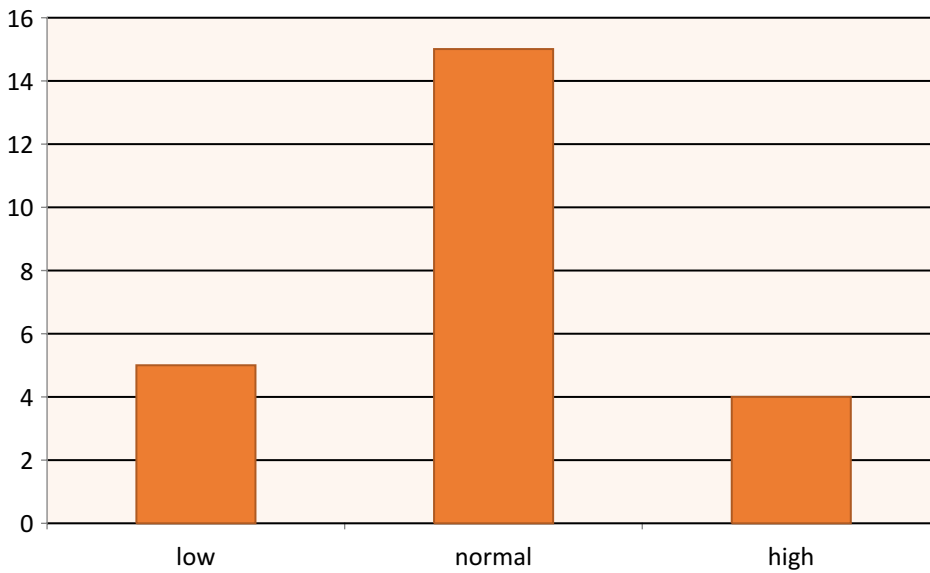


Figure 7: Distribution of Albumin Values

Albumin values are also slightly right skewed, with the highest number of values falling between 3.2 and 3.45 mg/dL (low) and the majority of values falling between 3.2 and 4.45 mg/dL. A visual representation of participants in the low and normal ranges can be found in figure 8.

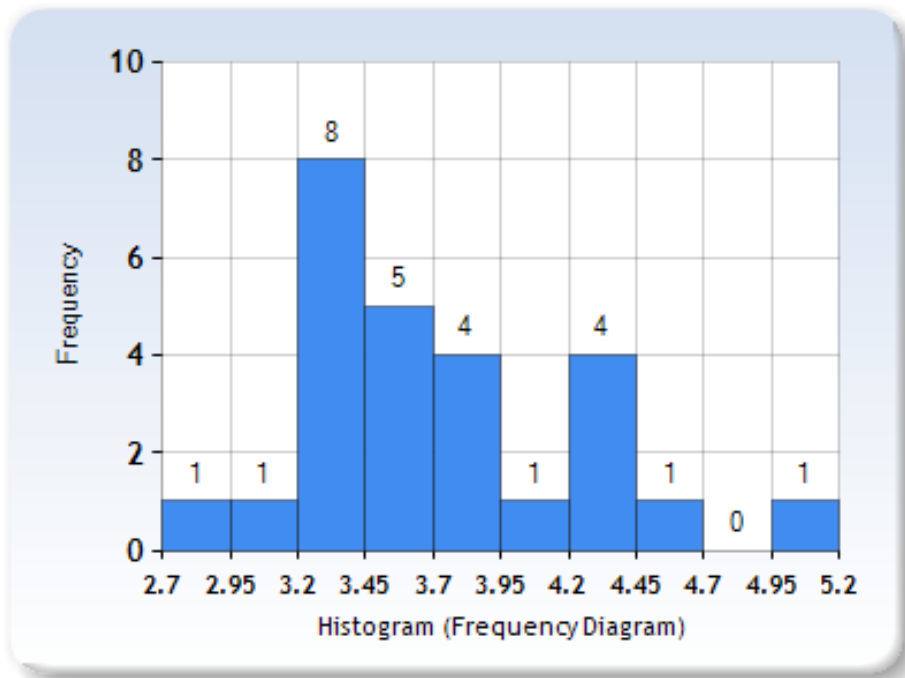
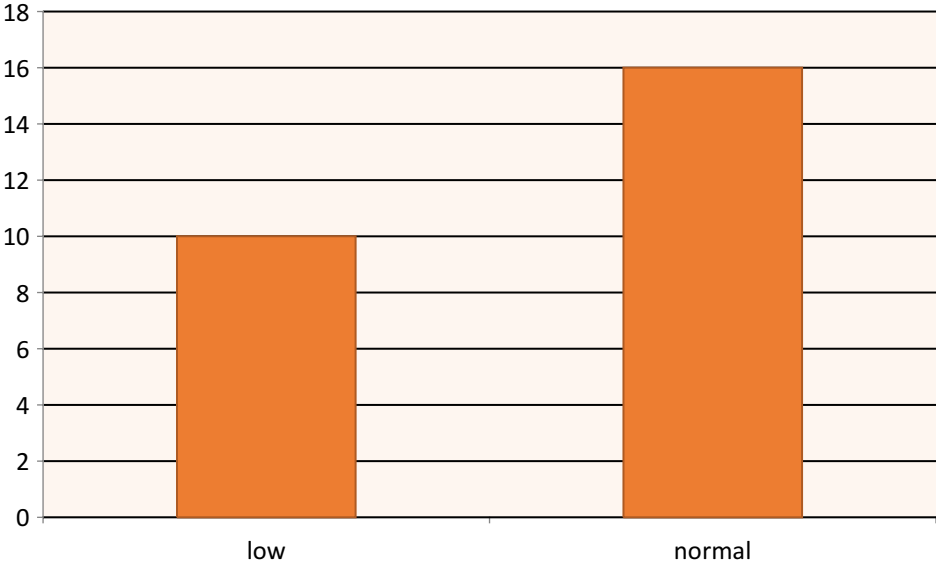


Figure 8: Number of individuals with low, normal and high albumin



CHAPTER 5: DISCUSSION

The results of our study showed that malnutrition was prevalent among dialysis patients in Rwanda, with 28% of dialysis patients presenting as moderately malnourished (SGA A). 63% of participants had a BMI of $<22 \text{ kg/m}^2$, highlighting a potentially increased risk for morbidity and mortality. While malnutrition prevalence rates vary greatly among studies from 12.1% to 94.8% (C. M. C. De Oliveira et al. 2010). It is unknown what the prevalence of adult malnutrition in the normal population is, so it a comparison cannot be made between specifically dialysis patients and the normal population.

Average potassium levels were also high, indicating that high potassium is an area of concern among dialysis patients in Rwanda. Diet likely has a large role in this and high potassium foods should be limited in order to avoid possible adverse complications related to high potassium, but the use of ACE inhibitors could also be a contributing factor (Harvard Medical School 2009). On average, values for calcium were normal, but those that were high could be due to excess PTH abnormalities or supplementation, as calcium supplements are commonly given to dialysis patients in Rwanda (Kidney Patients UK 2017). Phosphorus values were within the normal ranges. Phosphorus is of particular interest since high phosphorus is a common problem among dialysis patients (Nelms and Lacey 2016), yet that has not proven true in Rwanda as the average phosphorus levels were within the normal range and only 1 participant presented with high phosphorus. This is somewhat of a surprise, but the reason for this is not clear, as many foods commonly eaten by Rwandan patients, such as beans and milk, are high in phosphorus. Hypothesized causes could include the amount of processed food in the diet of Rwandans or differences in soil composition, but more research is needed in this area.

Some useful recommendations can be made from this data and the results can help to influence more accurate nutrition recommendations. Because of the prevalence of malnutrition, calorie and protein restrictions should not be imposed on patients. In general, the main food restriction that should be focused on would be potassium as this was, on average, high. Phosphorus and calcium appear to be less of an issue and should not be restricted in the general dialysis population, but on an individual basis, and only if necessary as indicated by laboratory values. In addition, minimal restrictions should be made on diet unless indicated by specific laboratory values in order to encourage intake and reduce prevalence of malnutrition. There is a correlation between low BMI and moderate malnutrition (SGA B) in this population, and because BMI is a very quick and easy measure to use, it can be recommended that BMI be used as a preliminary screening tool to identify patients at risk for malnutrition. Albumin is a marker of visceral protein storage and can sometimes be correlated with malnutrition but this study did not find a statistical association between low BMI and low albumin, or moderate malnutrition (SGA B) and albumin, but further research with a greater sample size is needed to confirm or deny this.

Despite successfully collecting the data on nutritional status of dialysis patients, this study was not without limitations. Obtaining current laboratory values for some participants was a slight challenge in some centers. Because some patients are privately paying for their dialysis, they opt out of having laboratory values done unless absolutely required in order to save money, which resulted in some laboratory values either being unavailable, or not up to date. Due to language barriers, nurses were used as translators to translate between English and Kinyarwanda (or in one case, English to French) in order to collect SGA data. Because the language abilities of the nurses varied and none had formal training in translation, there is a

possibility that some items were not translated with 100% accuracy and data may be skewed because of this.

Some data including a component of the SGA and height were self-reported by patients, accuracy could not be guaranteed for a variety of reasons. When determining SGA, some patients fell on the border of A and B in the current definition. In future studies, it is recommended that a slightly different SGA form be used with more classifications, which would help alleviate some uncertainty around classification for those participants. Trying to measure patient height turned out to be impossible in many instances as much of the data was collected at the same time that patients were undergoing dialysis, so they could not stand up. Some facilities also did not have a tool for height measurements, and some patients were wheelchair bound and could not stand up for height to be collected. As a result, height was patient reported. Lastly, the sample size was small during our short study period; a greater samples size could create a more comprehensive picture of nutrition status in Rwanda.

CHAPTER 6: CONCLUSION

28% of participants were classified as moderately malnourished (SGA B) and 62.5% as underweight. 69% of participants presented with high potassium, 70% with normal phosphorus, and 62% with normal calcium. 38.5% of participants had low albumin while 61.5% were normal. It can be concluded that malnutrition is prevalent among dialysis patients in Rwanda and there is a general increased risk of morbidity and mortality among patients due to low BMI scores. When conducting nutrition counseling, restrictions should be put on high potassium foods, but not on necessarily on high phosphorus or calcium containing foods, in order to encourage greater intake levels and reduce the prevalence of malnutrition. Further research on knowledge levels of patients in regards to nutrition could help to determine sources of misinformation. More research is needed around dietary intake of phosphorus and high phosphorus levels in order to make conclusions around phosphorus laboratory values. Additional research in other areas of East Africa could help to draw further conclusions around malnutrition, laboratory values and dialysis in the region.

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CHAPTER 8: APPENDICES

1. Laboratory Values

4.2.a Albumin

Albumin is a marker of visceral protein storage and levels can be a predictor of malnutrition, but should not be used alone to make a diagnosis, as other factors can affect this parameter, such as inflammation, fluid overload and infection. A normal albumin level falls between 3.5 and 5 mg/dL (Nelms and Lacey 2016).

4.2.b Phosphorus

Serum phosphorus levels should be maintained between 3.0-5.5mg/L (Nelms and Lacey 2016).

4.2.c Potassium

Potassium levels should be maintained between 3.5-5.1 mEq/L (Royal College 2017), with >7.0 mEq/dL being defined as severe hyperkalemia (Nelms and Lacey 2016).

4.2.d Calcium

Serum calcium should be maintained between 8.4 and 10.2 mg/dL. Calcium levels are closely tied with albumin levels as albumin is the primary carrier for calcium in the body (Nelms and Lacey 2016). Therefore, it is important to take this into consideration if albumin levels are low. The following equation can be used to estimate true serum calcium:

$$[(4\text{-reported albumin}) \times (0.8)] + \text{reported Ca}^+$$

Often, serum low calcium levels are due to alterations in Vitamin D metabolism and low Vitamin D levels as a result of CKD. Low calcium levels and a lack of the active form of Vitamin D cause an increase in parathyroid hormone levels, which results in impaired calcium absorption and bones and mineral disorders (Nelms and Lacey 2016). It is important to monitor calcium intake to ensure that patients receive adequate amounts, but do not exceed 2,000mg a day. Vitamin D supplements can help to increase absorption (Nelms and Lacey 2016). It will be noticed if study participants take calcium supplements, and if so, this needs to be factored into the amount consumed per day.

They are important to note, however, when providing counseling to patients because if they are high, it may be necessary to pose restrictions on foods containing that particular nutrients. If they are normal or low, however, advising against foods containing these nutrients could restrict a patient's diet unnecessarily.

2. SGA Form

Subjective Global Assessment

Name:

Date:

Medical History	A	B	C
<p>WEIGHT</p> <p>Wt change past 6 months</p> <p>Usual weight Amount weight loss</p> <p>Current weight % weight loss</p> <p>0-<5% loss 5-10% loss >10% loss</p> <p>Weight change past 2 weeks</p> <p>No change; normal weight Increase to within 5% Increase (1 level above) No change, but below usual wt Increase to within 5-10% Decrease</p> <p>Amount</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p>
<p>DIETARY INTAKE</p> <p>No change; adequate No change; inadequate</p> <p>Change</p> <p>Suboptimal diet Full liquid Hypocaloric liquid Starvation</p> <p>Intake borderline; increasing Intake borderline; decreasing Intake poor; no change Intake poor; increasing Intake poor; decreasing</p> <p>Duration of change ...</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p> <p>*</p>	<p>*</p> <p>*</p> <p>*</p> <p>*</p>
<p>GASTROINTESTINAL SYMPTOMS</p> <p>Frequency (never, daily, no. of times/week)</p> <p>Duration (<2wk, >2wk)</p> <p>Nausea .. Vomiting . Diarrhoea ... Anorexia ...</p> <p>None; intermittent Some (daily >2 week) All (daily >2 week)</p>	<p>*</p>	<p>*</p>	<p>*</p>
<p>FUNCTIONAL CAPACITY</p> <p>No dysfunction Difficulty with ambulation/normal activities Bed/chair-ridden</p> <p>Change past 2 week</p> <p>Improved No change Regressed</p> <p>Duration of change ..</p>	<p>*</p> <p>*</p>	<p>*</p> <p>*</p>	<p>*</p> <p>*</p>

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Posted: May 2009

Due for Review: April 2019

Physical examination	A	B	C
SUBCUTANEOUS FAT			
Under the eyes	Slightly bulging area		Hollowed look, depression, dark circles
Triceps	Large space between fingers		Very little space between fingers, or fingers touch
Biceps	Large space between fingers		Very little space between fingers, or fingers touch
MUSCLE WASTING			
Temple	Well-defined muscle/flat	Slight depression	Hollowing, depression
Clavicle	Not visible in Males; may be visible but not prominent in females	Some protrusion; may not be all the way along	Protruding/prominent bone
Shoulder	Rounded	No square look; acromion process may protrude slightly	Square look; bones prominent
Scapula/ribs	Bones not prominent; no significant depressions	Mild depressions or bone may show slightly; not all areas	Bones prominent; significant depressions
Quadriceps	Well rounded; no depressions	Mild depression	Depression; thin
Calf	Well developed		Thin; no muscle definition
Knee	Bones not prominent		Bones prominent
Interosseous muscle between thumb and forefinger	Muscle protrudes; could be flat in females		Flat or depressed area
OEDEMA (related to malnutrition)	No sign	Mild to moderate	Severe
ASCITES (related to malnutrition)	No sign	Mild to moderate	Severe
OVERALL SGA RATING	A	B	C

Adapted from: Detsky et al., 1994⁸; Baxter Healthcare Corporation, 1993; McCann, 1996 (Ferguson, Bauer, Banks, Capra, 1996)©

3. Data Table

Patient	SGA Score	BMI	Potassium	Phosphorus	Calcium	Albumin	# of sessions per week
100	A	25.3	6.4	1.29	9.24	5.1	3
101	A	28.2	7.8	3.5	8.56	4	3
102	A	29.5	5.8	5.88	10.4	4.3	2
103	A	21.3	6.12	2.91	12.4	3.78	3
104	A	24.26		4.67	8.56	4.2	3
105	B	16.35	4.9	4.67	12	3.5	3
106	A	18.68	5.43		12.4	4.4	3
107	B	21.24	5.88			3.3	3
108	A	23.53	5.33	3.1	8.4	3.4	3
109	A	25.49	3.5				1 to 2
110	A	23.83	6.17	3.53	8.04	4.5	3
111	A	20.57	5.73				3
112	A	24.47	5.78			3.4	3
113	A	25.57	5.1	2.41	9.2	3.2	3
114	A	18.8	4.7	5.05	8.6	3.9	3
115	A	18.35	5.6	1.7	8.6	3.9	3
116	B	17.9					3
117	A	17.99	7	2.26	8	3.4	3
118	A	25.7	2.9	3.28	9.2	3.6	3
119	B	21.96	4.5	2.66			3
120	B	16.72	5.5	3.99	8.6	3.2	3
121	B	18.96	3.9	1.11	8.4	2.7	3
122	A	20.92	4.9	4.6	7.7	3.1	3
123	A	19.92	5.7	4.46	9	3.5	3
124	B	19.59	4.7	4.05	8.96	3.3	3
125	A	19.03	6.2	2.38	8.08	4.3	3
126	A	21.1	6.8				3
127	A	26.56					3
128	B	15.42	5	4.86	9.6	3.4	3
129	B	19.85	5.8	2.07	8.8	3.5	3
130	A	24.5	5.8	2.85	7.3	3.6	3
131	A	21.54	6.3	4.02	8.3	3.7	3

Capstone practicum final report grading scheme

Area	Max score	Score
<p><u>The Problem Statement</u> Does the Problem Statement describe specifically what the problem is, which issues the capstone will explore, and why they need to be explored?</p>	4	4
<p><u>Objectives</u> Is the overall objective of the project SMART and clearly stated, providing a clear indication of the expected contribution of the project to the specific organization/institute where the project is conducted? - If included, do specific/secondary objectives clearly outline the steps through which the overall objective will be achieved?</p>	4	4
<p><u>Background and Justification</u> Does the Background to the Study provide a description of: (i) The significant and topical background issues (historical, current) pertaining to the study; (ii) why the project is being undertaken; and (iii) previous work related to the study? It is expected that the Justification of the project should provide a quick sketch of the proposed solution or study approach and briefly explain how it differs from other works – and within this context, it should make a strong case for why the project is needed, how the results of the study would fill this need and be beneficial; and why it is significant.</p>	4	4
<p><u>Layout of the Thesis</u> Brief description of each of the chapters of the entire thesis</p>	2	2
<p><u>Literature review</u> To what level and extent has the candidate reviewed, analyzed, and synthesized relevant previous works? Has the candidate:</p> <ul style="list-style-type: none"> ● reviewed and documented the results of other studies that are closely related to the present study? ● demonstrated that s/he has a comprehensive understanding of the field of study and that he/she is aware of important recent substantive, methodological and theoretical developments in the field of study? ● identified the limitations of past/current research approaches and explained how s/he will build on the strengths of past studies while overcoming their limitations? ● identified potential outcomes of the study and discussed 	4 4 4 4	4 3.75 3.65 3.4

the importance of each?		
<u>Methodology</u>		
Project Design and Method		
<ul style="list-style-type: none"> Does the candidate identify which study design had been adopted/used (if any), and then describe, discuss and justify the choice, relevance, and implementation of the intervention? 	2	2
Measures		
<ul style="list-style-type: none"> What type of data/Indicators has the project measured? 	2	2
Implementation		
<ul style="list-style-type: none"> Does the data collection method appear to be appropriate? Was the data collection tool clearly described? intervention appear to be addressing the root cause (if intervention is applicable)? 	1 2 1	.85 1.75 0
Data analysis		
<ul style="list-style-type: none"> Appropriate analysis method(s), statistical or coding method(s) (if applicable) described with sufficient detail. 	3	2.75
<u>Results</u>		
<ul style="list-style-type: none"> Does the candidate present relevant results, without interpretation? Are the results obtained using the analysis methods described previously in the report? Does the candidate use appropriate tables/figures if applicable? 	2 1 1	1.65 1 .7
<u>Discussion</u>		
<ul style="list-style-type: none"> Does the candidate interpret the results rather than simply restating them? Does candidate discuss the factors contributing to the results (success/failure of intervention, if applicable)? Does the candidate relate the results to the literature? Does the candidate discuss the challenges encountered and steps taken to overcome them? Does the candidate discuss the limitations of the project? 	1 1 1 1 1	.8 0.85 .85 1 1
<u>Conclusion</u>		
Does the candidate provide a clear summary of the project, and does the candidate provide recommendations for follow up and future studies?	5	3.25
<u>Adherence to the Guidelines for Writing Capstone Project Thesis</u>		
The candidate strictly adheres to the guidelines provided for		

preparing the capstone document. Document is prepared with appropriate structure, format and layout (size 12 font, double-spaced, 1-inch margins); text is well developed and coherent; language and style are clear and appropriate; sources and citation style are correct; and references are high quality and relevant.	5	4.5
Total	60	53.75 (89.58%)