University of Nairobi

COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICINE

DEPARTMENT OF CLINICAL MEDICINE AND THERAPEUTICS

DIALYSIS RECOVERY TIME AND ITS ASSOCIATED FACTORS IN PATIENTS UNDERGOING HAEMODIALYSIS AT THE KENYATTA NATIONAL HOSPITAL.

Dr. EBRAHIM YUSUF EBRAHIM

H58/11544/2018

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTERS OF MEDICINE DEGREE IN INTERNAL MEDICINE

SUPERVISORS' APPROVAL

This dissertation for Masters of Medicine in Internal Medicine has been submitted to the Department of Clinical Medicine and Therapeutics with our approval as university Supervisors.

Prof. Seth Mc Ligeyo

MBChB, MMED (Int. Medicine, UON),

Consultant Physician and Nephrologist,

Department of Clinical Medicine and Therapeutics

University of Nairobi.

Signature_____ Date____6/12/2022_____

Dr. Maranga Wambugu

MBChB, MMED (Int. Medicine, UON)

Consultant Physician and Nephrologist,

Kenyatta National Hospital.

Signature_____ Date_____6/12/2022_____

ACKNOWLEDGEMENTS

First and foremost, I would like to thank the Almighty Allah for everything in my life. Without my faith in Him, I would not have been able to achieve all that I have so far.

To my family – my wife Soulthy Azamkhan and Daughter, Zohreen Ebrahim to whom I owe it all.

I would like to extend my gratitude to a number of people whose help has been invaluable in this research.

I wish to express my deepest gratitude to my supervisors, the late Dr. A.J.O Were, Prof. McLigeyo and Dr. Wambugu who have invested immense time and effort to ensure the completion of this proposal.

I would like to pay special regards to my mentors, Dr. Rishad Ali Shosi and Mrs. Husna Haidar, who have been a constant guiding star and whose mentorship has been the foundation of my medical career.

And last but not least, to my friends and classmates who have supported me throughout this process.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS AND ACCRONYMS

A1C	Glycosylated Haemoglobin A1C
ADL	Activities of Daily Living
BFR	Blood Flow Rate
CCI/S	Charlson Comorbidity Index / Score
CFS	Chronic Fatigue Syndrome
CHOIR	Correction of Haemoglobin in Renal Insufficiency
CVD	Cardiovascular Disease
DOPPS	Dialysis Outcomes of Patterns Study
DRT	Dialysis Recovery Time
EDS	Excessive Daytime Sleepiness
ESA	Erythropoietin Stimulating Agents
ESRD	End Stage Renal Disease
HAP	Human Activity Profile
HD	Haemo-Dialysis
HPAA	Hypothalamic Pituitary Adrenal Axis

HRQOL	Health Related Quality of Life
HSCT	Hematopoietic Stem Cell Transplant
MAS	Maximum Activity Score
OSAHS	Obstructive Sleep Apnea Hypopnea Syndrome
PBMC	Peripheral Blood Mononuclear Cell
PDF	Post Dialysis Fatigue
RBD	REM sleep Behavior Disorder

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background: Patients with ESRD on maintenance haemodialysis are known to have reduced Health Related Quality of Life (HRQoL). One of the major factors postulated to contribute to this phenomenon is prolonged Dialysis Recovery Time (DRT), also known as Time to Recovery (TTR) after a single HD session. DRT is defined as the perceived time after completion of HD after which a patient can resume his/her daily activities. DRT is a quantifiable and validated measure of post-dialysis fatigue and serves as a useful indicator of dialysis adequacy. DRT has been shown to be an effective indicator the assessment of risk for hospitalization and mortality.

Objectives : The aim of this was study was to evaluate the Dialysis Recovery Time (DRT) of patients undergoing maintenance HD at the Kenyatta National hospital and to evaluate the factors that influence DRT.

Methods: This was a cross-sectional study carried out at Kenyatta National Hospital (KNH) Renal Unit over a period of 3 weeks. The study population was ambulant patients on maintenance HD for a period of 3 or more months. All those who met the inclusion criteria were enrolled into the study. After attaining an informed consent, the PI and Research assistants screened the dialysis charts for completeness and collected data of interest. Patients meeting the eligibility criteria were asked the internationally validated question “how long does it take you to return to your normal activities after a dialysis session?”. The responses were recorded and categorized into <2 hours, 2 to 6 hours, >6 to 12 and >12 hours. The patients then filled out the Human Activity Profile questionnaire independently or with assistance from a guardian or relative. Exploratory data analysis was done to identify and describe the patterns in the data. Statistically associations between DRT and patient clinical and demographic characteristics were analyzed using Chi- Square and student T-test. Analysis of Variance (ANOVA) was used to analyze the association between DRT and Maximum Activity Score (MAS) / Adjusted Activity Score (AAS).

Results:

A total of 96 patients participated in this study, 51(53.1%) of whom were male and 45(46.9%) female. The mean age was 43.0(± 1.4). 24%, 40%, 26% and 9% of patients reported DRTs of <2 hours, 2 to 6 hours, >6 to 12 hours and > 12 hours respectively. Longer DRTs were associated with IDWG (p= 0.030, 95% CI= 0.39 - 0.95) and UFR (p= 0.026, 95% CI= 0.80 - 0.99). Male patients were at least 3 times as likely to recover faster than females (OR = 3.25, 95%CI= 1.15 - 9.19). No statistical association was found with Age, dialysis vintage, marital status, education level, Pre-/ and Post-HD BP, BMI, dialysis access or blood flow rate. The mean Maximum Activity Score (MAS) and mean Adjusted Activity Score (AAS) was 63.9 (±14.9) and 56.7 (±18.5) respectively, both of which were found to have a statistically significant association with DRT; MAS (p=<0.001) and AAS (p=<0.001).

Conclusion:

This study finds that patients at the KNH renal unit have significantly prolonged DRT with lack of physical exercise, poor physical functioning and sub-optimal fluid control (as depicted by uncontrolled pre-dialysis BPs and IDWG) being the main factors responsible.

CHAPTER 1: INTRODUCTION

In 2008, the WHO estimated that 36 million of the 57 million global deaths were due to non-communicable diseases, chiefly chronic kidney disease, cardiovascular diseases, cancers, chronic respiratory diseases and diabetes, 9 million of whom were below the age of 60 and approximately 80% of those deaths occurred in developing countries like Kenya (1). Omran et. al recognized that chronic kidney disease was part of an epidemiological transition and a component of a new epidemic of diseases that were replacing infectious, degenerative diseases and malnutrition as an important cause of mortality in developing countries (2).

Global studies estimate the prevalence of chronic kidney disease as 10% of the general population (3). There exists a paucity of reliable statistics in Kenya with regards to chronic kidney disease and end stage renal disease, there however exists an abundance of studies in Sub-Saharan Africa, studies of which may represent the Kenyan population. Chronic kidney disease is at least 3 to 4 times more frequent in Africa than in developed countries (4). Recent studies have shown that the African population is at an increased risk of developing CKD and progression to ESRD (5,6), this is especially true in black diabetic patients (7).

ESRD patients require one of the two forms of Renal Replacement Therapy (RRT), with a 2005 study indicating that haemodialysis remains the most employed modality of renal replacement in 90% of patients (8).

Despite being a lifesaving intervention, HD has been associated with a significantly high symptom burden, with studies showing that on average a patient experiences 11 haemodialysis related symptoms (9), fatigue being the most commonly reported symptom in over 70% of patients (10). In a 2018, Flythe et al studied HD patients across 27 states in the USA and reported that 94% of the patients reported experiencing some level of fatigue, with 38% of the patients prioritizing fatigue as the most important symptom for which better treatment needed to be found (11).

Even though fatigue is a widely recognized dialysis related symptom affecting patients' quality of life, studies in Africa are lacking, with only one study in Egypt that is yet to be

concluded (12). This study will therefore be the first of its kind in the Africa, and will provide a much-needed insight into patients' levels of fatigue in our setup.

CHAPTER 2: LITERATURE REVIEW.

2.1. DIALYSIS RECOVERY TIME

Dialysis Recovery Time (DRT) is defined as the **perceived time after completion of haemodialysis after which a patient can resume his/her daily activities** (13). DRT is a quantifiable and validated measure of Post Dialysis Fatigue and serves as an effective indicator of a patient's HRQOL (14). The DRT survey is now recognized as a validated tool for the assessment of the DRT of a patient (15).

2.2. DIALYSIS RECOVERY TIME (DRT) SURVEY

The patient is simply asked "**how long does it take you to return to your normal daily activities after a single dialysis session"**. This survey first came into use in 2003 during the "London daily/nocturnal haemodialysis" study that followed up patients that were randomly assigned to undergo either daily in-center HD or nocturnal home-based haemodialysis and assessed whether they would have comparable or different outcomes. During this study, in a bid to assess differences in Post Dialysis Fatigue amongst the two interventions, the DRT survey was used, albeit unvalidated at the time (16). In 2006, Linday et al assessed the DRT survey for reliability over time, construct validity and sensitivity to change using standard methods. Linday et al was able to show that the DRT survey had a highly significant test-retest correlation over 3-months. Convergent construct validity was established by significant correlations between the DRT question and fatigue, the SF-36 vitality sub-scale, the health Utility index, dialysis and disease stress. Divergent construct validity was established by the lack of correlation between DRT question and the SF-36 psychosocial and emotional subscales, dialysis-related stressors e.g. dialysis access difficulties and malfunction of equipment (15).

Although the DRT survey is a simple tool, its use has been shown to be very important in the regular assessment of patients, as discussed below;

DRT has been shown to be an effective tool for identification of patients with poor HRQOL. Lindsay et. al noted that DRT had a positive association with psychosocial stress with patients that had prolonged DRTs having significant interference with their daily lives and decreased interest to engage in social-leisure activities (17). This view was further

supported by a 2018 study that showed a positive association of prolonged DRTs and depressive symptoms (18).

An analysis of the Dialysis Outcomes and Patterns of Practice Study (DOPPS) by Mapes et. Al showed a positive relationship between HRQOL and increased risk of hospitalization and mortality (17). In a recent study presented at the 2019 American Society of Nephrology (ASN), Vladimir et. Al presented a study depicting significant increase in hospitalization rates with successive increase in dialysis recovery times. Patients had admission rates ranging from 1.62, 1.61, 1.76 (DRT of 30 minutes) to 2, 2.11, 2.62 (DRT of 2 to 4 hours) at 6, 12 and 24 months respectively (13).

The prevalence of Protein-Energy Malnutrition (PEM) among patients with ESRD ranges from 23 to 73% (19–22). Malnutrition, depicted by hypoalbuminemia, has been identified as an independent predictor for increased morbidity and eventually mortality (23). Among the causes of hypoalbuminemia is anorexia attributed to long Dialysis Recovery Times (DRTs) and Post-Dialysis Fatigue (PDF) (24).

Increased Dialysis recovery time was associated with reduced physical activity and hence a sedentary lifestyle in one study(14), with >67% of patients in another study citing PDF as their main reason for reduced physical activity and lack of participation in exercise (25). Fatigue has been identified as an important predictor of cardiovascular events, independent of other more conventional risk factors, including age, diabetes and Cardiovascular disease history (26). PDF has been postulated to be part of the “Bermuda Triangle” due to its relationship with dialysis-induced Wall Motion abnormalities (WMAs) and cardiovascular death (27).

2.3. STUDIES ASSESSING DIALYSIS RECOVERY TIME

Study	Year	Location	Sample size	Results
Guedes et al (28)	2019	USA	98,616	19.1% < 1hour 22.9% > 4hours
Bossola et al (29)	2019	Italy	210	Median DRT: 180 minutes (60 – 420)
Rayner et al (17)	2014	12 countries	6040	32% < 2 hours 41% 2 to 6 hours 17% 7 to 12 hours 10% >12 hours
Awuah et al (30)	2013	USA	267	Mean DRT 246 ± 451 minutes
Antari et al (31)	2018	Indonesia	185	Mean DRT 578 ± 402 minutes

Table 1: Studies assessing DRT

Guedes et al examined data from 98,616 ESRD patients performing HD at a large dialysis organization in the USA, and reported that 19.1% of patients reported DRTs of > 1 hour with more than 22% reporting DRTs of >4 hours. They noted that factors that were associated with longer DRTs included the type of dialysis access used, lower albumin

concentrations, sodium profiling, parathyroid hormone levels, lower Kt/V, ultrafiltration volumes and the number of dialysis sessions per week. They also found that the interdialytic weight gain and phosphate levels had no effect on DRT (28).

Bossola et al assessed 210 patients from 5 HD centers in central Italy and reported a median DRT of 180 minutes (60 – 420) with 45% (95 patients) having a DRT above the median. The study also noted that patients with lower DRTs had higher ultrafiltration rates and were treated with lower dialysate temperatures. They also assessed the patients ' functional status using the Katz ADL test and noted that patients that were more independent in performing their daily activities had lower DRTs (29).

In a study carried out in 2014, Rayner et al assessed the DRTs of 6040 patients in 12 countries including Australia, Belgium, Canada, France, Germany, Japan, Italy, New Zealand, Spain, Sweden, United Kingdom and the USA. In the study, 32% of the patients reported DRTs of less than 2 hours, 41% reported DRTs of between 2 to 6 hours and 27% reported DRTs of more than 7 hours. It was noted that longer recovery times were associated with a greater IDWG and a longer dialysis session duration (17).

Awuah et al studied 267 ESRD patients receiving treatment at The Yale New Haven hospital. Patients were followed up over 3 consecutive HD sessions and reported mean DRTs of 246 ±451, 230 ±422 and 245 ±413 respectively, showing a strong test-retest correlation between the sessions. This study noted no significant relationship between the DRT and patients age, gender, number of comorbidities, dialysis vintage and dialysis session duration. It was however noted that DRT had a significant association with ultrafiltration (30).

A study carried out in West Java, Indonesia involving 185 ESRD patients on HD showed a mean DRT of 578 ± 402 minutes. Longer DRTs were associated with larger upper arm circumference, multiple comorbidities and a larger intradialytic weight loss (depicting a larger interdialytic weight gain and ultrafiltration). Patients with multiple intradialytic complications also reported longer DRTs (31).

2.4. PATHOPHYSIOLOGY OF POST-DIALYSIS FATIGUE

In patients undergoing haemodialysis, several factors have been postulated as contributory to, or causative of post-dialysis fatigue, thereby prolonging the time to recovery after dialysis. Some of these factors can be categorized into individual characteristics, treatment-related, behavior-related and physiological (32).

2.4.1. INFLAMMATION

Post dialysis fatigue is part of a clinical constellation of symptoms (in-activity, anorexia, somnolence, hyperalgesia and allodynia) called the “sickness behavior” with multiple clinical and animal studies showing its influence by pro-inflammatory cytokines (33). Several studies have shown the relationship between chronic illnesses for example cancer, cardiovascular and renal disease with chronic activation of inflammation with production of pro-inflammatory cytokines (23,34–36).

In patients with ESRD, the interaction of Peripheral Blood Mononuclear Cells (PBMCs) with the dialysis membranes leads to chronic activation of the PBMCs leading to overproduction of interleukin-1 and 6 (37). During the course of inflammation, IL-6 plays a major role during the hepatic acute phase response, stimulating (up to 1000-fold) the hepatic synthesis of C-Reactive Protein (CRP) and Serum Amyloid A (SAA) and reducing the circulating levels of albumin (considered a negative acute phase reactant in haemodialysis patients (38–40)), pre-albumin and transferrin (41,42). In one study, Maria Et. Al showed a relationship between increased serum IL-6 levels in ESRD patients and increased energy expenditure (43).

Cytokines also contribute to fatigue secondary to their direct effects on the central nervous system, Hypothalamic Pituitary Adrenal Axis (HPAA) or indirectly by triggering a multi-system deregulation due to chronic inflammation (44).

2.4.2. ANAEMIA

The effect of anaemia on pre-dialysis patients have provided contrasting views on the relationship of anaemia and fatigue. The Correction of Haemoglobin Outcomes in Renal Insufficiency (CHOIR) and the Cardiovascular Risk Reduction by Early anaemia Treatment with Epoietin Beta (CREATE) study compared HRQOL in patients with higher-

normal HB (13 to 15 g/dl) with patients with Lower HBs (10 to 11.5 g/dl). The CREATE study showed a significant improvement in HRQOL, with patients with patients with higher Haemoglobin levels having less fatigue compared with patients with lower Haemoglobin levels. The CHOIR study showed no significant change in HRQOL and fatigue between the two groups (45,46).

However, studies in patients on haemodialysis and peritoneal dialysis have shown that anaemia has a significant effect on the severity and duration of fatigue and ultimately on the HRQOL. In a study carried about by Moreno et al for the Spanish Cooperative Renal Patients Quality of Life Study Group of The Spanish Society of Nephrology showed an increase in haemoglobin (to normal range) by administration of Epoetin (ESA) had a significant effect in improving HRQOL, fatigue, functional status of patients, reducing frequency of hospitalizations and reduced hospital stay (47). An Open label study by Evans et al of haemodialysis Patients treated with epoetin and followed up for a period of up to 16 months showed significant improvement in most of the parameters in the Kidney Disease Questionnaire (KDQ), the sickness Impact Profile and the Nottingham Health Profile which included improvement in functionality, activity and energy sleep and eating, libido, psychological effect, well-being, behaviour and satisfaction with health (48). Baranay et. Al performed a long-term study in which 24 patients on haemodialysis were assessed by way of a questionnaire for physical, social and emotional well-being before treatment when the HB was 7.3mg/dl (+/- 1.1mg/dl), when HB reached 10mg/dl (1 to 7 months) and one year after correction of anaemia. It was noted that patients treated with erythropoietin to normality of HB had significant improvement in satisfaction with health, day to day physical activity and significantly reduced fatigue (49). Muirhead et. Al performed a double blind, placebo-controlled, randomized trial for the Canadian Erythropoietin group, where patients were grouped into the placebo group, low haemoglobin group (treated to a HB of 9-11.5g/dl) and high haemoglobin group (treated to HB of 11.5 to 13g/dl). Patients treated with erythropoietin reported significantly reduced fatigue and scored better on relationships (50).

2.4.3. SLEEP

Sleep has been hypothesized to impact fatigue by the effect of certain pro-inflammatory cytokines and disturbance of sleep by sleep disorders causing day time sleepiness. A large study carried out in 20 Italian dialysis centers involving more than 800 patients on maintenance haemodialysis showed that 80% of patients demonstrated at least one form of sleep disorder, including insomnia (69.1%), RLS (18.4%), OSAS (23.6%), EDS (11.8%) and possible RBD (2.3%) (51). A study conducted on 90 patients undergoing chronic haemodialysis at a Centre in Egypt showed the prevalence of sleep disorders being 79.5%, with the prevalence of the individual sleep disorders being similar to the study in Italy (52). Other studies have gone on to show the negative effect of sleep disorders on physical and mental activity, vitality, body pain and ultimately HRQOL (53).

Several studies have shown the physiologic role of cytokines on sleep with the most notable cytokines implicated being IL-1beta, TNF-alpha, IL-10 and IL-12. In healthy individuals, administration of IL-1beta and TNF-alpha were shown to have a regulatory role in NREMS with higher levels increasing time in NREMS eventually leading to poor sleep hygiene (54) with IL-6 and TNF-alpha noted to play a role in the disruption of circadian rhythm and have an association with OSA independent of obesity (55–57).

IL-6 is noted to have an effect on the regulation of the amount and the depth of sleep with increased IL-6 levels associated with poor sleep (58). Increased levels of IL-1B and TNF-alpha have been noted to have an association with sleep disordered breathing in patients on maintenance haemodialysis (59).

In a study carried out on patients undergoing peritoneal dialysis (PD), patients with high levels of IL-18 were noted to be poor sleepers based on the Pittsburgh Sleep Quality Index (PSQI) (60).

2.4.4. DEPRESSION

Depression is the most common psychiatric disorder in patients with ESRD with studies showing prevalence rates that range between 15% to 69% (61–63). Depression and fatigue are interrelated with depression manifesting as tiredness and lethargy. Furthermore, Depression has been shown to worsen the severity of symptoms like fatigue

in patients with ESRD (9). Depression may contribute to post-dialysis fatigue by inflammatory and immune pathways. Depression has been shown to be associated with both the cellular and humoral arms of immunity including decreased proliferation of T-lymphocytes, decreased activity of Natural Killer cells (NK-cells) and increased production of cytokines including IL-1,6 and IFN-Gamma (64,65).

Studies in older people have also demonstrated an association between major depression and IL-6,8 and TNF-alpha (66). Lee et al established that administration of antidepressants led to a decrease in the levels of IL-1beta, independent of whether the patients had a positive response to the treatment. In addition, Patients who responded to SSRIs were shown to have lower levels of IL-6 as compared to the non-responders (67).

2.4.5. PHYSICAL INACTIVITY

Lack of physical activity is associated with worsening of dialysis related symptoms including fatigue (68). Studies have gone ahead to show that acute exercise triggers an inflammatory response with an increase in overall white blood cell counts, cytokines including IL-1 and CRP, contrary to regular and maintained exercise that triggers an anti-inflammatory response with reduction of pro-inflammatory mediators (69–71). Catabolism has been shown to be increased in non-diabetic HD patients which may be caused by insulin resistance, acidosis and inflammation. This may in turn lead to muscle fatigue and contribute to physical inactivity (72,72).

2.4.6. REGIONAL WALL MOTION ABNORMALITIES

A study by Burton et. Al showed intra-dialytic myocardial stunning in 64% of patients, depicted by regional wall motion abnormalities (WMAs) of >20% in 2 or more regions on electrocardiogram that occur during dialysis and can persist up to half an hour after completion of the session. This confirmed the presence of myocardial ischemia during dialysis (73). Dublin et. Al found a significant association between symptoms of PDF and intradialytic WMAs, showing that the prevalence of severe PDF in participants with worse WMAs was 50%, compared with those who had unaltered or improving WMAs. They further showed that each one-point increase in WMA score was associated with 10% higher relative risk of severe PDF (74).

2.4.7. INTERDIALYTIC WEIGHT GAIN

Interdialytic weight gain (IDWG) is believed to be a consequence of salt and water intake between two consecutive dialysis sessions and is being used increasingly as a parameter in the assessment of fluid intake, taking into account the patient's daily urine output (75). IDWG is also a reliable indicator of dialysis outcomes as an IDWG of >4% is associated with an increase in all-cause mortality (26). Ryoung et al studied Korean patients on maintenance haemodialysis and showed a significant correlation between fatigue and IDWG (76).

2.4.8. HAEMO-DIALYSIS RELATED FACTORS

Several dialysis related factors have been shown to have an effect on PDF thereby increasing DRTs. These factors include Ultrafiltration Rate (UFR), falls in intra-dialytic systolic BP, greater inter-dialytic weight loss, dialysate sodium concentration, longer dialysis session duration, dialysis frequency, dialysate temperature and interdialytic physical exercises.

2.4.8.1. Intra-dialytic physical exercise.

Intra-dialytic physical exercise is a frequent recommendation given in order to encourage patients to be physically active. Studies have shown that intra-dialytic exercise is effective in reducing the severity of fatigue and in treatment of sleep disorders (77), improving exercise tolerance (78), psychosocial stress and ultimately HRQOL (79).

2.4.8.2. Intra-dialytic systolic BP falls

Patients undergoing haemodialysis often experience fluctuation in blood pressure during treatment and this has been shown to be associated with post-dialysis fatigue. In a study carried out in January 2020 by Yoowannakul et al in dialysis centers within London, the investigators showed that patients that had both asymptomatic and symptomatic intra-dialytic hypotension (defined as a drop of SBP of >20mmHg) reported more dialysis related symptoms (including dizziness, headache, back pain and muscle cramps) as well as increased dialysis recovery times (80).

2.4.8.3. Cool temperature dialysate.

In a study carried out by Azar et al on 50 clinically stable HD patients in Egypt showed that reducing the dialysate temperature from the conventional 37°C to 35°C led to a reduction in DRT and improved dialysis symptom scores with patients reporting that they preferred dialysis with the dialysate set at 35°C (81).

2.4.8.4. Ultra-filtration Rate (UFR)

Data on the correlation between Post-dialysis Fatigue and UFR are few and have provided conflicting and non-assuring results. UFR is a function of the amount of fluid removed during a dialysis session (filtration) and the session length (treatment duration) (82). A study carried out by Bossola et al on 210 HD patients from 5 dialysis units in central Italy showed an inverse relationship between DRT and UFR. In this study, DRT was significantly lower in patients with UFR >13mL/kg/hr as compared to patients with a UFR of 10mL/kg/hr (29). In the landmark DOPPS study, Lindsay et al showed that patients with both slow and fast UFR (<5mL/kg/hr and >15mL/kg/hr) reported lower DRT as compared to patients with UFR of 5-15mL/kg/hr (15). The pathophysiologic mechanisms that lead to this inverse relationship between UFR and DRT remain unclear, although it has been hypothesized that UFR may influence the production of cytokines as described by Müller-Steinhardt et al where it was shown that a stepwise reduction in UFR resulted in the increased production of IL-10 and reduced production of IL-1β (83).

2.4.8.5. Demographic factors.

In a study carried out by Caplin et al to assess the perspective of haemodialysis associated symptoms to patients, it was shown that PDF was the most frequently reported symptom (84%) with the symptom burden being significant in the female sex, younger patients, longer dialysis sessions. The time taken to recover from dialysis was significantly shorter in men and those with greater dialysis vintage (84).

2.5. IMPROVING POST DIALYSIS FATIGUE.

2.5.1. Dialysis adequacy.

Dialysis adequacy is defined as the level of treatment at which a patient is fully rehabilitated with no signs and symptoms of uraemia (85). Several factors have been

shown to alleviate patients 'post-dialysis fatigue, with improvements in dialysis adequacy representing one of the most modifiable and less intrusive methods. Guedes et Al followed up patients for 2 years and showed that patients with DRTs of > 4 hours had significant improvement in post dialysis fatigue with improvement in dialysis adequacy (28).

Due to the ease of use, the two most common methods of assessing dialysis adequacy are the Kt/V and the Urea Reduction Ratio (URR), with Kt/V being the most preferred formula in clinical guidelines. Kt/V is defined as a multiple of the dialyzer clearance of urea (K) by the duration of dialysis treatment (t) divided by the (V) volume of distribution of urea (which is equal to the volume of distribution of water in the same patient). URR as the name suggests, is calculated by subtraction of the post-dialysis BUN from the pre-dialysis BUN. The Kidney Disease Outcomes Quality Initiative (KDOQI) recommends a URR of >65%, a single-pool Kt/V of 1.4 per HD session for patients treated three times weekly and a single-pool Kt/V of 1.2 for patients on two times per week HD sessions, with the target recommended dose for all patients being 1.4 per HD sessions. Target Kt/V of more than 1.4 has not been shown to have any benefit in reducing hospitalization rates or improving survival (86).

One suggested method of improving dialysis adequacy and hence Kt/V includes the use of high flux dialyzers. A high flux dialyzer is defined as one that has a ß2-microglobulin clearance of more than 20mL/min. High flux membranes have larger pores that allow the removal of larger amounts of uraemic toxins, these include the small water-soluble compounds e.g. urea, the protein bound solutes e.g. indoles and phenols and the larger sized molecules e.g. ß-macroglobulin – all of which have been shown to have an effect on PDF (87).

The frequency and time on HD treatment have an effect on improving the dialysis adequacy. It is recommended that every ESRD patient should undergo three HD sessions weekly, regardless of the Kt/V. This is in contrast to the norms in Kenya, whereby most patients undergo two HD sessions per week. This due to the fact that the majority of patients rely on the NHIF to finance their treatments, with NHIF strictly covering for only two weekly sessions. The 2015 National Kidney Foundation's KDOQI guidelines

recommends that patients that have little or no residual kidney function (defined as eGFR of <2mL/min) should undergo three-times weekly HD treatments with a minimum of four hours per session (88). Despite the guidelines advocating for treatment sessions of not less than 4 hours, the TiME trial (Time to Reduce Mortality in End-Stage Renal Disease Trial) showed that some of the reasons for poor adoption of longer dialysis durations were the unwillingness of patients to undergo longer treatments, perception of nephrologists that longer sessions were unnecessary due to adequate urea clearance and perception that longer sessions were unnecessary for older patients (89). Other factors associated with shorter dialysis durations include the late arriving patient, late initiation of HD by dialysis nurses, early termination of dialysis by request of the patient and acute events that necessitate early cessation of treatment e.g. intradialytic hypotension, blood leak and frequent machine alarms due to high venous pressures.

Nocturnal haemodialysis is increasingly being prescribed in centers around the world as a method of increasing treatment time thereby increasing dialysis adequacy and in the long run improving patients fatigue scores and improving their HRQoL and survival. Nocturnal HD is slower, longer haemodialysis that is carried out while the patient is asleep. It can be performed at home or in hospitals and haemodialysis centers. Advantages of nocturnal HD include increased solute clearance (of all molecular sizes), improved control of calcium, phosphate and parathyroid hormone – thereby reducing the incidence of mineral bone disease and improved cardiovascular outcomes with better control of blood pressure, volume and reduced left ventricular mass. The major drawback for the implementation of nocturnal haemodialysis is the cost. The London Daily / Nocturnal haemodailysis study followed up patients for 5 to 36 months and compared conventional HD to nocturnal HD. This study showed that nocturnal HD was more physiologic than conventional HD and was associated with improved post-dialysis fatigue (16,90).

Increasing the Blood Flow Rate (BFR) has also been shown to have a positive effect in increasing dialysis adequacy. BFR is defined as the volume of blood being filtered through the dialyzer per unit time (Minutes). Borzou et Al studied HD patients in two groups, one group with BFR of 200 mL/min and the other group with 250 mL/min. 16.7% of patients in the BFR 200 mL/min had Kt/V of more than 1.3 while 26.2% of patients in the BFR 250

mL/min had Kt/V of more than 1.3, results of which showing that higher flow rates were associated with increased dialysis adequacy (91). The results of this study were consistent with a study carried out by Kim et Al that showed that the adequacy of dialysis was improved by simply increasing the BFR by 15 to 20% (92).

2.5.2. Cool temperature dialysate.

Cooling the dialysate temperature below the conventional 36.5^{o}C is recognized as an important factor that improves haemodynamic stability in patients undergoing HD. Studies conducted to assess the effect of a cool dialysate show an improved cardiovascular tolerance with reduced episodes of intradialytic hypotension. Reducing the dialysate temperature becomes essential in patients with cardiovascular instability associated with increased ultrafiltration rates, allowing more fluid removal without compromising the efficacy of dialysis. The effect of cold temperature HD is associated with increased peripheral vascular resistance, increased venous vascular tone and improved ventricular contractility (93).

A study carried out by Ayoub et Al and published in the journal of nephrology, dialysis and transplantation assessed the effect of a cool dialysate on haemodynamic stability and dialysis adequacy using the URR. Patients were divided into two groups – those dialysed with a dialysate temperature of 36.5^{o}C and a second group dialysed with a temperature of 35^{o}C. Patients in the 35^{o}C temperature group had better tolerance to higher ultrafiltration rates with >80% reporting dramatic improvement in general health and feeling more energetic. 80% of these patients also requested that they always be dialysed with a cool dialysate (94).

2.5.3. Sodium profiling.

Sodium profiling is a method employed during the course of dialysis that involves deliberately changing the dialysate sodium concentration in-order to ameliorate the side effects associated with dialysis. Sodium profiling has been shown to avert muscle cramps, symptomatic hypotension and disequilibrium syndrome, all of which have are known to contribute to post-dialysis fatigue. Sodium profiling involves initiating dialysis with a hyperosmolar dialysate sodium concentration then gradually decreasing the dialysate sodium concentration proportionately to eventually complete dialysis with an iso-osmolar

dialysate (usually a sodium concentration of 138 mEq/L). The rationale of starting dialysis at higher dialysate osmolality (Na^+ 148) is to counteract the decrease in osmolality caused by removal of urea and other solutes (95).

Sadowski et Al studied the effects of sodium profiling in non-diabetic young ESRD adults (age 16 to 32) without advanced cardiovascular disease. Patients were followed up over an 8-week duration where they were assigned to two groups; the intervention group that would undergo HD with sodium profiling and the control group that would undergo HD using conventional sodium concentrations. Patients were then assessed for intradialytic symptoms including cramps, headache, nausea and hypotension as well as interdialytic symptoms including thirst, fatigue and cramps. this study showed a significant improvement in both the intra- and inter-dialytic symptoms with sodium profiling (96).

2.5.4. Physical exercise.

Physical exercise in patients on maintenance HD is becoming increasingly appreciated as a means of improving physical functioning. Several factors have been identified to contribute to the reduced physical functioning of patients on ESRD including a decreased functional capacity, reduced flexibility and impaired coordination due to cardiovascular disease, uraemic myopathy, mineral bone disease, anaemia and fatigue.

ESRD patients are advised to gradually start a physical exercise routine involving most days of the week (at least 5 days a week) and during dialysis sessions. It is also recommended that the physical exercise last for a duration of not less than 30 minutes.

The modes of exercise training that have been proposed for patients on HD include:

a. A supervised program carried out in a rehabilitation center.
b. A home exercise program, initially being supervised by a trained physical exercise instructor.
c. An exercise program carried out three times a week during HD for 30 minutes per session, performed during the first 2 hours of dialysis (97).

CHAPTER 3: STUDY JUSTIFICATION

Despite being a lifesaving intervention, local and international studies have shown that patients on HD have increased morbidity and mortality as compared to the general population. There has been increased interest internationally on methods to improve HD effectiveness as well as identify causes of increased mortality in ESRD patients. Over the last 5 years, PDF has been postulated to be a significant contributor to patients' poor outcomes on HD. DRT being an internationally accepted measure of PDF and a surrogate marker of dialysis adequacy and effectiveness, serves as an important predictor of adverse outcomes in ESRD patients on HD.

This study will be a first of its kind carried out in East Africa, the results of which will inform on the need to regularly assess the DRT of patients on HD and point out areas of a patients' HD prescription that can modified and tailored in order to reduce the risk of hospitalization, cardiovascular morbidity and mortality (13).

The results of this study will build on the current knowledge on the practices of HD at the KNH and highlight the need (or lack thereof) of improving the current NHIF dialysis package to three times a week treatment, rather than the current two treatments per week.

DRT being an effective method of identifying patients with poor HRQoL, this study will build upon the pervious study carried out by Kamau et al that showed that patients at the KNH renal unit had significantly reduced Health Related Quality of Life (HRQoL) (98).

CHAPTER 4: RESEARCH QUESTION AND OBJECTIVES

4.1. RESEACH QUESTION

What are the levels of post-dialysis fatigue experienced by patients undergoing maintenance haemodialysis at the KNH renal unit as determined using the DRT survey and what are the factors influencing it?

OBJECTIVES

4.2. BROAD OBJECTIVE

To determine the Dialysis Recovery Time (DRT) of patients on maintenance HD at The KNH and to determine its association with selected clinico-demographic variables and physical functioning.

4.3. SPECIFIC OBJECTIVES

4.3.1. Primary objectives.

- To determine the Dialysis Recovery Time (DRT) of patients attending haemodialysis at KNH.

4.3.2. Secondary objective.

- To correlate DRT with selected patient clinico-demographic variables.
- To determine the correlation between DRT and physical functioning using the HAP questionnaire.

CHAPTER 5. METHODOLOGY

5.1. STUDY DESIGN

This study adopted a cross-sectional analytic design with data being collected from selected patients undergoing maintenance haemo-dialysis (HD) at KNH.

5.2. STUDY AREA DESCRIPTION

The study was conducted at the Renal Unit in KNH.

KNH is a level 6 National Referral Hospital. It is located in Upper Hill in Nairobi. It was founded in 1901 as a native civil hospital and has since grown in bed capacity, from a 40 to an 1800 bed capacity. The Renal Unit at KNH has been operational since 1972 and receives the greatest number of ESRD patients requiring HD from all areas within Nairobi. The Renal Unit has 27 HD machines with an estimated 20 HD machines fully functional at any given time. On average, 60 HD sessions are performed daily. Statistics point towards 240 HD sessions weekly, with an estimated 140 ESRD patients attending regular haemodialysis.

The rationale for selection of KNH was based on the fact that this center has the optimal number of patients to meet the desired sample size and due to its status as a National Referral Hospital, will provide an optimal variation in patient characteristics. Dialysis sessions in all the centers in Kenya are financed by the NHIF medical cover which only covers for 2 haemodialysis sessions per week, with only a handful of patients in any given dialysis center undergoing 3 weekly dialysis sessions. Due to this fact, most patients in KNH and other dialysis facilities in the country undergo only 2 dialysis sessions and hence carrying out this study in any other dialysis centers will not add benefit to the study in terms of patient or dialysis characteristics.

5.3. STUDY POPULATION

The target population in this study comprised of patients with a confirmed diagnosis of ESRD and on maintenance haemodialysis for a duration not less than 3 months.

5.3.1. Inclusion criteria

- Patients aged 18 years of age or more undergoing intermittent haemodialysis at KNH.
- Patient should either be literate or have a literate relative or guardian to aid in filling questionnaire.
- Patient should give a written informed consent in-order to participate in the study.

5.3.2. Exclusion criteria

Patients undergoing Haemodialysis with the following will be excluded;

- Incomplete or inaccurate dialysis chart records.
- Patients with a confirmed and documented diagnosis of dementia or cognitive impairment.

5.4. SAMPLE SIZE ESTIMATION

DRT, the main outcome of this study is a continuous variable. Sample size was therefore calculated using the formula for estimating population variance for a continuous outcome. The reference for the sample size calculation will be drawn from study by Kwabena et.al that reported an average DRT of 241 minutes and a standard deviation of 451 minutes (29).

$$n = \left(\frac{Z\frac{\alpha}{2} * \sigma}{d}\right)^2$$

Where:

n = minimum sample size required

$Z_{\alpha/2}$ = Standard normal distribution critical value at α-level of significance (α=0.05, $Z_{\alpha/2}$=1.96)

σ = Estimated standard deviation of DRT among patients from a previous study (σ=7.5 hours (Kwabena et al.).

d = Desired margin of error (d= +/- 1.5 hours)

Using the above formula, the minimum sample size that was used was **96 patients.**

5.5. SAMPLING METHOD

Study participants were selected using convenience sampling.

5.6. PARTICIPANT SCREENING AND RECRUITMENT

The principal investigator (PI) and trained research assistants reviewed the daily outpatient HD sessions bookings in order to ascertain the number of patients booked for the day and to prevent double sampling - this data was available at the entrance and was kept in a booking register by the guard on duty. In the event this was not accessible at the renal unit entrance, the daily booking was accessed at the dialysis items store at the ground floor of the renal unit.

Prior to initiating HD, patients (or their relatives) are requested to obtain their dialysis files at the records office, they then report to the dialysis items store to collect (purchase) the dialysis items after which the patient is reviewed by the Medical officer in the renal unit or the head nurse in order to ascertain that the patient is stable to undergo treatment. This assessment takes place at the clinician's desk. It is at this point that we recruited patients into the study. After the patient was cleared for treatment, the PI and research assistant took the patient through the purpose of the study and provided the patient with in-depth information, and answered any questions they had. The patients were then taken through the consent form.

Upon receipt of consent to take part in the study, the patients biodata was recorded, their anthropometric measures taken and recorded and the HAP questionnaire handed to them, which they filled once dialysis was commenced. The regular HD treatment session takes 4 hours, during which it is recommended that a patient take part in constructive activities and/ or physical exercise. This was sufficient time to fill out the questionnaire, which was collected when the patient was leaving the unit. While the patient was on HD and filling out the questionnaire, the patient's dialysis file was scrutinized for the required HD prescription variables of interest.

5.7. DATA COLLECTION

A study Proforma was used to capture individual patients 'demographic and clinical characteristics. These included the name, age, gender, dialysis vintage (see definition below), marital status, area of residence, level of education and employment status.

The patients 'dialysis files, that contains all the patients 'dialysis charts, was used to collect additional data that will then be filled into the study pro-forma. This data included:

1. Weight – the patient's weight during the last 8 dialysis sessions was recorded. The weight and height will be used to calculate the:
    a. The interdialytic Weight Gain (IDWG) - subtraction of the weight between the two consecutive sessions.
    b. BMI – weight divided by the height and recorded in Kg/m^2
2. The patients' dialysis details were also collected from the dialysis charts and files and recorded in the study pro-forma. These included the:
    a. The number of dialysis sessions per week.
    b. The patient's dialysis duration, in hours.
    c. The average pre-dialysis blood pressure.
    d. The average post-dialysis blood pressure.
    e. Average ultrafiltration Rate (UFR).
    f. Blood flow rate (BFR).
3. The question "how long does it take you to return to normal activities after a dialysis session" was then be posed. The answer was recorded in Hours. This question posed in English and Kiswahili depending on the patient's preference. Ability to understand this question was also be used to determine which study participants will receive the English or Kiswahili HAP questionnaire.
4. The patient was then be handed a Human Activity Profile (HAP) questionnaire to fill out – assistance by a literate guardian or relative was allowed in the presence

of the PI or research assistant to prevent the questionnaire being filled by the guardian instead of the study participant. From the HAP, two scores were obtained;

a) Maximum Activity Score (MAS): representing the highest oxygen-demanding activity the patient is still able to perform.

b) Adjusted Activity Score (AAS): which is derived from subtracting the activity the patient is unable to perform from the MAS. The AAS reflect the patient's typical daily activity.

5.8. DATA COLLECTION TOOLS.

a) A study proforma

b) Structured Human Activity Profile (HAP) Questionnaire.

The Human Activity Profile is a 94-item self-reported tool, initially developed by Daughton et al in 1982 to assess energy expenditure and physical activity of patients with pulmonary diseases (99).

Since its inception, the HAP has been used in clinical practice and healthcare research due to its ease of use and low cost as compared to other forms of physical activity assessment for example podometers and accelerometers.

The HAP has been used to objectively assess physical activity and functioning in a multitude of conditions including osteoarthritis, post hematopoietic stem cell transplant (HSCT), geriatric patients with chronic pain, COPD and multiple sclerosis (100–103). The HAP questionnaire was validated for use in patients with CKD in a study by Robinson et al (104), and later used by Bonner et al to evaluate patients with CKD, showing that the HAP is a valuable tool for the assessment of physical activity in this cohort (105).

The items on the list are arranged in order based on the energy expenditure required to complete the activity. The activities range from the very easy to perform and which require the least amount of energy (getting up from a chair or bed) to very strenuous activities (running for 5km). It requires the respondent to indicate which activities they are still doing, the activities that they have stopped doing and the activities that they have never done.

Two scores are calculated from the HAQ questionnaire;

Maximum Activity Score (MAS): representing the highest oxygen-demanding activity the patient is still able to perform.

Adjusted Activity Score (AAS): which is derived from subtracting the activity the patient is unable to perform from the MAS. The AAS reflect the patient's typical daily activity.

The Physical activity score will then be classified as low (inactive) if the MAS score is less than or equal to 53, moderate (moderately active) of the score is more than 53 but less than 73 and high (active) if the score is more than 73.

For example, a patient that records that he is still able to climb 36 steps of stairs (item 60 on the HAP) but has ceased performing 3 less strenuous activities than this will have a MAS of 60 and an AAS of 57, putting him/her in the active category

5.9. DEFINITION OF STUDY VARIABLES

- Age – expressed in years and categorized into <30, 30 – 39, 40 – 49, 50 – 59 and >60.
- Gender – expressed as either male or female
- Marital status – expressed as single, married or separated/divorced.
- Level of education - highest level of education that the study participant has successfully completed
- Dialysis Recovery Time – expressed in hours. This is the time required for a patient to go back to normal daily activity after a single haemodialysis session.
- Dialysis Access – Cuffed or uncuffed catheters, A-V fistula or graft.
- Dialysis vintage – duration of time from the first dialysis session, expressed in years.
- Weekly dialysis sessions – number of sessions a patient undergoes haemodialysis in a week.
- BMI – calculated from the weight and height, expressed in Kg/M^2
- Average pre- and post- dialysis BP – calculated from the last 8 haemodialysis sessions.

- Average ultrafiltration Rate – obtained from the dialysis charts and calculated as a mean of the last 8 haemodialysis sessions.
- Blood Flow Rate – calculated as an average from the last 8 haemodialysis sessions.
- Sodium profiling – whether a patient has needed sodium profiling in any of the last 8 sessions.
- Maximum Activity Score (MAS): representing the highest oxygen-demanding activity the patient is still able to perform.
- Adjusted Activity score: which is derived from subtracting the activity the patient is unable to perform from the MAS.

5.10. QUALITY ASSURANCE

The patients' hospital IP number was recorded on the consent forms to prevent double sampling. Each participant was issued a unique 7-digit code generated automatically using a random number generator and the code was recorded on both the study proforma and HAP questionnaire. The forms were verified on a daily basis following collection to ensure completeness. Study participants that were not literate were allowed the help of the caregiver albeit under supervision of the primary investigator or research assistants to minimize risk erroneous data. The Primary investigator and research assistants were trained on the use of the proforma and the HAP questionnaire.

The HAP being a self-reported questionnaire was translated into Kiswahili in order to counter any language barrier that may arise. Forward translation was carried out by two translators, one who was privy to the exact use of the questionnaire and one that was not aware of the intended use of the questionnaire. Backward translation was then carried out by two independent translators (both of whom were not aware of the intended use of the questionnaire), with discrepancies being discussed and resolved between the two. Both the forward and backward translations were discussed with the supervisors who were considered to be the expert committee and both the supervisors agreed on the semantics used and agreed that the questionnaire is practical and easy to understand.

The HAP Questionnaire was tested for practicability and suitability via a pilot study carried out at the KNH renal Unit on 10th April 2020. The HAP was administered to 25 patients in the renal unit with 24 patients (96%) filling the form within the 4-hour dialysis session and reporting no difficulty. To assess the face validity of the questionnaire, the patients and their relatives / guardians were asked what they thought the questionnaire in general and every item in the questionnaire was testing, and the responses included; a test of physical function, a test for physical limitation and a test for daily activities, all of which are the intended measures of the HAP questionnaire.

5.11. DATA MANAGEMENT AND ANALYSIS METHODS

Data from the Proforma and HAP questionnaire were keyed into a Microsoft excel database that was then secured with a password. Prior data verification was done to flag any erroneous entries and corrected appropriately. Data cleaning to correct for duplicates, missing data, inconsistencies was carried out and statistical analysis was done using SPSS in consultation with a statistician.

Data was summarized using descriptive statistics; measures of central tendency (mean/median) and dispersion (standard deviation, interquartile range) was reported for continuous variables. Categorical variables were summarized using counts and proportions. Bar charts, pie charts and box plots were used to show the distribution of categorical variables.

Statistically associations between DRT, gender, level of education, marital status, BMI and dialysis access was tested using the Chi- square. The student T- test was used to test the association between DRT and age, dialysis vintage, blood pressure, InterDialytic Weight Gain and ultrafiltration rate. Analysis of Variance (ANOVA) was used to analyze the association between DRT, Maximum Activity Score (MAS) and Adjusted Activity Score (AAS). All variables with a P value less than 0.05 was considered significant.

5.12. ETHICAL CONSIDERATIONS

The study was carried out upon approval from the Department of Clinical Medicine and Therapeutics (UoN) and the Kenyatta National Hospital / University of Nairobi – Ethics and Research Committee (KNH/UON-ERC)

The purpose of this study was clearly explained to the eligible participants, thereafter an informed consent was obtained.

The confidentiality of the patients ’information was at all times be maintained. An anonymous-randomly generated number was assigned to each study subject. This was the sole identification appearing on the study proforma and questionnaires. The subjects reserved the right to withdraw from the study at any point and at their own volition.

The collected proformas and questionnaires will be stored securely at all times during the duration of the study and will be destroyed thereafter.

Due to the unfortunate fact that this study will be carried out during the unrelenting COVID-19 pandemic, the PI and research assistant will ensure that the current ministry of health COVID-19 prevention measures are maintained, including;

- Maintaining a physical and social distance of 1.5 meters.
- Wearing of Personal Protective Equipment (PPE) including N95 masks, gowns and gloves.
- Proper hand washing and sanitizing of hands before and after any patient contact.

CHAPTER 6: RESULTS

A total of 113 patients were scheduled to undergo outpatient haemodialysis at the KNH renal unit during the duration of this audit, 96 (84.9%) were included in the study. 3 patients were unable to complete the questionnaires – 2 due to their inability to understand both the English and Kiswahili questionnaires in addition to not having a guardian or relative nearby to assist. 1 patient was not recruited into the study due to dementia or other cognitive impairments and 1 declined to participate in the study. The others had been on dialysis for less than 3 months.

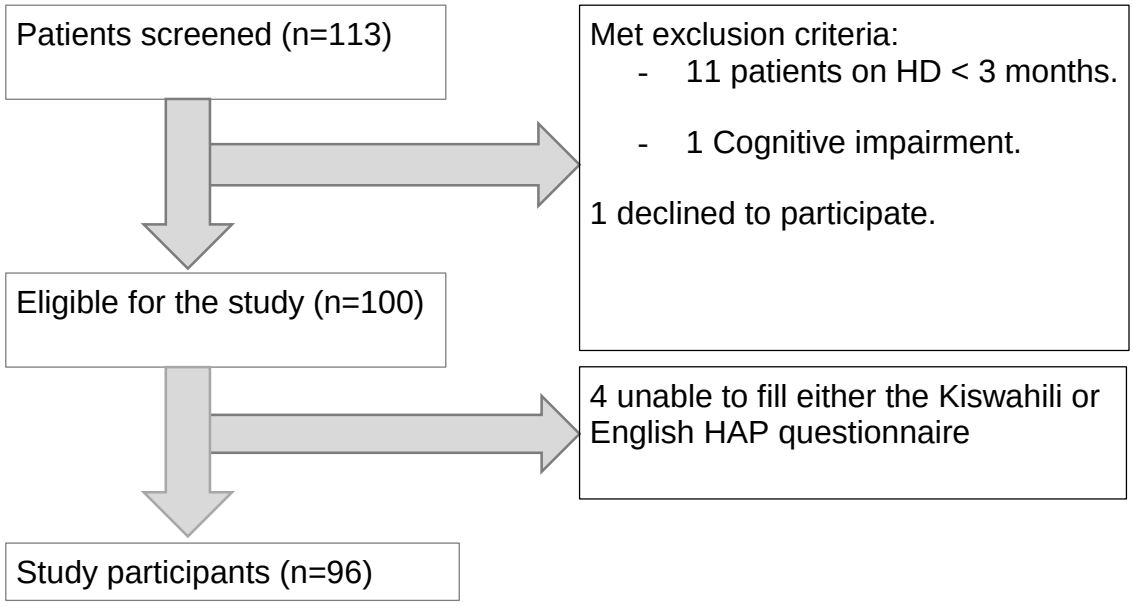

Figure 1: Sample selection flow chart.

6.1. STUDY POPULATION.

Of the 96 participants that took part in the study, 51 (53.1%) were male and 45 (46.9%) were female. We recorded a mean age of 42.9 ± 14 with a large proportion 67 (69.9%) of the patients being less than 50 years old. More than half of the participants 56 (58.3) were married.

Variable	Frequency (n=96)	Percent (%)
Age		
<30	17	17.7
30 – 39	23	24.0
40 – 49	27	28.1
≥50	29	30.2
Gender		
Male	51	53.1
Female	45	46.9
Education		
None	8	8.3
Primary	31	32.3
Secondary	43	44.8
Tertiary	14	14.6
Marital status		
Married	56	58.3
Single	21	21.9
Separated	7	7.3
Divorced	8	8.3
Widowed	4	4.2

Majority of the patients 43 (44.8%) had attained a secondary level of education.

Table 2: Socio-demographic characteristics.

6.2. PATIENT CLINICAL CHARACTERISTICS.

Majority of the patients 72 (75%) that were included in the study were classified as “healthy” on the BMI scale.

It is also noted that most of the patients 71 (74%) were on dialysis catheters and 25 (26%) of the patients had been transitioned to the preferred Arterio-Venous Fistula (AVF).

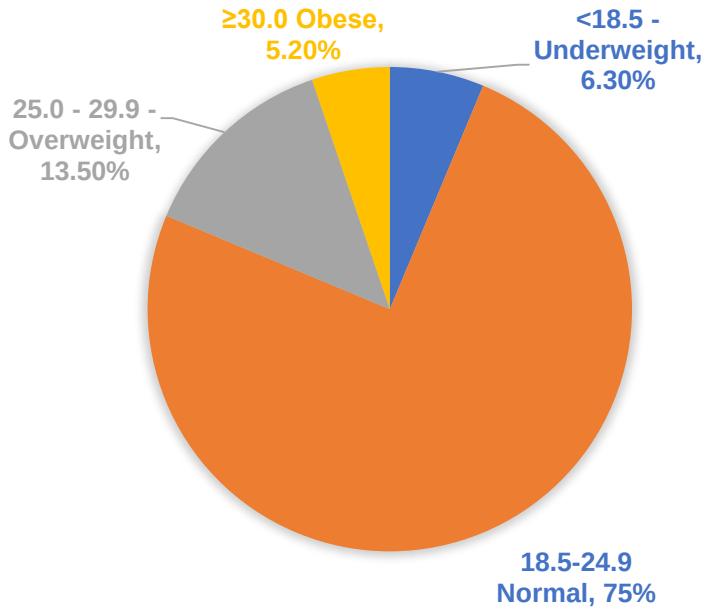

Figure 2: Patients' BMI.

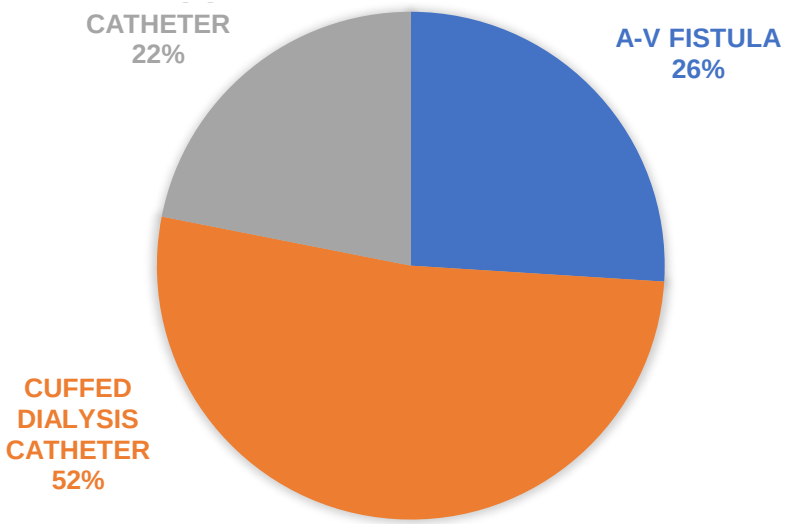

Figure 3: Patients' dialysis access.

All the patients in the dialysis unit attended dialysis twice weekly. They all had a dialysis duration of 4 hours.

Variable	Frequency (n=96)	Percent (%)
Weekly dialysis sessions		
2 sessions per week	96	100.0
Dialysis duration (in hours)		
4	96	100.0

Table 3: Patients weekly dialysis sessions.

The mean time on dialysis (dialysis vintage) was 2.1 (± 1.4) years. The patients had poor fluid control demonstrated by a high mean pre-dialysis BP 153/92 (± 25/15) mmHg, a significant mean Interdialytic weight gain 2.5 (± 1.2) kgs and mean ultrafiltration volume of 2.4 (± 1.1) liters. The mean dialysate sodium was 139 (± 10.6) although the dialysate sodium was determined by the machine the patient was being dialysed on - the Bellco machine not having adjustable dialysate sodium (fixed at 135), while the patients being dialysed on the Gambro machines were dialysed with a dialysate sodium of 140.

Variables	Mean (SD)	Median (IQR)	Min-Max
Dialysis vintage	2.1 (1.4)	1.6 (1.0 – 3.0)	0.3 – 6.0
Pre-dialysis SBP	153 (25)	151 (136 - 167)	95 - 226
Pre-dialysis DBP	92 (15)	90 (84 - 98)	58 – 165
Post-dialysis SBP	153 (24)	151 (138 - 169)	85 – 204
Post-dialysis DBP	92 (17)	89 (84 - 100)	53 – 177
Interdialytic weight gain (IDWG)	2.5 (1.2)	2.50 (1.5 – 3.4)	0.00 – 5.0
Ultrafiltration volume	2.4 (1.1)	2.5 (1.5 – 3.4)	0.0 – 4.3
UFR	10.2 (4.7)	10.0 (6.0 – 14.0)	0.0 – 18.0
Blood flow rate	297.5 (32.6)	297.5 (280.0 – 315.0)	200.0 – 400.0
Dialysate sodium	137.9 (1.7)	137.9 (136.8 – 140.0)	135.0 – 140.0

Table 4: Dialysis characteristics.

6.3. PATIENTS DRT PROFILES.

As depicted by the pie chart below, we found that majority of the study participants had prolonged Recovery Times (RTs) with 73 (76%) participants reporting that it takes them more than 2 hours to return to their daily activities after a single session of haemodialysis. Only a quarter (n= 23, 24%) of the patients reported a DRT of less than 2 hours.

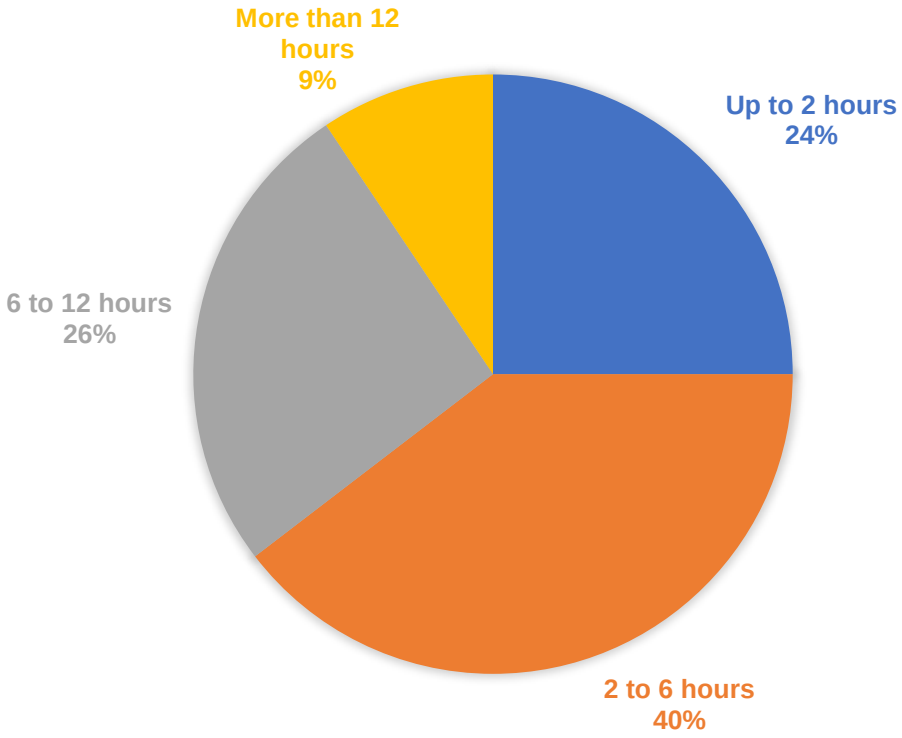

Figure 4: DRT profiles.

6.4. DRT AND PHYSICAL ACTIVITY / FUNCTIONING.

The mean Maximum Activity Score (MAS) was 63.9 (± 14.9). The median Maximum Activity Score (MAS) was 64.0 (IQR = 58.0 – 76.0), denoting that half of the patients in this study could be classified as moderately active to active. The highest physical activity score attained was 85/94 and the lowest was 42/94. The outliers signify patients that scores well below the minimum score attained, as the study also included patients with severe Mineral Bone disease (MBD).

The Adjusted Activity Score (AAS) is derived from the MAS, calculated by subtracting the number of activities on the HAP questionnaire that the patient was unable to do anymore. The AAS represents the patient's typical daily activity. Based on the AAS, it is noted that half of the patients scored above 58 and were still within the "moderately active" to "active" categories.

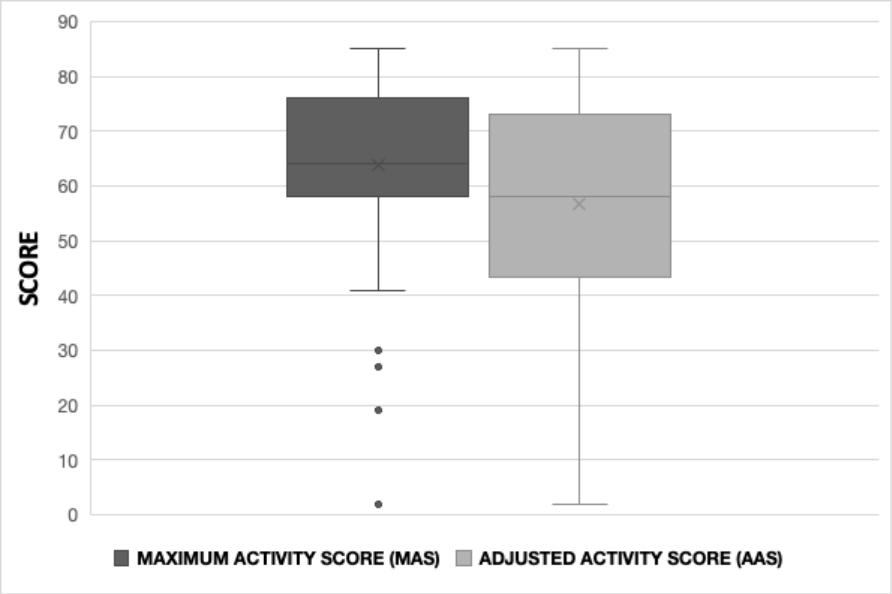

Figure 5: Box plot showing MAS and AAS scores – A score <53 = "inactive", ≥53 but <73 = "moderately active", ≥73 = "active".

An analysis of variance (ANOVA) was carried out to assess the association between DRT and the physical activity scores (MAS and AAS). The results show a statistically significant association between DRT and the patients Maximum Activity Scores (P= <0.001), demonstrating that the time to recover after a single dialysis session was inversely related to the patient's physical activity.

DRT	n	Mean MAS	SD	p-value
Up to 2 hours	23	78.1	3.6	**<0.001**
2 to 6 hours	34	67.3	7.3	
6 to 12 hours	28	59.2	7.9	
More than 12 hours	11	35.9	17.6	

Table 5: DRT and MAS association.

Analysis of Variance (ANOVA) results (table 8) indicate a statistically significant association between DRT and AAS (P= <0.001), denoting that recovery after dialysis increases with reduced daily levels of daily functioning.

DRT	n	Mean AAS	SD	p-value
Up to 2 hours	23	76.2	5.3	**<0.001**
2 to 6 hours	34	60.8	10.5	
6 to 12 hours	28	47.3	12.0	
More than 12 hours	11	27.2	16.9	

Table 6: Association between AAS and DRT.

Analysis of the association between the Maximum Activity Score (MAS) and the various clinico-demographic variables showed no statistically significant association between a patient's physical activity level and the patient's age, gender and marital status. This study also found no statistically significant association between the level of activity and the total duration on dialysis (dialysis vintage).

6.5. ASSOCIATION BETWEEN DRT AND CLINICO- DEMOGRAPHIC VARIABLES.

As shown by table 6, men were at least 3 times as likely to have a Dialysis Recovery Time (DRT) of < 2hours as compared to women (OR = 3.25, CI = 1.15 – 9.19, P = 0.026). The results also indicate a statistically significant correlation between DRT, ultrafiltration rate (OR= 0.89, CI= 0.80 – 0.99, P= 0.026) and IDWG (OR= 0.61, CI = 0.39 – 0.95).

Variable	n	<2 hours	≥2 hours	OR (95% CI)	P - Value
Age, mean ± SD		39.3 ± 13.1	44.1 ± 14.1	0.97 (0.94 – 1.01)	0.151
Gender, n (%)					
Male	51	17 (73.9)	34 (46.6)	3.25 (1.15 – 9.19)	**0.026**
Female	45	6 (26.1)	39 (53.4)	Reference	-
Education, n (%)					
None	8	2 (8.7)	6 (8.2)	0.60 (0.09 – 4.17)	0.605
Primary	31	7 (30.4)	24 (32.9)	0.53 (0.13 – 2.09)	0.360
Secondary	43	9 (39.1)	34 (46.6)	0.48 (0.13 – 1.78)	0.270
Tertiary	14	5 (21.7)	9 (12.3)	Reference	-
Marital status, n (%)					
Married	56	16 (69.6)	40 (54.8)	2.13 (0.55 – 8.33)	0.276
Single	21	4 (17.4)	17 (23.3)	1.26 (0.24 – 6.50)	0.787
Sep./Div./Wid.	19	3 (13.0)	16 (21.9)	Reference	-
Dialysis vintage, mean ± SD		2.0 ± 1.5	2.1 ± 1.4	0.99 (0.71 – 1.37)	0.945
Dialysis Access, n (%)					
Uncuffed Catheter	21	2 (8.7)	19 (26.0)	Reference	-
Cuffed Catheter	50	16 (69.6)	34 (46.6)	4.47 (0.93–21.56)	0.062
A-V Fistula (AVF)	25	5 (21.7)	20 (27.4)	2.38 (0.41–13.75)	0.334
BMI, n (%)					
<18.5 *(Underweight)*	6	2 (8.7)	4 (5.5)	6.00 (0.42–85.24)	0.186
18.5 – 24.9 *(Healthy)*	72	20 (87.0)	52 (71.2)	4.61 (0.56–37.85)	0.154
25.0 – 29.9 *(Overweight)*	13	1 (4.3)	12 (16.4)	Reference	-
≥30.0 *(Obese)*	5	0 (0.0)	5 (6.8)	-	-
Blood Pressure (BP), *mean ± SD*					
Pre-dialysis SBP		148 ± 25	155 ± 25	0.99 (0.97 – 1.01)	0.209
Pre-dialysis DBP		93±15	92±16	1.00 (0.97 – 1.03)	0.863
Post-dialysis SBP		149±22	154±25	0.99 (0.97 – 1.01)	0.368
Post-dialysis DBP		91±12	93±19	0.99 (0.96 – 1.02)	0.629
InterDialytic Weight Gain, mean ± SD		2.0 ± 0.8	2.6 ± 1.2	0.61 (0.39 – 0.95)	**0.030**
UFR, mean ± SD		8.2 ± 3.4	10.8 ± 4.9	0.89 (0.80 – 0.99)	**0.026**
Dialysate Sodium, *mean ± SD*		138.0±2.1	137.9±1.6	1.05 (0.80 – 1.38)	0.724

Table 7: Patient demographic and clinical characteristics stratified based on DRT

CHAPTER 7: DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS.

7.1. DISCUSSION

Most ESRD patients will describe a feeling of tiredness and in need of rest or sleep following haemodialysis treatment. Despite being a frequently described symptom, the pathophysiology of PDF is poorly understood with several mechanisms implicated. These mechanisms include the flow of salt and water between the different body fluid compartments, osmotic imbalances between the intra- and extracellular fluid and across the Blood Brain Barrier, and the transport of electrolytes across cell membranes. It is postulated that recovery time after HD may be influenced by the different clinical and demographic factors – including the dialysis prescription itself.

Lindsay et al pointed out that the question "**How long does it take you to recover from a single dialysis session**" had a good internal consistency and was stable over time with a good test-retest consistency (15). This observation as affirmed by Harford et al that noted that recovery time was variable among patients but was consistent between treatments among individual patients (106). In this study, we investigated whether the Recovery time is influenced by the various patients' characteristics or the haemodialysis process itself. This would be important in modifying the patients HD prescription with the sole intention of improving the Recovery Times and their overall wellbeing.

The present study was carried out over a duration of one month with 96 patients included in total. The study included more males than females (53.9 vs 43.9), with a generally young age of patients (mean age of 42.9 ± 14). Most of the patients had attained a post primary level of education with 44% having attained a secondary level of education. Majority of the patients reported DRTs of more than 2 hours with the female gender, poor physical activity scores (MAS and AAS), IDWG, and UFR being the factors that had a statistically significant association with DRT.

In this study, 75% of patients reported taking more than 2 hours to recover from a dialysis session, and 25% and 35% reported Recovery Times (RTs) of <2 hours and >6 hours respectively. This was comparable to the DOPPS study carried out by Rayner et al in 12

countries, where 32%, 68% and 27% of patients reported RTs of <2hours, >2 hours and > 6 hours respectively. The slight variation in proportions can be attributed to the sheer magnitude of the DOPPS study and the accuracy associated with larger sample sizes, as the DOPPS study involved 7 countries, 320 haemodialysis units and 12,400 HD patients (17).

A study by Johansen et al at the University of California, USA, showed that patients had a mean Maximum Activity (MAS) score of 62 ± 14.0 and an Adjusted Activity Score of 44.4 ± 18 signifying that the patients in the study were on average “moderately active” based on the MAS score and “inactive” on the AAS score (107). On the other hand, our study found that patients at the KNH renal unit were slightly more active than those in the aforementioned study. Patients in our study had a mean MAS and mean AAS of 64.9 ± 14.9 and 56.7 ± 18.5 respectively, indicating that patients in our study were “moderately active” based on both the MAS and AAS, with an analysis of variance showing a statistically significant association between DRT, MAS (P=<0.001) and AAS (P=<0.001). The variation in the scores between the two studies can be attributed to differences in socio-economic and cultural practices as patients in our study had no personal transport and relied on public transportation to and from the dialysis unit at KNH. Of note also is the fact that the KNH renal unit is located on the 1st floor and most of the patients reported going up the stairs twice per week, in addition to walking to and from the bus stop, which contributed to the higher AAS scores. Most of the patients in our study also reported higher scores in the household chores section of the HAP questionnaire and reported still being in formal employment. Similar to our study, a study by Gordon et al assessed Post-Dialysis Fatigue among 58 HD patients and showed that prolonged recovery was inversely associated with the AAS (P=0.05) (14).

Anecdotal evidence historically linked females to more intradialysis and post-dialysis adverse symptoms. This notion was disputed by a study by Awuah et al carried out on 267 ESRD patients at the Yale New Haven hospital that found no statistically significant association between DRT and gender (30). A previous study carried out by Caplin et al in London associated increased PDF with the female sex, with female patients being 1.9 times likely to have delayed recovery from dialysis as men (OR = 1.9, 95% = 1.2 – 2.9)

(84). This observation was consistent with our study that showed a statistically significant correlation between sex and prolonged DRT with males being at least 3 times as likely to recover with in 2 hours as compared to females (OR= 3.25, P=0.026, CI= 1.15 – 9.19). The discrepancy in Recovery Times between men and women can be attributed to women in our study receiving a lower dialysis dose, a conclusion inferred from a study done in the United Kingdom. Spalding et al suggested that Kt/V underestimated the dialysis dose in women and that a higher dialysis dose is required for women. Spalding et al concluded that these differences in gender were related to an increase in adipose tissue-to-fat free mass ratio in women, who therefore have a disproportionately low 'V' for their body mass (108).

A study by Son et al among 104 Korean ESRD patients showed that Interdialytic Weight Gain (IDWG) significantly correlated with levels of fatigue (beta = .25, P<0.05) (76). Our findings were in keeping with the above study, noting that the association between DRT and IDWG (p= 0.030, 95% CI = 0.39 – 0.95) was statistically significant and that IDWG is a reliable predicter of prolonged DRT. IDWG is a consequence of increased salt and water intake between two consecutive HD sessions and is used in most dialysis centers as the only parameter for determining the ultrafiltration volume, including at the KNH renal unit. Poor fluid control and Increased fluid removal during HD is associated with increased incidence of intradialytic hypotension and muscle cramps, which explains the increased fatigue in this subset of patients.

A recent study by Harford et al assessing DRT over time in 364 patients (with a mean dialysis vintage of 2.4 years) identified HD vintage of > 6months (OR 2.43 [95% CI 1.42–4.16]), high BMI (OR 1.94 [95% CI 1.18–3.20]), post-dialysis SBP of < than 115mmHg (OR 1.57 [95% CI 1.04–2.37]) were all associated with a higher DRT (106). Despite the above study being comparable to our study in terms of dialysis vintage (mean Dialysis vintage 2.4 vs 2.1), we did not identify a significant statistical association between DRT, dialysis vintage (OR 0.99 [95% CI 0.71 – 1.37]), BMI (OR 6.00 [95% CI 0.42–85.24]) and post-HD SBP (OR 0.99 [95% CI 0.97 – 1.01]) (106). We attribute this disparity to the observation that most of the patients in our study had uncontrolled Pre-dialysis BPs

(mean BP 153/92 ± 25/15) and were classified as having a normal BMI as compared to the aforementioned study that had a wider variation in patient BMI's.

We were however unable to assess the relationship between DRT and the duration of dialysis treatment, the frequency of dialysis and the dialysate temperature as this was an across-the-board standard in all the patients. Since patients in our set up cannot afford HD treatment out of pocket and they seldom have an alternative medical cover, HD is predominantly financed by the NHIF. This meant that all the patients in this study were on only two HD sessions per week thereby hindering the evaluation of the correlation between DRT and more frequent HD regimens.

All the patients were on a 4-hour dialysis treatment and a dialysate temperature of 36.5 degrees Celsius and hence no correlation could be assessed between these variables and DRT even though other studies have shown a significant correlation between PDF and cool temperature dialysate HD (94).

The results of this study are positive, since it discovered that patients at the KNH renal unit were more active than those in a study in the United States, with a quarter of the patients experiencing fatigue lasting less than two hours. This suggests that by making alterations to a patient's dialysis prescription, fatigue in our patients can be mitigated and HRQoL enhanced.

7.2. CONCLUSION

This study finds that patients at the KNH renal unit have significantly prolonged DRT with lack of physical exercise, poor physical functioning and sub-optimal fluid control (as depicted by uncontrolled pre-dialysis BPs and IDWG) being the main factors responsible.

7.3. RECOMMENDATIONS

In order to have a comprehensive grasp on the factors that adversely influence DRT, more studies are needed in our set up to assess the relationship between DRT and the various modalities of HD (including nocturnal vs day time dialysis), the effect of various biochemical abnormalities (including Haemoglobin level, hyperkalemia, hyperphosphatemia, secondary hyperparathyroidism) and the use of erythropoietin.

7.4. LIMITATIONS

Most of the patients HD prescription was standardized with only the Ultrafiltration volume being individualized. As such, some of the HD related variables could not be assessed for relationship with the recovery time.

The study adopted a cross-sectional design and evaluated the DRT at this point in time. A prospective, longitudinal investigation would provide a better description of the factors that adversely affect Recovery Time and PDF.

Lastly, we did not evaluate the effect of comorbidities on DRT.

REFERENCES

1. Sciboz J. Research Guides: General Assembly - Quick Links: 69th Session (2014-2015) [Internet]. United Nations. Dag Hammarskjöld Library.

2. Omran AR. The Epidemiologic Transition: A Theory of the Epidemiology of Population Change. Milbank Q. 2005 Dec;83(4):731–57.

3. Fleming T, Robinson M, Blake T, Nicholas G, Margono C, Mullany EC, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014 Aug 30;384(9945):766–81.

4. Naicker S. End-stage renal disease in sub-Saharan and South Africa. Kidney Int Suppl. 2003 Feb;(83):S119-122.

5. Kiberd BA, Clase CM. Cumulative Risk for Developing End-Stage Renal Disease in the US Population. JASN. 2002 Jun 1;13(6):1635–44.

6. Peralta CA, Risch N, Lin F, Shlipak MG, Reiner A, Ziv E, et al. The Association of African Ancestry and Elevated Creatinine in the Coronary Artery Risk Development in Young Adults (CARDIA) Study. AJN. 2010;31(3):202–8.

7. Dreyer G, Hull S, Aitken Z, Chesser A, Yaqoob MM. The effect of ethnicity on the prevalence of diabetes and associated chronic kidney disease. QJM. 2009 Apr;102(4):261–9.

8. Grassmann A, Gioberge S, Moeller S, Brown G. ESRD patients in 2004: global overview of patient numbers, treatment modalities and associated trends. Nephrology Dialysis Transplantation. 2005 Dec 1;20(12):2587–93.

9. Abdel-Kader K, Unruh ML, Weisbord SD. Symptom burden, depression, and quality of life in chronic and end-stage kidney disease. Clin J Am Soc Nephrol. 2009 Jun;4(6):1057–64.

10. Whitehead L. The Measurement of Fatigue in Chronic Illness: A Systematic Review of Unidimensional and Multidimensional Fatigue Measures. Journal of Pain and Symptom Management. 2009 Jan 1;37(1):107–28.

11. Flythe JE, Hilliard T, Castillo G, Ikeler K, Orazi J, Abdel-Rahman E, et al. Symptom Prioritization among Adults Receiving In-Center Hemodialysis. Clin J Am Soc Nephrol. 2018 May 7;13(5):735–45.

12. Mohamed Mamdouh M. Dialysis Recovery Time: Associated Factors and Its Relation to Quality of Life in Hemodialysis Patients. [Internet]. Alexandria University: clinicaltrials.gov; 2021 Jan [cited 2021 Dec 10]. Report No.: NCT04727281.

13. Vladimir Rigodon, Murilo H. Dialysis Recovery Time as a Predictor of Hospitalization Among Incident Hemodialysis Patients. 2019

14. Gordon PL, Doyle JW, Johansen KL. Postdialysis fatigue is associated with sedentary behavior. Clin Nephrol. 2011 May;75(5):426–33.

15. Lindsay RM, Heidenheim PA, Nesrallah G, Garg AX, Suri R, Daily Hemodialysis Study Group London Health Sciences Centre. Minutes to recovery after a hemodialysis session: a simple health-related quality of life question that is reliable, valid, and sensitive to change. Clin J Am Soc Nephrol. 2006 Sep;1(5):952–9.

16. Lindsay RM, Leitch R, Heidenheim AP, Kortas C, London Daily/Nocturnal Hemodialysis Study. The London Daily/Nocturnal Hemodialysis Study--study design, morbidity, and mortality results. Am J Kidney Dis. 2003 Jul;42(1 Suppl):5–12.

17. Rayner HC, Zepel L, Fuller DS, Morgenstern H, Karaboyas A, Culleton BF, et al. Recovery Time, Quality of Life, and Mortality in Hemodialysis Patients: The Dialysis Outcomes and Practice Patterns Study (DOPPS). Am J Kidney Dis. 2014 Jul;64(1):86–94.

18. Davenport A, Guirguis A, Almond M, Day C, Chilcot J, Da Silva Gane M, et al. Postdialysis recovery time is extended in patients with greater self-reported depression screening questionnaire scores. Hemodial Int. 2018 Jul;22(3):369–76.

19. Enia G, Sicuso C, Alati G, Zoccali C. Subjective global assessment of nutrition in dialysis patients. Nephrol Dial Transplant. 1993;8(10):1094–8.

20. Cianciaruso B, Brunori G, Kopple JD, Traverso G, Panarello G, Enia G, et al. Cross-sectional comparison of malnutrition in continuous ambulatory peritoneal dialysis and hemodialysis patients. Am J Kidney Dis. 1995 Sep;26(3):475–86.

21. Leavey SF, Strawderman RL, Jones CA, Port FK, Held PJ. Simple nutritional indicators as independent predictors of mortality in hemodialysis patients. Am J Kidney Dis. 1998 Jun;31(6):997–1006.

22. Qureshi AR, Alvestrand A, Danielsson A, Divino-Filho JC, Gutierrez A, Lindholm B, et al. Factors predicting malnutrition in hemodialysis patients: a cross-sectional study. Kidney Int. 1998 Mar;53(3):773–82.

23. Bergström J. Malnutrition in Patients on Renal Replacement Therapy. In: Andreucci VE, Fine LG, editors. International Yearbook of Nephrology 1993 [Internet]. London: Springer; 1992 [cited 2021 Jan 20]. p. 245–65. Available from: https://doi.org/10.1007/978-1-4471-1948-7_14

24. Foley RN, Parfrey PS, Harnett JD, Kent GM, Murray DC, Barre PE. Hypoalbuminemia, cardiac morbidity, and mortality in end-stage renal disease. J Am Soc Nephrol. 1996 May;7(5):728–36.

25. Delgado C, Johansen KL. Barriers to exercise participation among dialysis patients. Nephrol Dial Transplant. 2012 Mar;27(3):1152–7.

26. Dantas LGG, de Seixas Rocha M, Junior JAM, Paschoalin EL, Paschoalin SRKP, Sampaio Cruz CM. Non-adherence to Haemodialysis, Interdialytic weight gain and cardiovascular mortality: a cohort study. BMC Nephrol. 2019 Nov 6;20(1):402.

27. Adrian C, Dimitrie S, Luminita V. Dialysis-induced segmental wall motion abnormalities, post-dialysis fatigue and cardiovascular mortality: the new Bermuda triangle [Internet]. Nephrology Dialysis and Transplantation. 2013. Available from: https://doi.org/10.1093/ndt/gft301

28. Guedes M, Pecoits-Filho R, Leme J, Jiao Y, Raimann J, Wang Y, et al. Impacts of Dialysis Adequacy and Intradialytic Hypotension on Changes in Dialysis Recovery Time. 2020.

29. Bossola M, Di Stasio E, Monteburini T, Parodi E, Ippoliti F, Cenerelli S, et al. Recovery Time after Hemodialysis Is Inversely Associated with the Ultrafiltration Rate. Blood Purification. 2018 Sep 19; 47:1–7.

30. Awuah KT, Afolalu BA, Hussein UT, Raducu RR, Bekui AM, Finkelstein FO. Time to recovery after a hemodialysis session: impact of selected variables. Clin Kidney J. 2013 Dec;6(6):595–8.

31. Antari GAA, Sukmarini L, Adam M. Associated factors of post-hemodialysis recovery time in kidney failure patients. Enferm Clin. 2019 Sep 1; 29:247–51.

32. Jhamb M, Weisbord SD, Steel JL, Unruh M. Fatigue in patients receiving maintenance dialysis: a review of definitions, measures, and contributing factors. Am J Kidney Dis. 2008 Aug;52(2):353–65.

33. Dantzer R, Kelley KW. Twenty Years of Research on Cytokine-Induced Sickness Behavior. Brain Behav Immun. 2007 Feb;21(2):153–60.

34. Ganz PA, Bower JE. Cancer related fatigue: a focus on breast cancer and Hodgkin's disease survivors. Acta Oncol. 2007;46(4):474–9.

35. Rao M, Wong C, Kanetsky P, Girndt M, Stenvinkel P, Reilly M, et al. Cytokine gene polymorphism and progression of renal and cardiovascular diseases. Kidney International. 2007 Sep 1;72(5):549–56.

36. Herbelin A, Nguyen AT, Zingraff J, Ureña P, Descamps-Latscha B. Influence of uremia and hemodialysis on circulating interleukin-1 and tumor necrosis factor alpha. Kidney Int. 1990 Jan;37(1):116–25.

37. Pereira BJG. Cytokine Production in Patients on Dialysis. BPU. 1995;13(3–4):135–46.

38. Lowrie EG, Lew NL. Death risk in hemodialysis patients: the predictive value of commonly measured variables and an evaluation of death rate differences between facilities. Am J Kidney Dis. 1990 May;15(5):458–82.

39. Owen WF, Lew NL, Liu Y, Lowrie EG, Lazarus JM. The urea reduction ratio and serum albumin concentration as predictors of mortality in patients undergoing hemodialysis. N Engl J Med. 1993 Sep 30;329(14):1001–6.

40. Kaysen G, Stevenson F, Depner T. Determinants of albumin concentration in hemodialysis patients - ScienceDirect. [cited 2020 Nov 26].

41. Nijsten MW, de Groot ER, ten Duis HJ, Klasen HJ, Hack CE, Aarden LA. Serum levels of interleukin-6 and acute phase responses. Lancet. 1987 Oct 17;2(8564):921.

42. Heinrich P, Castell J, Andus T. Interleukin-6 and the acute phase response. [Internet]. Biochemical Journal. 1990 [cited 2020 Nov 26].

43. Kamimura MA, Draibe SA, Dalboni MA, Cendoroglo M, Avesani CM, Manfredi SR, et al. Serum and cellular interleukin-6 in haemodialysis patients: relationship with energy expenditure. Nephrol Dial Transplant. 2007 Mar;22(3):839–44.

44. Galic MA, Riazi K, Pittman QJ. Cytokines and brain excitability. Front Neuroendocrinol. 2012 Jan;33(1):116–25.

45. Drüeke TB, Locatelli F, Clyne N, Eckardt K-U, Macdougall IC, Tsakiris D, et al. Normalization of Hemoglobin Level in Patients with Chronic Kidney Disease and Anemia. New England Journal of Medicine. 2006 Nov 16;355(20):2071–84.

46. Singh AK, Szczech L, Tang KL, Barnhart H, Sapp S, Wolfson M, et al. Correction of Anemia with Epoetin Alfa in Chronic Kidney Disease. New England Journal of Medicine. 2006 Nov 16;355(20):2085–98.

47. Moreno F, Sanz-Guajardo D, López-Gómez JM, Jofre R, Valderrábano F. Increasing the hematocrit has a beneficial effect on quality of life and is safe in selected hemodialysis patients. Spanish Cooperative Renal Patients Quality of Life Study Group of the Spanish Society of Nephrology. J Am Soc Nephrol. 2000 Feb;11(2):335–42.

48. Brophy D, Ripley E, Holdford D. Pharmacoeconomic considerations in the health system management of anaemia in patients with chronic kidney disease and end stage renal disease. Expert opinion on pharmacotherapy. 2003 Oct 1;4:1461–9.

49. Barany P, Pettersson E, Konarski-Svensson JK. Long-term effects on quality of life in haemodialysis patients of correction of anaemia with erythropoietin. Nephrology Dialysis Transplantation. 1993;

50. Muirhead N, Laupacis A, Wong C. Erythropoietin for anaemia in haemodialysis patients: results of a maintenance study (the Canadian Erythropoietin Study Group). Nephrol Dial Transplant. 1992;7(8):811–6.

51. Maung SC, El Sara A, Chapman C, Cohen D, Cukor D. Sleep disorders and chronic kidney disease. World J Nephrol. 2016 May 6;5(3):224–32.

52. Sabry AA, Abo-Zenah H, Wafa E, Mahmoud K, El-Dahshan K, Hassan A, et al. Sleep disorders in hemodialysis patients. Saudi Journal of Kidney Diseases and Transplantation. 2010 Mar 1;21(2):300.

53. Unruh ML, Levey AS, D'Ambrosio C, Fink NE, Powe NR, Meyer KB, et al. Restless legs symptoms among incident dialysis patients: association with lower quality of life and shorter survival. Am J Kidney Dis. 2004 May;43(5):900–9.

54. Krueger JM, Fang J, Taishi P, Kushikata T, Gardi J. Sleep: A Physiologic Role for IL-1β and TNF-α [Internet]. Wiley Online Library. 1998 [cited 2021 Jan 19]. Available from: https://nyaspubs.onlinelibrary.wiley.com/doi/abs/10.1111/j.1749-6632.1998.tb08323.x

55. Mills PJ, Dimsdale JE. Sleep apnea: a model for studying cytokines, sleep, and sleep disruption. Brain Behav Immun. 2004 Jul;18(4):298–303.

56. Entzian P, Linnemann K, Schlaak M, Zabel P. Obstructive sleep apnea syndrome and circadian rhythms of hormones and cytokines. Am J Respir Crit Care Med. 1996 Mar;153(3):1080–6.

57. Vgontzas AN, Papanicolaou DA, Bixler EO, Kales A, Tyson K, Chrousos GP. Elevation of plasma cytokines in disorders of excessive daytime sleepiness: role of sleep disturbance and obesity. J Clin Endocrinol Metab. 1997 May;82(5):1313–6.

58. Vgontzas AN, Zoumakis M, Bixler EO, Lin H-M, Prolo P, Vela-Bueno A, et al. Impaired nighttime sleep in healthy old versus young adults is associated with elevated plasma interleukin-6 and cortisol levels: physiologic and therapeutic implications. J Clin Endocrinol Metab. 2003 May;88(5):2087–95.

59. Gul A, Aoun N, Trayner EM. UNRESOLVED ISSUES IN DIALYSIS: Why Do Patients Sleep on Dialysis? Seminars in Dialysis. 2006;19(2):152–7.

60. Yang J-Y, Huang J-W, Chiang C-K, Pan C-C, Wu K-D, Tsai T-J, et al. Higher plasma interleukin-18 levels associated with poor quality of sleep in peritoneal dialysis patients. Nephrol Dial Transplant. 2007 Dec;22(12):3606–9.

61. Watnick S, Kirwin P, Mahnensmith R, Concato J. The prevalence and treatment of depression among patients starting dialysis [Internet]. Vol. 41, American journal of kidney diseases: the official journal of the National Kidney Foundation. Am J Kidney Dis; 2003 [cited 2021 Jan 19]. Available from: https://pubmed.ncbi.nlm.nih.gov/12500227/

62. Hedayati SS, Bosworth HB, Kuchibhatla M, Kimmel PL, Szczech LA. The predictive value of self-report scales compared with physician diagnosis of depression in hemodialysis patients. Kidney Int. 2006 May;69(9):1662–8.

63. Kimmel PL, Cukor D, Cohen SD, Peterson RA. Depression in end-stage renal disease patients: a critical review. Adv Chronic Kidney Dis. 2007 Oct;14(4):328–34.

64. Trzonkowski P, Myśliwska J, Godlewska B, Szmit E, Łukaszuk K, Więckiewicz J, et al. Immune consequences of the spontaneous pro-inflammatory status in depressed elderly patients. Brain, Behavior, and Immunity. 2004 Mar 1;18(2):135–48.

65. Penninx BWJH, Kritchevsky SB, Yaffe K, Newman AB, Simonsick EM, Rubin S, et al. Inflammatory markers and depressed mood in older persons: results from the Health, Aging and Body Composition study. Biol Psychiatry. 2003 Sep 1;54(5):566–72.

66. Bremmer MA, Beekman ATF, Deeg DJH, Penninx BWJH, Dik MG, Hack CE, et al. Inflammatory markers in late-life depression: results from a population-based study. J Affect Disord. 2008 Mar;106(3):249–55.

67. Lee S-K, Lee H-S, Lee T-B, Kim D-H, Koo J-R, Kim Y-K, et al. The effects of antidepressant treatment on serum cytokines and nutritional status in hemodialysis patients. J Korean Med Sci. 2004 Jun;19(3):384–9.

68. Brunier GM, Graydon J. The influence of physical activity on fatigue in patients with ESRD on hemodialysis. ANNA J. 1993 Aug;20(4):457–61; discussion 462, 521.

69. Kasapis C, Thompson PD. The effects of physical activity on serum C-reactive protein and inflammatory markers: a systematic review. J Am Coll Cardiol. 2005 May 17;45(10):1563–9.

70. Nicklas BJ, Mychaleckyj J, Kritchevsky S, Palla S, Lange LA, Lange EM, et al. Physical function and its response to exercise: associations with cytokine gene variation in older adults with knee osteoarthritis. J Gerontol A Biol Sci Med Sci. 2005 Oct;60(10):1292–8.

71. Wilund KR. Is the anti-inflammatory effect of regular exercise responsible for reduced cardiovascular disease? Clin Sci (Lond). 2007 Jun;112(11):543–55.

72. Rajan VR, Mitch WE. Muscle wasting in chronic kidney disease: the role of the ubiquitin proteasome system and its clinical impact. Pediatr Nephrol. 2008;23(4):527–35.

73. Hemodialysis-induced cardiac injury: determinants and associated outcomes - PubMed [Internet]. [cited 2021 Jan 19]. Available from: https://pubmed.ncbi.nlm.nih.gov/19357245/

74. Dubin RF, Beatty AL, Teerlink JR, Schiller NB, Bolger AF, Alokozai D, et al. Determinants of hemodialysis-induced segmental wall motion abnormalities. Hemodial Int. 2014 Apr;18(2):396–405.

75. Ipema KJR, Kuipers J, Westerhuis R, Gaillard CAJM, van der Schans CP, Krijnen WP, et al. Causes and Consequences of Interdialytic weight gain. Kidney Blood Press Res. 2016;41(5):710–20.

76. Kim HR, Son GR. Fatigue and its related factors in Korean patients on hemodialysis. Taehan Kanho Hakhoe Chi. 2005 Jun;35(4):701–8.

77. Maniam R, Subramanian P, Singh SKS, Lim SK, Chinna K, Rosli R. Preliminary study of an exercise programme for reducing fatigue and improving sleep among long-term haemodialysis patients. Singapore Med J. 2014 Sep;55(9):476–82.

78. Dobsak P, Homolka P, Svojanovsky J, Reichertova A, Soucek M, Novakova M, et al. Intra-dialytic electrostimulation of leg extensors may improve exercise tolerance and quality of life in hemodialyzed patients. Artif Organs. 2012 Jan;36(1):71–8.

79. Ouzouni S, Kouidi E, Sioulis A, Grekas D, Deligiannis A. Effects of intradialytic exercise training on health-related quality of life indices in haemodialysis patients. Clin Rehabil. 2009 Jan;23(1):53–63.

80. Yoowannakul S, Vongsanim S, Tangvoraphonkchai K, Mohamed A, Davenport A. Falls in systolic blood pressure during dialysis which require no nursing intervention are associated with increased patient intra-dialytic symptom self-reporting and prolonged post-dialysis recovery times. Renal Replacement Therapy. 2020 Jan 7;6(1):2.

81. Azar AT. Effect of dialysate temperature on hemodynamic stability among hemodialysis patients. Saudi J Kidney Dis Transpl. 2009 Jul;20(4):596–603.

82. Kim TW, Chang TI, Kim TH, Chou JA, Soohoo M, Ravel VA, et al. Association of Ultrafiltration Rate with Mortality in Incident Hemodialysis Patients. NEF. 2018;139(1):13–22.

83. Müller-Steinhardt M, Kock N, Härtel C, Kirchner H, Steinhoff J. Production of monokines in patients under polysulphone haemodiafiltration is influenced by the ultrafiltration flow rate. Nephrol Dial Transplant. 2001;(16: 1830–1837).

84. Caplin B, Kumar S, Davenport A. Patients' perspective of haemodialysis-associated symptoms. Nephrol Dial Transplant. 2011 Aug;26(8):2656–63.

85. Shosi R, Seth M. The adequacy of hemodialysis in end stage renal disease at Kenyatta National Hospital [Internet]. [cited 2021 Mar 30]. Available from: http://erepository.uonbi.ac.ke/handle/11295/6342

86. Depner T, Gerald B, Daugirdas J, Kusek J. Lessons from the hemodialysis (HEMO) Study: An improved measure of the actual hemodialysis dose. [Internet]. American journal of kidney diseases : the official journal of the National Kidney Foundation. 1990 [cited 2021 Apr 1]. Available from: https://www.ajkd.org/article/S0272-6386(99)70272-6/pdf

87. Momeni A, Rouhi H, Kiani G, Amiri M. Effects of High-Flux versus Low-Flux Membranes on Pulmonary Function Tests in Hemodialysis Patients. Tanaffos. 2013;12(1):31–5.

88. Daugirdas JT, Depner TA, Inrig J, Mehrotra R, Rocco MV, Suri RS, et al. KDOQI Clinical Practice Guideline for Hemodialysis Adequacy: 2015 Update. American Journal of Kidney Diseases. 2015 Nov 1;66(5):884–930.

89. Laura D, Eduardo L, Steven B, Jesse Y. The TiME Trial: A Fully Embedded, Cluster-Randomized, Pragmatic Trial of Hemodialysis Session Duration [Internet]. American Society of Nephrology. 2019 [cited 2021 Apr 1]. Available from: https://jasn.asnjournals.org/content/30/5/890

90. Ranganathan D, John GT. Nocturnal hemodialysis. Indian J Nephrol. 2012;22(5):323–32.

91. Borzou SR, Gholyaf M, Zandiha M, Amini R, Goodarzi MT, Torkaman B. The effect of increasing blood flow rate on dialysis adequacy in hemodialysis patients. Saudi Journal of Kidney Diseases and Transplantation. 2009 Jul 1;20(4):639.

92. Kim J, Song J, Yoon S, Shin M. The Effect of Increasing Blood Flow Rate on Dialysis Adequacy in Hemodialysis Patients with Low Kt/V. Hemodialysis International. 2004;8(1):85–85.

93. Sherman RA, Faustino EF, Bernholc AS, Eisinger RP. Effect of variations in dialysate temperature on blood pressure during hemodialysis. Am J Kidney Dis. 1984 Jul;4(1):66–8.

94. Ayoub A, Finlayson M. Effect of cool temperature dialysate on the quality and patients' perception of haemodialysis. Nephrology Dialysis Transplantation. 2004 Jan 1;19(1):190–4.

95. Stefanidis I, Stiller S, Ikonomov V, Mann H. Sodium and body fluid homeostasis in profiling hemodialysis treatment. Int J Artif Organs. 2002 May;25(5):421–8.

96. AlIred N. Sodium Modeling Ameliorates lntradialytic and Interdialytic Symptoms in Young Hemodialysis Patients"2. Journal of the American Society of Nephrology. 1993;4(5):7.

97. Kosmadakis G, Zerefos N. Physical Exercise in Dialysis Patients. The International journal of artificial organs. 2007 Jun 1;30:429–34.

98. Kamau E, Kayima J, Otieno CF. The determinants of health related quality of life of patients on maintenance haemodialysis at Kenyatta National Hospital, Kenya. East African Medical Journal. 2014;91(10):368–74.

99. Daughton DM, Fix AJ, Kass I, Bell CW, Patil KD. Maximum oxygen consumption and the ADAPT quality-of-life scale. Arch Phys Med Rehabil. 1982 Dec;63(12):620–2.

100. Bennell KL, Hinman RS, Crossley KM, Metcalf BR, Buchbinder R, Green S, et al. Is the Human Activity Profile a useful measure in people with knee osteoarthritis? J Rehabil Res Dev. 2004 Jul;41(4):621–30.

101. Herzberg PY, Heussner P, Mumm FHA, Horak M, Hilgendorf I, von Harsdorf S, et al. Validation of the human activity profile questionnaire in patients after allogeneic hematopoietic stem cell transplantation. Biol Blood Marrow Transplant. 2010 Dec;16(12):1707–17.

102. Farrell MJ, Gibson SJ, Helme RD. Measuring the activity of older people with chronic pain. Clin J Pain. 1996 Mar;12(1):6–12.

103. Nield M, Hoo GS, Roper J, Santiago S, Dracup K. Usefulness of the human activity profile, a functional performance measure, in people with chronic obstructive pulmonary disease. J Cardiopulm Rehabil. 2005 Apr;25(2):115–21.

104. Robinson-Cohen C, Littman AJ, Duncan GE, Roshanravan B, Ikizler TA, Himmelfarb J, et al. Assessment of physical activity in chronic kidney disease. J Ren Nutr. 2013 Mar;23(2):123–31.

105. Fassett RG, Robertson IK, Geraghty DP, Ball MJ, Burton NW, Coombes JS. Physical activity levels in patients with chronic kidney disease entering the LORD trial. Med Sci Sports Exerc. 2009 May;41(5):985–91.

106. Harford A, Gul A, Cumber S, Paine S, Schrader R, Trujillo N, et al. Low dialysate potassium concentration is associated with prolonged recovery time. Hemodial Int. 2017 Oct;21 Suppl 2:S27–32.

107. Johansen KL, Painter P, Kent-Braun JA, Ng AV, Carey S, Da Silva M, et al. Validation of questionnaires to estimate physical activity and functioning in end-stage renal disease. Kidney International. 2001 Mar;59(3):1121–7.

108. Spalding EM, Chandna SM, Davenport A, Farrington K. Kt/V underestimates the hemodialysis dose in women and small men. Kidney International. 2008 Aug;74(3):348–55.

APPENDICES

APPENDIX I:

PART I: INFORMATION SHEET

Introduction

My name is Dr. Ebrahim Yusuf Ebrahim. I am a post-graduate student at the University of Nairobi, Department of Internal Medicine. I am carrying out this study to find out what are the Dialysis Recovery times (DRTs) of patients undergoing dialysis at this unit (KNH). I seek your participation in this study. The intension of this document is to explain to you the details of this study that you will be a part of. Kindly ensure you read through the information in this form thoroughly and freely ask any questions.

What is this study about?

In carrying out this study, in intend to find out how long it takes each one of you to go back to your normal daily activities after each dialysis session that you undergo, this is the “Dialysis Recovery time”. The Dialysis Recovery Time is important because it gives me an idea about how dialysis affects you personally and whether the dialysis process has an effect on the levels of fatigue you may be experiencing.

What we will ask you to do.

If you decide to participate in this study, we will hand you a questionnaire that will contain 94 items. This questionnaire will give us an insight into your daily physical activities.

Voluntary participation

Your participation in this study will be entirely voluntary. If by any chance you decide not to participate, the services you are currently receiving at this facility will continue without any change or alteration.

Risks and costs

This study does not involve a change in any of your treatment and therefore there will be no risk to your health. You do however stand a minor risk of sharing personal information by chance or sharing information that you feel uncomfortable speaking about. You will not be forced to answer any questions that you feel are to personal or that you feel uncomfortable speaking about.

You will not be asked to pay a fee to participate in this study nor will you incur any costs if you decide to participate. Your participation will be absolutely free of charge.

Benefits

The benefit you will derive from this study is that we will have a better understanding of your treatment and this information will likely help in improving your health care.

Reimbursements and compensation

You will not be provided with any monetary compensation or incentive to take part in this study.

Confidentiality

The information you provide in this study will be kept strictly private. In the event that we have to publish the results that we have found, we will not include any personal information that will make it possible to identify you. The forms will be kept in a securely locked cabinet and the information stored in a password protected computer that will only be accessible to the researchers

Who to contact

If you have any questions or clarifications, you can ask them now or contact me privately later with the contact information below:

Dr. Ebrahim Yusuf Ebrahim

P.O BOX 21509 – 00100,

Nairobi, Kenya.

Tel: 0735-505-550

The Secretary,

KNH/UoN Ethics and Review Committee,

Tel: 27263900 Extension 44102

PART II: CERTIFICATE OF CONSENT (MANDATORY)

I have read the above information, or it has been read out to me. I have had the opportunity to ask questions about it and I am satisfied. I consent voluntarily to be a participant in this study.

Print Name of the Participant _____

Signature of the Participant _____ Date _____

(DD/MM/YY)

If illiterate[1]

Print Name of the Witness_____

Signature of the Witness_____

Thumb print of the Participant

Date _____

(DD/MM/YY)

PART III: STATEMENT BY THE RESEARCHER / PERSON TAKING THE CONSENT

I confirm that the individual has not been coerced into giving consent, and that the consent has been given freely and voluntarily. A copy has been provided to the participant.

Print Name & Signature of the Researcher / person taking the consent

_____ Date _____

(DD/MM/YY)

An illiterate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb print as well.

APPENDIX II: KISWAHILI CONSENT FORM

SEHEMU I: WARAKA WA HABARI MUHIMU
Utangulizi

Jina langu ni Dr. Ebrahim Yusuf Ebrahim. Mimi ni mwanafunzi ninayehitimu katika Chuo Kikuu cha Nairobi, Idara ya Tiba ya Ndani. Ninafanya utafiti huu ili kujua ni muda gani inachukua wagonjwa kurudi kufanya kazi zao za kawaida baada ya kipindi kimoja cha dialysis. Ningependa ushiriki wako katika utafiti huu. Nia ya waraka hili ni kukuelezea kwa kina kuhusu utafiti huu. Tafadhali hakikisha unasoma habari yote katika fomu hii vizuri na kwa uhuru uulize maswali yoyote.

Utafiti huu unahusu nini?

Katika kutekeleza utafiti huu, kwa nia ya kujua ni muda gani inachukua kila mmoja wenu kurudi kwenye shughuli zake za kawaida baada ya kila kikao cha dialysis (DRT). Wakati wa Uponaji wa Dialysis (DRT) ni muhimu kwa sababu inanipa wazo kuhusu jinsi dialysis inakuathiri wewe binafsi na ikiwa matibabu ya dialysis ina athari kwenye viwango vya uchovu unaoweza kuwa unapata.

Ni nini kinachohitajika kutoka kwako?

Iwapo utaamua kushiriki katika utafiti huu, tutakupa orodha ya maswali ambalo litakuwa na vihoja 94. Orodha hili litatupa ufahamu juu ya shughuli zako za kila sikui. Tutapata pia maelezo ya matibabu yako ya dialysis kutoka kwa faili yako.

Ushiriki wa hiari.

Ushiriki wako katika utafiti huu utakuwa wa hiari kabisa. Ikiwa kwa wakati wowote utaamua kutoshiriki, huduma unazopokea sasa katika kituo hiki zitaendelea bila mabadiliko yoyote.

Hatari na gharama.

Utafiti huu hauhusishi mabadiliko ya matibabu yako yoyote na kwa hivyo hakutakuwa na hatari kwa afya yako. kunao hatari ndogo ya habari zako za kibinafsi kujulikana na watu wasiohusika

na utafiti huu. Hautalazimika kujibu maswali yoyote ambayo unahisi ni ya kibinafsi au ambayo hauhisi kuuzungumzia.

Hutaulizwa kulipa ada ya kushiriki katika utafiti huu wala hautapata gharama yoyote ukiamua kushiriki. Ushiriki wako utakuwa bure kabisa

Faida za kushiriki.

Faida ambayo utapata kutokana na utafiti huu ni kwamba tutakuwa na ufahamu mzuri wa matibabu yako na habari hii itatuwezesha kuboresha huduma yako ya afya.

Kulipwa na fidia

Hautapewa fidia yoyote ya pesa au motisha ya kushiriki katika utafiti huu.

Usiri

Habari unayotoa katika utafiti huu itahifadhiwa vizuri. Katika tukio ambalo tunapaswa kuchapisha matokeo ambayo tumepata, hatutajumuisha habari yoyote yako ya kibinafsi ambayo itafanya iwezekane kukutambua. Fomu hizo zitahifadhiwa kwenye kabati lililofungwa salama na habari iliyohifadhiwa kwenye kompyuta iliyolindwa na nywila (neon la siri au password).

Nani wa kuwasiliana naye

Ikiwa una maswali yoyote au ukihitaji ufafanuzi zaidi, unaweza kutuuliza sasa au wasiliana nami baadaye na habari ya mawasiliano zilizo hapa chini:

Dakt. Ebrahim Yusuf Ebrahim
P.O BOX 21509 – 00100,
Nairobi, Kenya.
Tel: 0735-505-550

Katibu,
KNH/UoN Ethics and Review Committee,
Tel: 27263900 Extension 44102

SEHEMU II: CHETI CHA UKUBALI (WAJIBU)

Nimesoma habari hiyo hapo juu, au imesomwa kwangu. Nimepata nafasi ya kuuliza maswali juu yake na nimeridhika. Ninakubali kwa hiari yangu kuwa mshiriki katika utafiti huu.

Jina la Mshiriki:
_____

Sahihi la Mshiriki na Tarehe:
_____(DD/MM/YY)

Jina la Shahidi:
_____

Sahihi la Shahidi na Tarehe:
_____(DD/MM/YY)

SEHEMU III: TAARIFA YA MTAFITI

Jina la mtafiti
_____

Sahihi la mtafiti na Tarehe
_____(DD/MM/Y

APPENDIX III: STUDY PRO-FORMA

PARTICIPANTS NAME _____

PARTICIPANT IP / HOSPITAL NUMBER _____

PART 1: SOCIODEMOGRAPHIC CHARACTERISTICS

Age …….. (Years)

Gender…… (M / F)

Marital status

1. Single
2. Married
3. Separated
4. Divorced

Level of Education

1. None
2. Primary
3. Secondary
4. Tertiary

PART 2: ANTHROPOMETRIC MEASUREMENTS

1. Height (M) ☐
2. BMI (Kg/M2) ☐

PART 3: DIALYSIS RECOVERY TIME

HOW LONG DOES IT TAKE YOU TO GO BACK TO NORMAL ACTIVITIES AFTER A DIALYSIS SESSION?

INAKUCHUKUA MUDA GANI KURUDI KWENYE SHUGHULI ZAKO ZA KAWAIDA BAADA YA KIPINDI KIMOJA CHA "DIALYSIS"?

1) Up to 2 hours ☐
2) 2 to 6 hours ☐
3) 6 to 12 hours ☐
4) More than 12 hours ☐

PART 4: DIALYSIS DETAILS

(OBTAINED FROM THE MONTHS 'DIALYSIS CHARTS)

1. Dialysis Access

a) A-V Fistula ☐
b) Permanent Catheter ☐
c) Temporary Catheter ☐

2. Dialysis Vintage _____ (IN YEARS AND MONTHS)

3. Number of weekly dialysis sessions (tick where applicable)

a) 1 Session per week ☐
b) 2 sessions per week ☐
c) more than 2 / week ☐

4. Average Interdialytic Weight Gain (IDWG) _____ (x/8 kg)
5. Dialysis duration _____ (hours)
6. Average Pre-dialysis BP (last 8 sessions) _____ (x/8 mmHg)
7. Average post dialysis BP _____ (x/8 mmHg)
8. Average Ultrafiltration Rate (UFR) _____(x/8)
9. Average Blood Flow Rate (BGR) _____(x/8)

10. Average dialysate sodium _____

11. Average dialysate temperature_____ ^{o}C

APPENDIX IV: HUMAN ACTIVITY PROFILE QUESTIONNAIRE

		TICK WHERE APPLICABLE TIA SAHIHI SEHEMU HUSIKA		
POINTS (ALAMA)	**ACTIVITY (SHUGHULI)**	**I HAVE NEVER DONE (SIJAWAHI FANYA)**	**I STOPPED DOING (USED TO BUT CANNOT ANYMORE) (SIWEZI TENA)**	**STILL DOING (NINA ENDELEA KUFANYA)**
1.	Getting in and out of chairs or bed (without assistance) **Kuingia na kutoka kwenye kitanda au kiti (bila usaidizi)**			
2.	Listening to the radio **Kusikiza redio**			
3.	Reading books, magazines, or newspapers **Kusoma kitabu, jarida au gazeti.**			
4.	Writing (letters, notes) **Kuandika (barua)**			
5.	Working at a desk or table **Kufanya kazi kwenye dawati ama meza**			
6.	Standing (#1 min) **Kusimama (#Dakika moja)**			
7.	Standing (#5 min) **Kusimama (#Dakika tano)**			
8.	Dressing or undressing (without assistance) **Kuvaa au kuvua nguo (bila usaidizi)**			
9.	Getting clothes from drawers or closets **Kuchukua nguo kutoka kwenye droo au kabati**			
10.	Getting in or out of a car (without assistance) **Kuingia au kutoka kwenye gari (bila usaidizi)**			

11.	Dining at a restaurant **Kula kwenye mkahawa / hoteli**			
12.	Playing cards/table games **Kucheza karata / michezo ya mezani**			
13.	Taking a bath (without assistance) **Kuoga (bila usaidizi)**			
14.	Putting on shoes, stockings, or socks (no rest/break needed) **Kuvaa viatu au soksi**			
15.	Attending a movie, play, church event or sports activity **Kuhudhuria sinema, maonyesho ya moja kwa moja, tukio la kanisani au michezo**			
16.	Walking 30 yards (27 meters) **Kutembea yadi 30 (mita 27)**			
17.	Walking 30 yards (nonstop) (27 meters) **Kutumbea yadi 30 (bila mapumziko) (Mita 27)**			
18.	Dressing/undressing (no rest/break needed) **Kuvaa / Kuvua nguo (bila mapumziko) (bila mapumziko)**			
19.	Using public transport or driving a car (#99 miles) (160 kms) **Kutumia sanaa za usafiri wa umma au kuendesha gari (kilomita 160)**			
20.	Using public transport or driving a car (#110 miles) (177 kms) **Kutuma sanaa za usafiri wa umma au kuendesha gari (kilomita 177)**			
21.	Cooking your own meals **Kujipikia vyakula**			
22.	Washing or drying dishes **Kufua nguo au kukausha vyombo**			
23.	Putting groceries on shelves **Kupanga mboga kwenye rafu au shelfu**			
24.	Ironing or folding clothes **Kupiga pasi au kunja nguo**			
25.	Dusting/polishing furniture or polishing car **Kutimua vumbi kwenye samani au kupangusa gari**			
26.	Showering **Kuoga**			

27.	Climbing 6 steps **Kupanda ngazi stepu 6**			
28.	Climbing 6 steps (nonstop) **Kupanda ngazi stepu 6 (bila mapumziko)**			
29.	Climbing 9 steps **Kupanda ngazi step 9**			
30.	Climbing 12 steps **Kupanda ngazi stepu 12**			
31.	Walking half a block on level ground **Kutembea mita 40**			
32.	Walking half a block on level ground (nonstop) **Kutembea mita 40 (bila mapumziko)**			
33.	Making a bed (not changing sheets) **Kunyoosha shuka**			
34.	Cleaning windows **Kusafisha madirisha**			
35.	Kneeling or squatting to do light work **Kupiga magoti au kuchuchumaa kufanya kazi kidogo**			
36.	Carrying a light load of groceries **Kubeba mboga yenye uzito kidogo**			
37.	Climbing 9 steps (nonstop) **Kupanda ngazi stepu 9 (bila mapumziko)**			
38.	Climbing 12 steps (nonstop) **Kupanda ngazi stepu 12 (bila mapumziko)**			
39.	Walking half a block uphill **Kupanda mlima mdogo wa mita 40**			
40.	Walking half a block uphill (nonstop) **Kupanda mlima mdogo mita 40 (bila mapumziko)**			
41.	Shopping (by yourself) **Ununuzi (bila usaidizi)**			
42.	Washing clothes (by yourself) **Kufua nguo (bila usaidizi)**			
43.	Walking 1 block on level ground (80 meters) **Kutembea mita 80**			
44.	Walking 2 blocks on level ground (160 meters) **Kutembea mita 160**			
45.	Walking 1 block on level ground (nonstop) (80meters)			

	Kutembea mita 80 (bila mapumziko)			
46.	Walking 2 blocks on level ground (nonstop) (160meters) **Kutembea mita 160 (bila mapumziko)**			
47.	Scrubbing (doors, walls or cars) **Kusugua (milango, kuta au magari)**			
48.	Making beds (changing sheets) **Kutandika vitanda (kubadilisha shuka)**			
49.	Sweeping **Kufagia**			
50.	Sweeping (5 min nonstop) **Kufagia (dakika 5 bila mapumziko)**			
51.	Carrying a large suitcase or bowling (1 line) **Kubeba sanduku moja kubwa**			
52.	Vacuuming carpets **Kufagia zulia kwa kutumia mashine ya kufagia**			
53.	Vacuuming carpets (5 minutes nonstop) **Kufagia zulia kwa kutumua mashine ya kufagia (dakika 5 bila mapumziko)**			
54.	Painting (interior/exterior) **Kupaka rangi (ndani na nje)**			
55.	Walking 6 blocks on level ground (500 meters) **Kutembea mita 500**			
56.	Walking 6 blocks on level ground (nonstop) (500 meters) **Kutembea mita 500 (bila mapumziko)**			
57.	Carrying out the garbage **Kutoa takataka nje**			
58.	Carrying a heavy load of groceries **Kubeba mzigo wenye uziko mkubwa**			
59.	Climbing 24 steps **Kupanda ngazi stepu 24**			
60.	Climbing 36 steps **Kupanda ngazi stepu 36**			
61.	Climbing 24 steps (nonstop) **Kupanda ngazi stepu 24 (bila mapumziko)**			
62.	Climbing 36 steps (nonstop) **Kupanda ngazi stepu 36 (bila mapumziko)**			
63.	Walking 1 mile (1.6kms) **Kutembea kilo mita 1.6**			

64.	Walking 1 mile (1.6kms) (nonstop) **Kutembea kilomita 1.6 bila mapumziko**			
65.	Running 110 yards (100 meters) or playing softball/baseball **Kukimbia mita 100**			
66.	Dancing (social) **Kudensi**			
67.	Doing calisthenics /aerobics (5 minutes nonstop) **Kufanya michezo ya erobiki**			
68.	Mowing the lawn (not riding mower) **Kufyeka majani**			
69.	Walking 2 miles (3.2 kms) **Kutembea kilomita 3.2**			
70.	Walking 2 miles (3.2kms) (nonstop) **Kutembea kilomita 3.2 bila mapumziko**			
71.	Climbing 50 steps **Kupanda ngazi stepu 50**			
72.	Shoveling, digging, or spading **Kuchimba kwa kutumia jembe**			
73.	Shoveling, digging, or spading (5 minutes nonstop) **Kuchimba kwa kutumia jembe (dakika 5 bila mapumziko)**			
74.	Climbing 50 steps (nonstop) **Kupanda ngazi stepu 50 bila mapumziko**			
75.	Walking 3 miles (4.8kms) or golfing 18 holes **Kutembea kilomita 4.8**			
76.	Walking 3 (4.8 kms) miles (nonstop) **Kutembea kilomita 4.8 (bila mapumziko)**			
77.	Swimming 25 yards (23 meters) **Kuogelea mita 23**			
78.	Swimming 25 yards (nonstop) (23 meters) **Kuogelea mita 23 bila mapumziko**			
79.	Bicycling 1 mile (1.6kms) **Kupeleka baiskeli kilomita 1.6**			
80.	Bicycling 2 miles (3.2 kms) **Kupeleka baiskeli kilomita 3.2**			
81.	Bicycling 1 mile (1.6kms) (nonstop)			

	Kupeleka baiskeli kilomita 1.6 bila mapumziko			
82.	Bicycling 2 miles (3.2kms) (nonstop) **Kupeleka baiskeli kilomita 3.2 bila mapumziko**			
83.	Running or jogging 0.25 mile (400 meters) **Kukimbia mita 400**			
84.	Running or jogging 0.5 mile (800 meters) **Kukimbia mita 800**			
85.	Playing tennis or racquetball **Kucheza mchezo tenisi**			
86.	Playing basketball (game play) **Kucheza mchezo mpira wa kikapu**			
87.	Running or jogging 0.25 mile (400 miles) (nonstop) **Kukimbia mita 400 bila mapumziko**			
88.	Running or jogging 0.5 mile (800 meters) (nonstop) **Kukimbia mita 800 bila mapumziko**			
89.	Running or jogging 1 mile (1.6 kms) **Kukimbia kilomita 1.6**			
90.	Running or jogging 2 miles (3.2 kms) **Kukimbia kilomita 3.2**			
91.	Running or jogging 3 miles (4.8 kms) **Kukimbia kilomita 4.8**			
92.	Running or jogging 2 miles (3.2 kms) in #12 min **Kukimbia kilomita 3.2 kwa dakika 12**			
93.	Running or jogging 2 miles (3.2 kms) in #20 min **Kukimbia kilomita 3.2 kwa dakika 20**			
94.	Running or jogging 2 miles (3.2kms) in #30 min **Kukimbia kilomita 3.2 kwa dakika 30**			

Figure 6: HAP Questionnaire.

APPENDIX V: DUMMY TABLES

Demographic characteristics	**Count**	**Percentage**
Age group (years)		
1. <30		
2. 30-39		
3. 40-49		
4. ≥50		
Gender		
1. Female		
2. Male		
Highest education level		
1. Never attended school		
2. Primary		
3. Secondary		
4. Tertiary		

Clinical profile	**Count**	**Percentage**
BMI		
1. Underweight		
2. Normal weight		
3. Overweight		
4. Obese		

Dialysis access		
1. Cuffed		
2. Uncuffed catheters		
3. A-V fistula		
4. Graft		
Weekly dialysis sessions		
1		
2		
>3		

Dialysis profile	**Mean (Std dev.)**	**Median (IQR)**	**Min-Max**
Dialysis recovery time			
Dialysis vintage			
Average pre- dialysis BP			
Average post- dialysis BP			
Average ultrafiltration Rate			
Blood flow rate			
Sodium profiling			
Maximum Activity Score			
Adjusted Activity Score			

Covariates	**OR**	**95% Conf. Interval**	**P-value**
Maximum Activity Score			
Adjusted Activity Score			
BMI			
Underweight (Ref group)			
Normal weight			
Overweight			
Obese			

APPENDIX VI: STUDY TIMELINES

Activity	**Proposed time**
Protocol Development	January – April 2021
Protocol Presentation	May 2021
KNH Ethical Approval	June – August 2021
Data Collection	October 2021
Data Analysis and dissertation write-up	November 2021
Results Presentation, corrections and handing in of final report	December 2021

APPENDIX VII: ESTIMATED STUDY BUDGET

ITEM	**COST (Kshs)**
Statistician	40,000
Kiswahili translator	10,000
Research assistants	20,000
Stationary	20,000
Contingencies (20%)	16,000
Total	**106,000**

BUDGET JUSTIFICATION

The stationery included printing costs of data results at the end of the study. Research assistants were also recruited to assist in data collection. A 20% contingency of the subtotal was added in case of unforeseen eventualities.

FUNDING SOURCE

The Primary Investigator solely catered for the study costs.

APPENDIX VIII: KNH-UON ERC APPROVAL

UNIVERSITY OF NAIROBI
FACULTY OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel (254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh-erc@uonbi.ac.ke
Website: http://www.uonbi.ac.ke/uonknh-erc
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/356

4th October, 2021

KENYATTA NATIONAL HOSPITAL
APPROVED
04 OCT 2021
P.O. BOX 20723, NAIROBI
KNH/UON-ERC

Dr. Ebrahim Yusuf Ebrahim
Reg. No H58/15444/2018
Dept of Clinical Medicine and Therapeutics
Faculty of Health Sciences
University of Nairobi

Dear Dr. Ebrahim

RESEARCH PROPOSAL: DIALYSIS RECOVERY TIME AND ITS ASSOCIATED FACTORS IN PATIENTS UNDERGOING HAEMODIALYSIS AT THE KENYATTA NATIONAL HOSPITAL (Fs30/08/2021)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH-UoN ERC) has reviewed and approved your above research proposal. The approval period is 4th October 2021 – 3rd October 2022

This approval is subject to compliance with the following requirements:

i. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
ii. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
iii. Death and life threatening problems and serious adverse events (SAEs) or unanticipated adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
iv. Any changes anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from KNH- UoNERC for each batch of shipment.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (Attach a comprehensive progress report to support the renewal)
vii. Submission of an executive summary report within 90 days upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website http://www.erc.uonbi.ac.ke

Yours sincerely,

PROF. M.L CHINDIA
SECRETARY, KNH- UoN ERC

c.c. The Dean-Faculty of Health Sciences, UoN
The Senior Director, CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information, KNH
The Chair, Dept. of Clinical Medicine and Therapeutics, UoN
Supervisor: Prof. Seth Mc Ligeyo, Dept.of Clinical Medicine and Therapeutics, UoN
Dr. Maranga Wambugu(Consultant Physician and Nephrologist), KNH