



UNIVERSITI PUTRA MALAYSIA

***ASSESSING MUSCLE STRENGTH AND ITS ASSOCIATED FACTORS
AMONG PERITONEAL DIALYSIS PATIENTS AT SELECTED
GOVERNMENT HOSPITALS***

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The logo of Universiti Putra Malaysia (UPM) is a shield-shaped emblem. It features a red and white stylized design with a book in the center. The letters 'UPM' are prominently displayed in the top left corner of the shield.

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PERITONEAL DIALYSIS PATIENTS AT SELECTED GOVERNMENT HOSPITALS

By

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A project submitted as a partial fulfillment of the requirement for the degree of Bachelor of
Science (Dietetics) from the Faculty of Medicine and Health Sciences, Universiti Putra
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This project submitted as a partial fulfilment of the requirement for the degree of Bachelor of Science (Dietetics) from Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. This project entitled “Assessing muscle strength and its associated factors among peritoneal dialysis patients at selected government hospitals” was prepared by Nurul Saddiqah binti Adnan and submitted to the Faculty of Medicine and Health Sciences as a partial fulfilment of the requirement for the degree of Bachelor of Science (Dietetics) from the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

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ABSTRACT

ASSESSING MUSCLE STRENGTH AND ITS ASSOCIATED FACTORS AMONG PERITONEAL DIALYSIS PATIENTS AT SELECTED GOVERNMENT HOSPITALS

Nurul Saddiqah binti Adnan

Dialysis patients with low muscle strength have increased mortality risk. Hence, this study aimed to determine the muscle strength and its associated factors among peritoneal dialysis (PD) patients at selected government hospitals. This study was a combination study of primary and secondary data of cross-sectional study among PD patients. Socio-demographic background was obtained through an interviewer-administered questionnaire, medical history and biochemical data retrieved from patient's medical record. Height, weight, skinfold, mid-upper arm circumferences (MUAC) and lean body mass (LBM) were measured. Dietary intake was assessed using 3 days diet recall. Muscle strength was measured using Jamar handgrip dynamometer [handgrip strength (HGS)]. A total of 104 patients included in this study, 26 was primary data from Hospital Serdang and Hospital Kuala Lumpur, meanwhile, 78 was secondary data from Hospital Pakar Sultanah Fatimah. A total of 31.7 % (n=33) PD patients had low handgrip strength. There was significant association between HGS with age ($r = -0.257$, $p = 0.009$), gender ($\chi^2 = 5.593$, $p = 0.018$), LBM ($r = 0.303$, $p = 0.002$), MUAC ($r = 0.252$, $p = 0.010$), serum albumin ($r = 0.265$, $p = 0.006$), serum creatinine ($r = 0.212$, $p = 0.030$), and energy intake ($r = 0.251$, $p = 0.017$). There are several factors found to be associated with HGS among PD patients in these centres. Hence, HGS should be regularly assessed in PD patients as it can help in monitoring nutritional status.

Keywords: Peritoneal dialysis, mid-upper arm circumferences, lean body mass, handgrip strength

ABSTRAK

KEKUATAN OTOT DAN FAKTOR-FAKTOR YANG BERHUBUNG KAIT DENGAN KEKUATAN OTOT DALAM KALANGAN PESAKIT DIALISIS PERITONEAL (*PERITONEAL DIALYSIS*) DI HOSPITAL KERAJAAN YANG TERPILIH

Nurul Saddiqah binti Adnan

Kekuatan otot yang rendah dalam kalangan pesakit dialisis boleh meningkatkan kadar kematian. Oleh itu, kajian ini dijalankan bertujuan untuk menilai kekuatan otot dan faktor-faktor yang berkaitan dengannya dalam kalangan pesakit peritoneal dialysis (PD) di hospital kerajaan yang terpilih. Kajian ini merupakan kajian keratan rentas daripada kombinasi data prima dan sekunder pesakit PD. Socio-demografi diperolehi daripada soal selidik secara temuduga, manakala, sejarah perubatan dan data biokimia diperolehi daripada rekod perubatan. Tinggi, berat, lipatan kulit, ukur lilit lengan (MUAC) dan jisim badan tanpa lemak (LBM) juga diukur. Pengambilan makanan diukur menggunakan rekod pemakanan selama 3 hari. Kekuatan otot diukur menggunakan Jamar handgrip dynamometer. Sejumlah 104 subjek telah menyertain kajian ini, 26 subjek merupakan data prima dari Hospital Serdang dan Hospital Kuala Lumpur. Manakala, 78 subjek merupakan data sekunder daripada Hospital Pakar Sultanah Fatimah. Sejumlah 31.7 % (n=33) pesakit PD mempunyai kekuatan otot yang rendah. Terdapat kaitan antara kekuatan genggam tangan (HGS) dengan umur ($r = -0.257$, $p = 0.009$), jantung ($\chi^2 = 5.593$, $p = 0.018$), LBM ($r = 0.303$, $p = 0.002$), MUAC ($r = 0.252$, $p = 0.010$), serum albumin ($r = 0.265$, $p = 0.006$), serum kreatinin ($r = 0.212$, $p = 0.030$), dan pengambilan tenaga ($r = 0.251$, $p = 0.017$). Beberapa faktor telah dijumpai berkaitan dengan kekuatan otot. Oleh itu, kekuatan otot haruslah diukur secara berkala dalam kalangan pesakit PD memandangkan ia dapat membantu memantau status nutrisi seseorang.

Kata kunci: dialisis peritoneal, ukur lilit lengan, jisim badan tanpa lemak, kekuatan genggam tangan

CHAPTER 1

INTRODUCTION

1.1 Background

Kidney disease have become epidemic nowadays. Levin & Zoccali (2018) reported over 850 million of people suffer from kidney disease worldwide. End-stage renal disease (ESRD) is one of the outcomes of chronic kidney disease. ESRD is diagnosed with glomerular filtration rate of less than $15 \text{ ml/min/1.73m}^2$ which need replacement therapy such as renal transplantation, haemodialysis and peritoneal dialysis (Mohamad et al., 2005). It is estimated over 2 million people now need renal replacement therapy worldwide in order to prolong life (Couser, Remuzzi, Mendis, & Tonelli, 2011). In Malaysia, prevalence of kidney patient on dialysis treatment was 1220 per million population in 2015. The number of new dialysis patient keep increasing each year where the number increased almost 40,000 in 2016. The 24th Report of the Malaysia Dialysis & Transplant Registry 2016 reported the number of peritoneal dialysis (PD) patients increased from 1549 patients in 2007 to 3930 patients in 2016 with prevalence rate of 127 per million population. Around 84% PD patients receiving continues ambulatory peritoneal dialysis (CAPD) and 13% received ambulatory peritoneal dialysis (APD) (Ahmad et al., 2018). Hence, the data showed there are increment in kidney patients who undergo PD treatment.

Any chronic patient prone to develop malnutrition, same goes to CKD patient. However, for CKD patients the malnutrition condition is being termed as 'protein-energy wasting' (PEW). The is because the etiology of malnutrition in CKD are unique in which inflammation are implicated instead of reduced dietary intake per se. Meanwhile, the definition of PEW is loss of muscle and visceral protein. It is not entirely caused by inadequate caloric intake (Fouque et al., 2008). Besides PEW, studies showed CKD can cause emerging of many

other problems such as loss of muscle, reduce muscle strength and physical disability (Bataille et al., 2017; Stenvinkel & Larsson, 2013; Wang & Mitch, 2014).

CKD and dialysis treatment are found affecting skeletal muscle mass and strength. In HD patients, the prevalence of sarcopenia is 3.9% to 63% meanwhile the prevalence of dynapenia is 44.9%-88.3% (Bataille et al., 2017; Isoyama, Qureshi, Avesani, Lindholm, Bárány, et al., 2014; Kim et al., 2014; Kittiskulnam et al., 2017; Lamarca et al., 2014; Pinto, Ramos, Meireles, Kamimura, & Cuppari, 2015). On the other hand, As'Habi, Najafi, Tabibi, & Hedayati, (2018) reported the prevalence of sarcopenia and dynapenia in PD patients is 11.5% and 43% respectively. Sarcopenia is the term used for low in muscle mass and muscle strength while dynapenia is for low muscle strength only. Besides, skeletal muscle mass and strength can be functional as the indicator of nutritional status (Carrero et al., 2016). Skeletal muscle contribute around 40% of body weight and 50% of body protein. Skeletal muscle is important in regulating protein storage and it will be broken down when needed.

Comparing between muscle strength and muscle mass, the loss of muscle strength occur before muscle mass and muscle strength can diminish even though muscle mass is maintained (Isoyama, Qureshi, Avesani, Lindholm, Bárány, et al., 2014). Moreover, assessment of muscle strength is a better predictor of prognosis and comorbidities compare to muscle mass (Stenvinkel, Carrero, Von Walden, Ikizler, & Nader, 2016). On the other hand, low hand grip strength which indicate muscle strength is 1.88 times higher risk of death from all cases compared to high hand grip strength. Hand grip strength also used in screening malnutrition and inflammation among CKD patients (Hwang, Lee, Min, & Jeon, 2019). Therefore, this study will investigate on the muscle strength among PD patients.

Muscle strength can be influenced by many factors which include age, comorbidities, PEW, physical activity, low albumin and inflammation (Isoyama, Qureshi, Avesani, Lindholm,

Ba, et al., 2014). Low muscle strength also caused by the complications of CKD itself. This include metabolic acidosis, hypertension, increased angiotensin II levels, poorly controlled diabetes, oedema and the accumulation of unexcreted waste products of metabolism (Wang & Mitch, 2014). Many studies investigated the factors associated with low muscle strength in HD patients, however, the studies among PD patients are scarce. Moreover, there is no study have been done among PD patients to assess the muscle strength and its associated factors in Malaysia.

1.2 Problem statement

Since low of muscle strength associated with mortality, there is urgent need to assess muscle strength among CKD patients. The factor associated with muscle strength among HD patients are widely discussed, nevertheless there is limited data available for PD patient. Only limited study done among peritoneal patient. Wang et al. (2005) stated that the factors that predicts the outcome associated with muscle strength in HD patients may not necessarily apply to PD patients. Hence, this study will assess the muscle strength among PD patients as well as determine the associated factors that influence muscle strength.

Studies showed that muscle strength is strongly affected by age and sex (Stenvinkel, Bárány, Chung, Lindholm, & Heimbürger, 2002; Wang et al., 2005). Hwang et al. (2019) generally explained that aging process will decrease muscle mass and strength. The older person more likely to have low handgrip strength (HGS) which show low muscle strength. Besides, the association between HGS and mortality in HD patients is higher in women compare to male (M. B. Lopes et al., 2018). However, the study in PD patients by As'Habi et al. (2018) found there was no significant association between sex and muscle strength. Hence, socio-demographic factors such as age and sex should be investigated to find more clear association.

Next, comorbidities especially diabetes mellitus (DM) are found to be the significantly association with muscle strength. People with DM have low HGS regardless their age or sex. Significant decrease in muscle mass, musculoskeletal complications and diabetic neuropathy can be the factors contribute to low muscle strength (Pinto et al., 2015). Besides, atherosclerotic vascular disease also associated with lower HGS (Leal, Mafra, Fouque, & Anjos, 2011). Therefore, comorbidities related to CKD such as cardiovascular disease, DM, hypertension, hyperlipidemia, liver failure and others must be further investigated.

Apart from that, anthropometry measurements such as lean body mass and body mass index also consider as the factors that influence muscle strength. Since lean body mass are composed of skeletal muscle which is responsible with for movement, reduce function of lean body mass will affect the muscle strength (Carrero et al., 2016). Previous studies showed strong association between lean body mass and muscle strength (Leal, Mafra, et al., 2011). Besides, albumin and creatinine are important biomarker that indicate muscle strength. Creatinine is the breakdown of carnitine in muscle functions. The concentration of plasma creatinine may be altered in CKD patients and shows lower concentration in low HGS (Leal, Mafra, et al., 2011). Meanwhile, the association between albumin and muscle strength need to be further investigated as the albumin may be influences by other factors such as inflammatory respond. This is because a study showed there is no association between albumin and muscle strength (Heimbürger, Qureshi, Blaner, Berglund, & Stenvinkel, 2000).

Lastly, Hirai, Ookawara, & Morishita, (2016) reviewed that inadequate protein intake may be found in CKD patients because of their protein-restricted diet. Since protein is importance in building muscle mass which eventually associated with muscle strength, it is essential to investigate the relationship between dietary intake and muscle strength. However, limited study found investigating dietary intake as one of the factors associated with muscle strength.

1.3 Research question

What is the muscle strength status of PD patients and what is the association between socio-demographic characteristic, medical history, anthropometric measurement, biochemical data and dietary intake with muscle strength among peritoneal dialysis patients at selected government hospitals?

1.4 Significant of study

Studies among PD patients in Malaysia are scarce compared to HD patients due to the low number of PD patients. However, low muscle strength in dialysis patients related to mortality, hence, it is importance to carry out study regarding muscle strength and its associated factors among PD patients. Therefore, this study will be able to provide the value of HGS among PD patients as well as provide data regarding factors associated with muscle strength. By knowing the current value of HGS, healthcare practitioner can figure out next steps to reduce the risk or mortality among PD patients.

Moreover, the outcome of this study will help to assist healthcare practitioners such as physician, nurse and dietitian to identify the factors affecting poor muscle strength. Hence, early intervention can be provided. Lopes et al. (2018) suggested that HGS should help to guide nutritional interventions in order to improve quality of life and survival patients. In addition, since the decrease of muscle strength occur first before the decrease of muscle mass, it was suggested that treatment options in dialysis patients should not only target maintaining or increasing of muscle mass but also need to improve muscle functionality (Isoyama, Qureshi, Avesani, Lindholm, Bárány, et al., 2014).

1.5 Objective

General Objective:

To determine muscle strength and its associated factors among peritoneal dialysis patients at selected government hospitals.

Specific Objectives:

1. To determine the socio-demographics characteristics and medical history among peritoneal dialysis patients.
2. To assess muscle strength, anthropometric measurements, biochemical data and dietary intake among peritoneal dialysis patients.
3. To determine the associations between muscle strength and socio-demographic characteristics, medical history, anthropometric measurement, biochemical data, and dietary intake among peritoneal dialysis patients at selected government hospitals.

1.6 Hypotheses

Null hypotheses:

There is no association between muscle strength and socio-demographic characteristics, medical history, anthropometric measurement, biochemical data, and dietary intake among peritoneal dialysis patients at selected government hospitals.

1.7 Conceptual framework

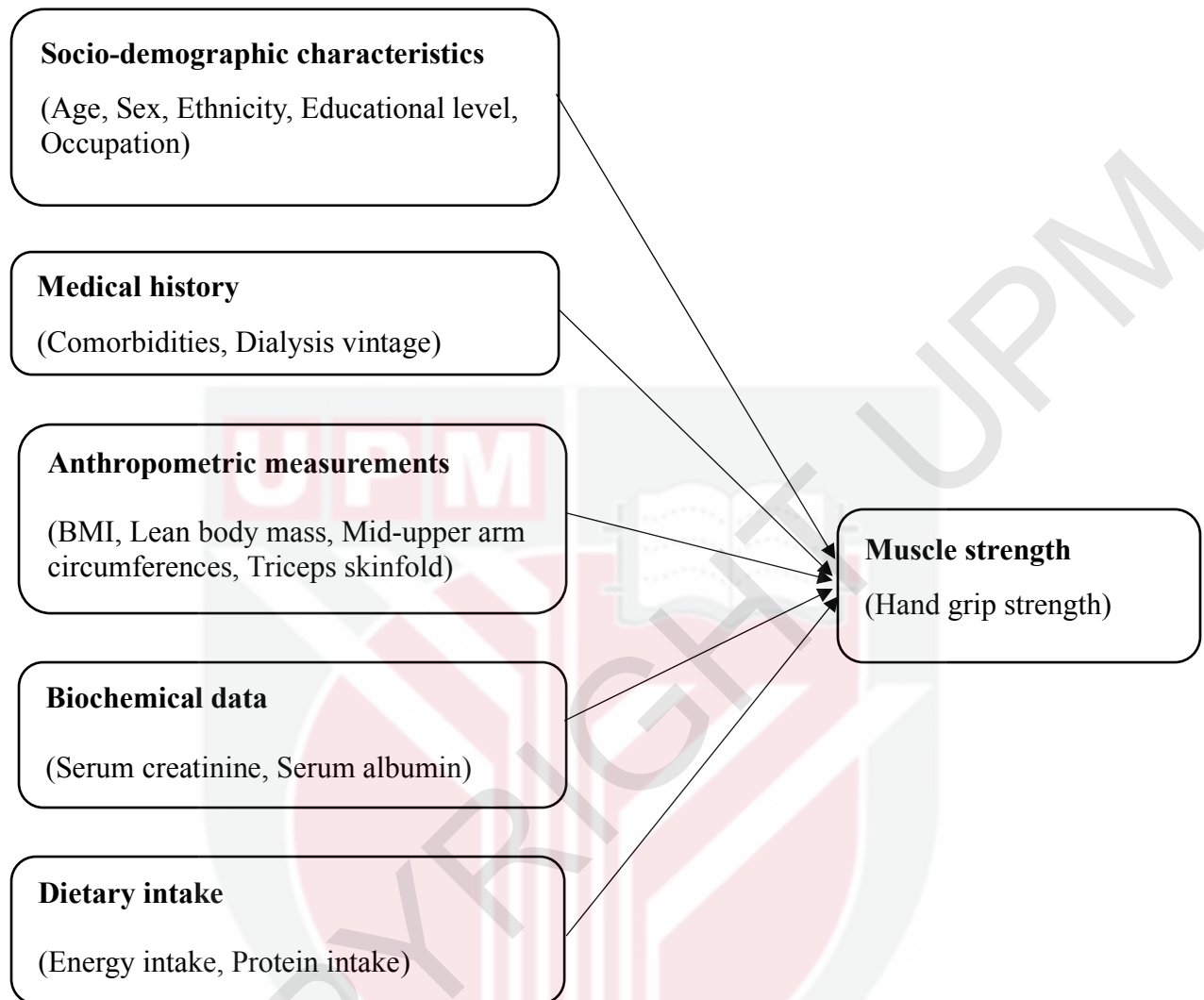


Figure 1: Conceptual framework of study which consist of socio-demographic characteristics, medical history, anthropometric measurements, biochemical data, dietary intake and muscle strength.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of peritoneal dialysis

Peritoneal dialysis (PD) is one of the medical treatments available for end stage renal disease (ESRD) besides haemodialysis and transplantation. PD use the body's own semi-permeable membrane called peritoneum where a catheter is implanted surgically through the abdominal and into the peritoneal cavity. A solution called dialysate containing high-dextrose concentration is instilled into the peritoneum. Then, because of differences in osmotic pressure, the water diffused carrying waste products from blood through the peritoneal membrane and into the dialysate. The solution is then withdrawn and discarded. New solution is added multiple times each day (Mahan & Raymond, 2011).

Peritoneal dialysis can be divided into two type which is continuous ambulatory peritoneal dialysis (CAPD) and automated peritoneal dialysis (APD), formerly called continuous cyclic peritoneal dialysis (CCPD). In CAPD, the dialysate is left in the peritoneum and manually exchanged through gravity. Meanwhile, for APD, the exchange of dialysate is mechanically done by a machine at night. There is also combination of CAPD and APD treatment received by the patients (Mahan & Raymond, 2011).

PD offers few advantages such as the ability of patients to lead more normal lifestyle, avoidance of large fluctuations in blood chemistry and longer residual renal function. However, some of the disadvantages are peritonitis, hypotension that require fluid and sodium replacement and weight gain (Mahan & Raymond, 2011).

2.2 Muscle strength

Sarcopenia or a syndrome of loss skeletal muscle mass and function is well known complication of PEW in dialysis patients (Bataille et al., 2017). Muscle strength is closely related to muscle mass. Comparing between muscle mass and muscle strength, decreased in muscle strength is more strongly associated with mortality compare to decrease in muscle mass. Furthermore, muscle strength and muscle mass do not seem to occur simultaneously as loss of muscle strength occur first before loss of muscle mass (Isoyama, Qureshi, Avesani, Lindholm, Bárány, et al., 2014). According to Carrero et al. (2016), the loss of muscle strength may be functional parameter that associated with the loss of muscle mass and weakness of lower extremities. Moreover, low muscle strength is more strongly related with aging, PEW, physical inactivity, inflammation and mortality compared to low muscle mass (Isoyama, Qureshi, Avesani, Lindholm, Bárány, et al., 2014). Besides, a study by Stenvinkel et al. (2002) found that dialysis patients with HGS's values above medium have higher survival rates compare to those with HGS values below medium. Hence, assessing muscle strength among PD patients should be further investigated to improve their health status.

Muscle strength can be divided into upper and lower extremities strength. Hand grip strength which measured using handgrip dynamometer is simple, portable, and relatively inexpensive. Besides of the grip strength is reliable for upper extremities strength, it is also associated with lower extremities strength and function. Meanwhile, to measure lower extremities strength, the standard method is by using isokinetic dynamometer since it has high precision. However, the price is expensive and bulky (Carrero et al., 2016).

2.3 Comparison of studies regarding factors associated with muscle strength

Table 2: Comparison table of studies on factors associated with muscle strength.

Title/ Author/ Year	Study location	Study population	Prevalence of low MS	Factors associated with MS	
				Significant	Non-significant
Prevalence of sarcopenia and dynapenia and their determinants in Iranian peritoneal dialysis patients (As'Habi et al., 2018)	Iran	PD	43%	- age - physical activity level (PAL) - DM	- sex - dialysis vintage - total dialysis adequacy - energy and protein intakes - inflammation -oxidative stress - intake of calcitriol (active form of vitamin D)
Evaluation of handgrip strength as a nutritional marker and prognostic indicator in peritoneal dialysis patients (Wang et al., 2005)	Hong Kong	PD	N/A	-LBM -serum albumin -SGA -age -sex -DM -hemoglobin -residual glomerular filtration rate	-atherosclerotic vascular disease -PD Kt/V (urea clearance) -dialysis duration -C-reactive protein -smoking
Gender and age differences in plasma carnitine, muscle strength, and exercise tolerance in haemodialysis patients (Constantin-Teodosiu et al., 2002)	UK	HD	N/A	-sex (female) -plasma free carnitine	-age
Handgrip strength and its dialysis determinants in hemodialysis patients (Leal, Stockler-Pinto, et al., 2011)	Brazil	HD	55.8% loss of muscle function	-forearm circumference -% body fat (anthropometry) -LBM (anthropometry, DXA) - age - stature & body mass	-biochemical variable - dialytic variable -BMI

Sex-age-specific handgrip strength and mortality in an incident hemodialysis cohort: The risk explained by nutrition and comorbidities (M. B. Lopes et al., 2018)	Brazil	HD	49.6 %	-age -less than high school -diabetes -cerebrovascular disease -catheter -haemoglobin -albumin -MIS	-sex -married -hypertension -heart failure -ischemic heart disease -peripheral vascular disease -cancer -duration of dialysis -PTHi -Calcium -phosphorus - Kt/V -BMI -Creatinine
Comparative Associations of Muscle Mass and Muscle Strength with Mortality in Dialysis Patients (Isoyama, Qureshi, Avesani, Lindholm, Bárány, et al., 2014)	Sweden	Dialysis patient	15 %	-old age -comorbidities (DM, CVD) -PEW -Physical inactivity -serum creatinine -serum albumin -inflammation (hsCRP, IL-6, TNF) -DEXA-LBMI	-sex -BMI -DEXA-FBMI -MAMC (mid arm muscle circumference) -GFR -haemoglobin -ferritin -leptin -cholesterol
Handgrip strength is an independent predictor of all-cause mortality in maintenance dialysis patients. (Vogt, Borges, Goés, & Caramori, 2016)	Brazil	HD & PD	N/A	-sex	N/A
Is body weight or muscle strength correlated with the Malnutrition Inflammation Score (MIS)? A cross-sectional study in hemodialysis patients (Marini & Pimentel, 2019)	Brazil	HD	N/A	-MIS	N/A

Handgrip strength is an independent predictor of renal outcomes in patients with chronic kidney diseases (Chang et al., 2011)	Taiwan	Non-dialysis-dependent chronic kidney disease (CKD-ND)	N/A	- age - sex - MAMA - MAMC - SGA - serum albumin	-BMI -MAC -Body Fat -All body composition data (BIA)
Hand-Grip Muscle Strength, Lean Body Mass, and Plasma Proteins as Markers of Nutritional Status in Patients With Chronic Renal Failure Close to Start of Dialysis Therapy (Heimbürger et al., 2000)	Sweden	CRF (close to start dialysis)	N/A	-LBM (AM&DXA) -MAMC -creatinine clearance (women)	-serum albumin

Based on Table 2, only two studies investigating muscle strength were done in PD population (As'Habi et al., 2018; Wang et al., 2005) . Other than that, most studies done in HD population and mix dialysis population (HD & PD). Besides, the studies were not done in local population of Malaysia. There were also many factors which differ from one study to another. Hence, it is important to study regarding factors associated with muscle strength among PD patients in Malaysia.

2.4 Socio-demographic factor with muscle strength

Socio-demographic especially age and gender are found to be significantly associated with muscle strength in dialysis patients. Aging is generally associated with muscle strength and muscle mass. A meta-analysis by Hwang et al. (2019) found that almost all the older dialysis patients have low value of HGS. This finding also supported by other study that found similar finding (As'Habi et al., 2018; Isoyama, Qureshi, Avesani, Lindholm, et al., 2014; Stenvinkel et al., 2002). In addition, Lopes et al. (2018) found that women have stronger association between HGS and mortality compare to men. Fahal (2014) indicated that men tend to have low HGS due to low secretion of testosterone which will alter protein metabolism. However, Isoyama et al. (2014) reported no association between gender and muscle strength. Therefore, further investigation is needed as Stenvinkel et al. (2002) concluded that sex is an important factor that must be included in dialysis study.

2.5 Medical history

Dialysis patients usually comes with many comorbidities such as diabetes mellitus (DM), cardiovascular disease (CVD), hypertension (HTN), hyperlipidaemia and others. Bataille et al., (2017) found that the prevalence of low muscle strength was mostly presented with DM. This supported by Lopes et al. (2018) which reported patients with low HGS groups were often have diabetes, cerebrovascular disease, and received HD by catheter. HGS levels is often low in patients with diabetes compare to non- diabetic. This could be because of decrease muscle mass, musculoskeletal complications, and diabetic neuropathy which is a condition characterized by sensory and motor disorders conducive to muscle weakness (Pinto et al., 2015). As'Habi et al. (2018) and Isoyama et al. (2014) also showed significant association between comorbidities and muscle strength. However, Sakkas et al. (2006) found there is no significant differences between muscle size and muscle strength between diabetes and non-

diabetes groups. Hence, comorbidities are an importance factors to be investigated as the causes of low muscle strength.

2.6 Anthropometric measurements

Heimbürger et al., (2000) found a positive correlation between HGS and lean body mass (LBM). This is supported by a study from Stenvinkel et al. (2002) where HGS was correlated well with lean body mass in patients both male and female. HGS is a simple and easily performed bedside test that was most strongly correlated with lean body mass (Wang et al., 2005). Moreover, HGS also significantly associated with forearm circumference (Leal, Stockler-Pinto, et al., 2011). HGS function as nutritional marker in CKD patient where patient with low HGS has low BMI, low serum albumin and low nutritional status (Amparo et al., 2013). CKD patient have increased risk of low muscle mass due to inflammation and malnutrition (Fahal, 2014). Since many studies found significant association between HGS and anthropometry data among haemodialysis patients, it is important to investigate this association in peritoneal dialysis patients.

2.7 Biochemical data

Plasma creatinine is found to be correlated with muscle strength and it is an important marker of functional muscle mass (Bataille et al., 2017). Constantin-Teodosiu et al., (2002) shows that the concentration of plasma creatine was lower in women and positively correlated with HGS. Besides, creatinine, few studies shows association of low albumin with HGS (Isoyama, et al., 2014; Lopes et al., 2018; Stenvinkel et al., 2002). Hence, serum creatinine and serum albumin should be measured in this study.

2.8 Dietary intake

There is no significant association found between the prevalence of low muscle strength with energy and protein intakes among PD patients in Iran population (As'Habi et al., 2018). There are limited studies investigating dietary intake as an associated factor of muscle strength. However, the decline in nutritional status during the renal failure may interfere with protein and energy metabolism which might affect muscle strength. Greenhall & Davenport, (2017) indicate that there was an association between dietary protein and urine volume, where by dietary interventions and strategies may be done to preserve urine output in order to reduce muscle loss in PD patients. The study explained that the association with dietary protein intake, urinary urea and serum creatinine may reflect muscle mass and dietary protein intake. Since, muscle mass is also associated with muscle strength, it is important to study the association of dietary intake with muscle strength.

CHAPTER 3

METHODOLOGY

3.1 Study design

This was a cross-sectional study with combination of primary and secondary data. Two data resources were used due to limited sample size from primary data as data collection need to be stopped due to pandemic of COVID-19. This study aimed to assess muscle strength and its association with socio-demographic characteristics, medical history, anthropometric measurements, biochemical data, and dietary intake among peritoneal dialysis patients at selected government hospital.

3.2 Study location

The primary data was collected in Hospital Serdang and Hospital Kuala Lumpur. Both hospitals are located in Klang Valley. The estimated population of Serdang was 150,000. Meanwhile, Hospital Kuala Lumpur or known as HKL is located at the capital city of Malaysia of Jalan Pahang, 50586 Kuala Lumpur. It is built on 150 acres of prime land making it as the largest hospital under the Ministry of Health of Malaysia. Currently, Kuala Lumpur consist of 7,780,301 population. Both hospitals were chosen since their location was within the proximity of researchers.

For secondary data, it was carried out in Hospital Pakar Sultanah Fatimah (HPSF), 84000 Muar, Johor Darul Takzim, Malaysia. It is located at northern zone of the Johor which consists of Batu Pahat, Segamat and Tangkak districts. It estimated Muar had a population of 233,779. Besides, it is also known as a reference hospital for the districts. It was selected since the study provide many common variables as investigated in primary data.

3.3 Sample size determination

Sample size was estimated using the formula of correlation sample size as shown below;

Adapted: Hulley et al (2013)

$$N = [(Z\alpha + Z\beta) / C]^2 + 3$$

$$C = 0.5 * \ln [(1+r) / (1-r)]$$

Where

N= sample size

r = the expected correlation coefficient

The standard normal deviate for $\alpha = Z\alpha = 1.96$

The standard normal deviate for $\beta = Z\beta = 0.84$

Table 3.1: Sample size calculation

Correlation study	Correlation, r	Sample size, n
Muscle strength and age (socio-demographic) (Leal, Stockler-Pinto, et al., 2011)	-0.37	$C = 0.5 * \ln [(1-0.37) / (1+0.37)]$ $= -0.39$ $N = [(1.96 + 0.84) / -0.39]^2 + 3$ $= 55$
Muscle strength and lean body mass (anthropometric measurements) (Leal, Stockler-Pinto, et al., 2011)	0.55	$C = 0.5 * \ln [(1+0.55) / (1-0.55)]$ $= 0.62$ $N = [(1.96 + 0.84) / 0.62]^2 + 3$ $= 23$
Muscle strength and plasma creatinine (biochemical data) (Constantin-Teodosiu et al., 2002)	0.36	$C = 0.5 * \ln [(1+0.36) / (1-0.36)]$ $= 0.38$ $N = [(1.96 + 0.84) / 0.38]^2 + 3$ $= 57$

Muscle strength and albumin (biochemical data) (Wang et al., 2005)	0.294	$C = 0.5 * \ln [(1+0.294)/ (1-0.294)]$ $= 0.3$ $N = [(1.96 +0.84) /0.3]^2+3$ $= \mathbf{90}$
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The sample size was derived by comparing the sample size from correlation studies and the highest number of sample size were used. The highest sample size was from study of the association between muscle strength and serum albumin (Wang et al., 2005) which is 90. After that, additional 20% was added to estimated sample size in order to account for non-response, loss of follow up or any other errors. Hence, the estimated sample size was **112**.

3.4 Sampling design

The sampling design used was non-probability sampling method which is convenient sampling method. There are 15 cities located at Klang Valley. Serdang and Kuala Lumpur are chosen. The main hospitals in the cities are selected which is Hospital Serdang and Hospital Kuala Lumpur. This is because both hospitals were more accessible to the researcher and within the proximity of Klang Valley. Then, by using consecutive sampling method, the subjects were selected from PD patients that meet the inclusion criteria.

3.5 Study subjects

The subjects for this study were peritoneal dialysis (PD) patient from Hospital Serdang, HKL and HPSF. Selection of study subjects followed the inclusion and exclusion criteria as below;

Table 3.2: Inclusion and exclusion criteria of the subjects

Inclusion criteria	Exclusion criteria
Age of 18 years old and above	Patients with terminal illness and malignancy.
Receiving PD treatment for at least 3 months	Patients with physical, hearing, vision & speech impairment.
	Clinically diagnosed with mental illness (Dementia, Alzheimer)

3.6 Study Measure

3.6.1 Socio-demographic characteristics

The subjects in this study were interviewed using interviewer-administered questionnaire. Socio-demographic background consist of age, sex, ethnicity, educational level, and occupation. All the information obtained were protected and confidential.

3.6.2 Anthropometric measurement

Anthropometrics measure included Body Mass Index (BMI), lean body mass (LBM), mid-upper arm circumferences (MUAC), and triceps skinfold. Subjects' weight was measured using weighing scale and height using stadiometer. The BMI was categorized into underweight, normal, overweight and obesity based on WHO guidelines. Lean body mass was assessed using Fresenius Body Composition Monitor (Fresenius Medical Care, Germany). Meanwhile, MUAC was measured using Lufkin flexible steel tape and triceps skinfold measured using Harpenden skinfold calipers (Medical Devices Directive, United Kingdom). In measuring MUAC, reading was taken until consecutive reading only differ less than 0.5 cm. Meanwhile, for triceps skinfold, reading was taken until consecutive reading only differ less than 1 mm.

3.6.3 Medical history

Medical history consisted of any comorbidities. Comorbidities was defined as any diseased reported such as diabetes mellitus, hypertension, hyperlipidemia, cardiovascular disease,

Hepatitis B, Hepatitis, HIV, liver failure and others. All those comorbidities retrieved by medical record. Dialysis vintage obtained from medical record.

3.6.4 Biochemical data

Biochemical data such as serum albumin and serum creatinine were obtained by medical records. The normal value of serum albumin is ≥ 40 g/L (K/DOQI, 2000). While, the normal serum creatinine is 35-132 $\mu\text{mol/L}$ (TMCE, 2015). All data taken was from respondents' latest medical records.

3.6.6 Dietary intake

Dietary intake was analysed for energy intake and protein intake. The dietary intake was assessed using three days diet recall comprising two weekdays and one weekends. The subjects were asked to report and describe their dietary intake. Besides, the dietary interview was also done through telephone interview for primary data. To help the subjects quantify their intake, researcher used household measurement such as glass, plate, cup, teaspoon and tablespoon. The dietary intake was analysed using Nutritionist Pro Software Version 4.0. Dietary intake misreporting were calculated according to Goldberg equation (Black, 2000) and subsequently removed from the final analysis. After considering stable weight gain/ loss of patients, only patients with energy ratio of 0.8-2.0 for energy intake over basal metabolic rate (EI:BMR) was included in analysis. BMR was calculated using Harris-Benedict equation.

3.6.7 Muscle strength

Handgrip strength (HGS) was measured to represent muscle strength. HGS was measured using Jamar handgrip dynamometer. Three measurements were taken and mean reading being analysed. HGS then categorized into cut off from Ho, Chan, & Mat Daud (2019), where low HGS was ≤ 20 kg for male and ≤ 10 kg for female.

3.7 Pre-testing

A total of 10 subjects was recruited from either Hospital Serdang or HKL. The subjects were asked for their consent to join the study. The pre-testing was done to know the time taken for subjects to complete all the assessments and questionnaires. Also, it will make sure the subjects clearly understand the instructions in the questionnaire as well as be able to participate well in the study. All the issues or problems arise during the pre-testing were taken note and resolved prior to real data collections.

3.8 Data collection

For primary data, data collection was conducted from January to March 2020. The study protocol was obtained from Ministry of Health National Medical Research Registry & Medical Research and Ethics Committee (MREC) [Reference number: NMRR-19-2501-50205]. Upon approval from MREC, a letter was sent to Hospital Serdang and HKL in order to get the permission to conduct a study in the selected hospitals in Klang Valley. Prior to the administration of the questionnaires, an informed consent was obtained from the subjects. Then, the subjects were assessed on socio-demographic, anthropometric measurements and dietary intake by interviewer-administered questionnaire. Other data were obtained from medical report. As for secondary data, the data collection was done from January to February 2019 and study protocol approval were obtained from MREC [Reference number: NMRR-17-2950-3870].

3.9 Data Analysis

The data collected were analyse using IBM SPSS Statistic Version 25 and the statistical significant level is set at $p < 0.05$. The Kalmogorov-Smirnov test was used to test the normality

of the data. For descriptive data, continuous variables presented in mean and standard deviation for normally distributed data while non-normal data presented with median and interquartile (IQR). Next, categorical variables presented in frequency and percentage. As for bivariate analysis, the association between continuous variables for normally distributed data were analysed using Pearson's product moment correlation coefficient. Meanwhile, the correlation between continuous variables for non-normally distributed data were analysed using Spearman rank correlation. Lastly, chi-square test used to analyse association between categorical variables.



CHAPTER 4

RESULTS AND DISCUSSION

A total of 104 subjects were successfully recruited into this study. A total of 25% (n=26) of subjects were primary data, 23 of them from Hospital Serdang and 3 subjects from Hospital Kuala Lumpur. Meanwhile, 75% (n=78) of subjects were secondary data from Hospital Pakar Sultanah Fatimah.

4.1 Socio-demographic Characteristics

The respondents consisted of 45.2% male (n=47) and 54.8% female (n=57) with the median age of 57 (20) years (Table 4.1). For ethnicity, 66.3% of them were Malay (n=66.3), 28.8% Chinese (n=30), 2.9% Indian (n=3) and 1.9% others (n=2). Besides, majority of patients not working and had education level up to secondary level with 78.8% (n=83) and 52.9% (n=55) respectively. Comparing with 25th Report of the Malaysian Dialysis & Transplant Registry 2017, the proportion of male and female contradict whereby supposedly male outweigh female. The data discrepancies might be due to the duration of study itself since the duration of this study was shorter compare to the report. The proportion of ethnicity found in this study in line with previous local study by Hooi et al. (2013) which study the prevalence of chronic kidney disease among adults in West Malaysia. For age, the finding also consistent 25th Report of the Malaysian Dialysis & Transplant Registry 2017 which the report indicated the highest treatment rates was between 55-64 years old. Same goes to educational level, the finding was similar whereby majority of dialysis patients had secondary level of education. On the other hand, the number of unemployed subjects found not consistent with the report. This maybe because half of the subjects were older age, hence contributed to huge proportion of unemployment.

Table 4.1: Socio-demographic status of respondents (n=104)

Variables	n (%)	Median (IQR)
Age (years)		57 (20)
Sex		
Male	47 (45.2)	
Female	57 (54.8)	
Ethnicity		
Malay	69 (66.3)	
Chinese	30 (28.8)	
Indian	3 (2.9)	
Others	2 (1.9)	
Educational level		
No formal education	6 (5.8)	
Primary level	19 (18.3)	
Secondary level	55 (52.9)	
Tertiary level	24 (23.1)	
Employment status		
Working	22 (21.2)	
Not working	83 (78.8)	

4.2 Medical History

Among 104 respondents, the median of dialysis vintage was 9.5 (25) months. The highest prevalent of patients was within 0-<6 months dialysis vintage and followed by 6-11 months. The number of patients declined proportionately to PD vintage (25th Report of the Malaysian Dialysis & Transplant Registry, 2017). In term of comorbidities, majority the respondents had hypertension (71.2%, n=74). Meanwhile, half of the respondents, 47.1 % (n=49) had diabetes followed by 16 % (n=15.4) coronary heart disease. According to Global Kidney Atlas (2019), hypertension, diabetes mellitus and coronary heart disease were common risk factors of CKD. Hypertension was a common comorbidity for dialysis patients as it is one

of the leading causes of worsening kidney function. Besides, half of them had diabetes which can be explained by the rate of diabetes-related ESRD increased faster than the rate of ESRD itself (Robinson et al., 2016). Since the researcher did not have the data of the root cause of dialysis, hence, the subjects might firstly diagnose with DM and then developed to ESRD.

Table 4.2: Medical history among subjects (n=104)

Variables	n (%)	Median (IQR)
Dialysis vintage (months)		9.5 (25)
Comorbidities*		
Diabetes mellitus	49 (47.1)	
Coronary heart disease	16 (15.4)	
Hypertension	74 (71.2)	

*there were multiple responses from participants for each comorbidity

4.3 Anthropometric measurement

Based on Table 4.3, the median Body Mass Index (BMI) was 24.82 (7.18) kg/m² with 44.2 % the respondents had normal BMI (n=46). 8.7 % respondents were underweight (n=9), 26.9 % overweight (n=28) and 20.2 % obese (n=21). Besides, the average of lean body mass and MUAC were 35.02±10.97 kg and 27.39 ± 5.00 cm respectively. Apart from that, the median of triceps skinfold was 14.4 (8.81) mm.

Table 4.3: Anthropometric measurement among subjects (n=104)

Variables	n (%)	Mean ± SD / Median (IQR)
Body Mass Index		24.82 (7.18)
Underweight (<18.5 kg/m ²)	9 (8.7)	
Normal (18.5-24.9 kg/m ²)	46 (44.2)	
Overweight (25.0-29.9 kg/m ²)	28 (26.9)	
Obesity (>30.0 kg/m ²)	21 (20.2)	
Lean body mass (kg)		35.02 ± 10.97

MUAC (cm)	27.39 ± 5.00
Triceps skinfold (mm)	14.4 (8.81)

4.4 Biochemical Data

Only two types of biochemical data were collected in this study which are serum creatinine and serum albumin. The median serum creatinine was 859.51 (272.98) $\mu\text{mol/L}$, meanwhile, the median serum albumin was 34.12 (5.75) g/L (Table 4.4). Comparing with the range of normal creatinine in normal adult (35-132 $\mu\text{mol/L}$), the serum creatinine was extremely high. Nevertheless, it was common for patients with kidney failure to have high serum creatinine levels. Although PD imitates the functions of the kidneys, however, the process does not remove all metabolic wastes from the body. According to KDOQI (2000), the normal range for albumin is ≥ 40 g/L. Half of the subjects have low albumin level. Serum albumin levels may reduce due to inflammation or acute/ chronic stress.

Table 4.4: Biochemical data among subjects (n=104)

Variables	n (%)	Median (IQR)
Serum creatinine ($\mu\text{mol/L}$)		859.51 (272.98)
Serum albumin (g/L)		34.12 (5.75)

4.5 Dietary Intake

The median total energy intake and protein intake among respondents were 1389.46 (366.83) kcal/day and 41.81 (19.88) g/day respectively (Table 4.5). Energy intake and protein intake were then categorised based on Clinical Practice Guideline (CPG) of 25-35 kcal/kg/day and 1.0-1.2 g/kg/day respectively (National Kidney Foundation, 2019). Misreporting data were removed based on Golberg equation (Black, 2000) and 13.4% (n=14) were removed. Majority of them had energy intake and protein intake below recommendation which were 46.7%

(n=42) and 78.9% (n=71) respectively. 41.1% (n=37) of subjects achieved recommended energy intake and 12.2% (n=11) exceed the recommendation. For protein intake, only 10 subjects achieved recommended protein intake with percentage of 11.1% and 10 % of subject exceed the recommendation (n=9). According KDOQI (2000), patients undergoing dialysis frequently have low protein and energy intake. This finding in line with among HD patients from local study as well as PD population in Iran, which showed almost 90% of the patients had inadequate intakes for both energy and protein intake (As'Habi et al., 2018; Chan, Mohd Shariff, Lim, & Goh, 2019). The main reason of inadequate dietary intake was due to lack of appetite (Therrien, Byham-Gray, & Beto, 2015). Inflammation was one of factors reported to be associated with low appetite (Lopes et al., 2007). Besides, National Kidney Foundation suggested lack of appetite may be due to low dialysis adequacy where it led to edema.

Table 4.5: Dietary intake among respondents (n=90, misreporting; n=14)

Variables	n (%)	Median (IQR)
Total energy intake (kcal/day)		1389.46 (366.83)
Energy per Ideal body weight (kcal/IBW/day)		25.5 (8.71)
Below recommendation (< 25 kcal/IBW/day)	42 (46.7)	
Achieved (25-35 kcal/IBW/day)	37 (41.1)	
Above recommendation (> 35 kcal/IBW/day)	11 (12.2)	
Dietary protein intake (g/day)		41.81 (19.88)
Protein per Ideal body weight (g/IBW/day)		0.76 (0.38)
Below recommendation (<1.0 g/IBW/day)	71 (78.9)	
Achieved (1.0 – 1.2 g/IBW/day)	10 (11.1)	
Above recommendation (>1.2 g/IBW/day)	9 (10)	

4.6 Muscle Strength

The respondents' muscle strength was measured by handgrip strength. The median handgrip strength was 16.95 (8.8) kg. Among the subjects, 68.3 % had normal handgrip strength (n=71) and 31.7 % had low handgrip strength (n=33) (Table 4.6). The cut off used from Ho et al. (2019) which is low HGS is ≤ 20 kg for male and ≤ 10 kg for female. Using the cut off, Ho et al. (2019) found 26.3% of low HGS among HD patients. The finding from Ho et al. (2019) was comparable with the current finding of 31.7% of low HGS among PD patients. In contrast, As'Habi et. al (2018) found prevalence of low muscle strength in PD patients is 43%. The finding was quite high maybe because the differences in cut off used. The cut off used in this study much higher compare to current study. Low HGS was < 26 kg for men and < 18 kg for women.

Table 4.6: Muscle strength among subjects (n=104)

Variables	n (%)	Median (IQR)
Handgrip strength		16.95 (8.8)
Normal	71 (68.3)	
Low	33 (31.7)	

Low HGS: ≤ 20 kg for male, ≤ 10 kg for female (Ho et al., 2019).

4.7 Association of socio-demographic characteristics with muscle strength

Based on Table 4.7.1 and Table 4.7.2, there was association between socio-demographic background and muscle strength. Age was negatively correlated with muscle strength ($r = -0.257$, $p < 0.05$). This means muscle strength will decrease as age increase. This finding is consistent with previous study by As'Habi et al. (2018), Isoyama et al. (2014) and Stenvinkel et al. (2002). Moreover, a meta-analysis study by Hwang et al., (2019) found that almost all the older dialysis patients have low value of HGS. Ageing will reduce the rate of

muscle mitochondrial protein synthesis as well as the oxidative capacity and mitochondrial function of skeletal muscle (Rooyackers, Adey, Ades, & Nair, 1996). Hence, it will reflect low muscle strength. Besides, there was association between sex with muscle strength ($\chi^2=5.593$, $p=0.018$). A significant difference in muscle strength between male and female found in this study. The number of males with low HGS was higher compare to female with low HGS. This finding in line with previous study by As'Habi et al. (2018). This may be due to decreased secretion of testosterone, resulting in reduced muscle protein synthesis and increased muscle protein catabolism (Fahal, 2014). Besides, the difference of cut off between male and female (low HGS: ≤ 20 kg for male, ≤ 10 kg for female) may also contribute to the differences. There were no association between ethnicity, educational level and occupation with muscle strength with; $\chi^2=2.290$, $p=0.130$; $\chi^2=3.093$, $p=0.079$; and $\chi^2=3.224$, $p=0.073$ respectively. This finding contradicted with Lopes et. al (2018) that found HD patient with educational level of less than high school was associated with low muscle strength. But, limited study in PD patients found to investigate those variables.

Table 4.7.1: Association of age with muscle strength

Variable	r_s	p -value
Socio demographic		
Age (years)	-0.257	0.009*

* significantly associated at $p < 0.05$
 r_s =using Spearman's Correlation Test

Table 4.7.2: Association of socio-demographic background with muscle strength

Variables	Muscle strength (HGS)		χ^2 or z-score	p-value
	Normal (n=71)	Low (n=33)		
Age (years)	51 (19)	61 (18)	-2.767	0.006*
Sex			5.593	0.018*

Male	26 (36.6)	21 (63.6)		
Female	45 (63.4)	12 (36.4)		
Ethnicity			2.290	0.130
Malays	51 (71.8)	18 (54.5)		
Non-malay	20 (28.2)	15 (45.5)		
Educational level			3.093	0.079
No formal education & primary level	13 (18.3)	12 (36.4)		
Secondary & Tertiary level	58 (81.7)	21 (63.6)		
Occupation			3.224	0.073
Yes	19 (26.8)	3 (9.1)		
No	52 (73.2)	30 (90.9)		

* significantly associated at $p < 0.05$

4.8 Association of medical history with muscle strength

According to Table 4.8.1 and Table 4.8.2, there was no association between medical history and muscle strength. Dialysis vintage is not associated with muscle strength ($r=0.164$, $p=0.096$). This finding in line with others study from As'Habi, et al. (2018), Wang et al. (2005) and Lopes et al. (2018). This may be because the duration of subjects undergo peritoneal dialysis was short. Since the median was 9.5 months, half of them only started dialysis less than 9 months, so, the association cannot be found. Apart from that, comorbidities such as diabetes, coronary heart disease and hypertension also showed no association with muscle strength with $\chi^2= 1.522$, $p=0.213$; $\chi^2=0.061$, $p=0.805$; and $\chi^2=0.848$, $p=0.249$ respectively. This finding contradict with most study that found DM associated with low muscle strength (As'Habi et al., 2018; Wang & Mitch, 2014). However, a study by Sakkas et al., (2006) supported this finding where they found no significant differences between muscle strength of

diabetes and non-diabetes groups. Further investigation needs to be done since DM might be cofounding factor to low muscle mass among CKD patients. This is because CKD patients often have DM and peripheral neuropathy should be consider as one of contributing factors to loss HGS (Gundmi et al., 2018).

Table 4.8.1: Association of dialysis vintage with muscle strength

Variable	r_s	p -value
Medical history		
Dialysis vintage	0.164	0.096

r_s =using Spearman's Correlation Test

Table 4.8.2: Association of comorbidities with muscle strength

Variables	Muscle Strength (HGS)		X^2 or z-score	p -value
	Normal (n=71)	Low (n=33)		
Dialysis vintage (months)	11 (28)	6 (25.5)	-1.105	0.269
Diabetes mellitus			1.522	0.213
Yes	30 (42.3)	19 (57.6)		
No	41 (57.7)	14 (42.4)		
Coronary heart disease			0.061	0.805
Yes	10 (14.1)	6 (18.2)		
No	61 (85.9)	27 (81.8)		
Hypertension			0.848	0.249
Yes	53 (74.6)	21 (63.6)		
No	18 (25.4)	12 (36.4)		

4.9 Association of anthropometric measurement with muscle strength

Based on Table 4.9, there is significant relationship between anthropometric measurement and muscle strength. Lean body mass and MUAC were positively associated with

muscle strength with $r=0.303$, $p=0.002$ and $r=0.252$, $p=0.010$ respectively. This in line with previous studies by Leal, et al. (2011), Wang et al. (2005), and Heimbürger, et al. (2000). Lean body mass is composed of skeletal muscle and responsible with for movement, hence, reduce function of lean body mass will affect the muscle strength (Carrero et al., 2016). However, BMI and triceps skinfold not significantly associated with muscle strength with each one $r=0.066$, $p=0.505$ and $r=0.031$, $p=0.751$.

Table 4.9: Association of anthropometric measurement with muscle strength

Variables	r_s	p -value
BMI	0.066	0.505
Lean body mass	0.303	0.002*
MUAC	0.252	0.010*
Triceps skinfold	0.031	0.751

* significantly associated at $p<0.05$
 r_s =using Spearman's Correlation Test

4.10: Association of biochemical data with muscle strength

There was association between biochemical data with muscle strength. Serum creatinine and serum albumin were positively associated with muscle strength with $r=0.212$, $p=0.030$ and $r=0.265$, $p=0.006$ respectively (Table 4.10). This finding consistent with previous study by Constantin-Teodosiu et al. (2002), Isoyama et al. (2014), Heimbürger et al. (2000) and (Lopes et al., 2018). Creatinine is the breakdown of carnitine in muscle functions. The concentration of plasma creatinine may be altered in dialysis patients and shows lower concentration in low HGS (Leal, Mafra, et al., 2011). Metabolic acidosis in CKD patients has been shown to cause negative nitrogen balance and decrease albumin synthesis (Chen, Lin, Chen, & Hsu, 2013).

Table 4.10: Association of biochemical data with muscle strength

Variable	r_s	p -value
Serum creatinine	0.212	0.030*
Serum albumin	0.265	0.006*

* significantly associated at $p < 0.05$

r_s =using Spearman's Correlation Test

4.11: Association of dietary intake with muscle strength

Based on Table 4.11, there was association between dietary intake and muscle strength. Energy intake was positively associated with muscle strength ($r=0.251$, $p=0.017$), meanwhile, protein intake was not associated with muscle strength ($r=0.085$, $p=0.426$). This finding contradicts with As'Habi et al. (2018) which showed no significant association found between the prevalence of dynapenia with energy and protein intakes among PD patients in Iran population. The decline in nutritional status during the renal failure may interfere with protein and energy metabolism which might affect muscle strength (Greenhall & Davenport, 2017). Not association found with protein intake may because of the protein intake analysed was not from high biological value (HBV) protein source. A food with a high value correlate to a high supply of the essential amino acids. This is because amino acid supplements and/or anabolic agents were proposed can increase muscle mass stores in CKD-associated PEW (Feldt-Rasmussen et al., 2007; Supasyndh et al., 2013).

Table 4.11: Association of dietary intake with muscle strength

Variable	r_s	p -value
Energy intake	0.251	0.017*
Protein intake	0.085	0.426

* significantly associated at $p < 0.05$

r_s =using Spearman's Correlation Test

CHAPTER 5

CONCLUSION

5.1 Conclusion

Approximately 32% of PD patients had low muscle strength. It was estimated three out of ten PD patients may have low muscle strength. Current study found no association between ethnicity, educational level, comorbidities, dialysis vintage, BMI, triceps skinfold and protein intake with HGS. Increase in age associated with reduced muscle strength, as per general population. Meanwhile, decrease in serum creatinine, albumin, LBM, MUAC, and energy intake may impair muscle strength. Hence, maintaining the good range LBM, MUAC and energy intake will help in preserving good muscle strength. This study also able to provide several factors that can be monitored by health practitioners, for example serum creatinine and serum albumin. Thus, health practitioners may target the patients at risk and make plan to maintain good muscle strength status among PD patients since it will be helpful in reducing mortality. Moreover, HGS should be regularly assessed as it can help in monitoring nutritional status. National Kidney Foundation (2019) also suggested the use of handgrip strength (HGS) as a surrogate measure of protein-energy status and functional status in clinical practise. HGS indeed a simple and reliable method to evaluate muscle function in patients with CKD. Further investigation regarding factors associated with muscle strength in PD patients in the Malaysia setting is really recommended.

5.2 Limitations

There were several limitations that need to be considered. Firstly, the study design of secondary data may contribute to discrepancies of result and limited variable to be investigated. Researcher had no control over the quality of data collected. Since the data collection had been done by others researchers, the skills or methods of data collection need to be consistent. Thus, skills, approaches or methods used for primary data collection must be matched. For example, in interviewing dietary recall, researchers need to be very skilful in probing and use essential tools to enhance the accuracy of the data. But, by using secondary data, we cannot make sure how past researchers carried out the data collection. Besides, the secondary data available did not able met the researcher's goal. For example, malnutrition status and physical activity were planned to be analysed its association with muscle strength as many studies proved the association. However, the variable need to be removed as the data were not available in secondary data. Next, number of subjects from the three study locations were not equally distributed. Hence, it may not really represent study population since majority of the subjects were recruited from HPSF, Muar, Johor. In addition, there was limited involvement of difference ethnicity in this study. Current study involved majority of Malay only. Apart from that, dietary recall was subjected to measurement and recall bias since it relied on patient's memory. However, the researcher already minimized error in data collection by use the standard household measurement and proper probing technique. Although weighted food record remained as the gold standard in dietary intake assessment, but it could likely burdensome to population. Moreover, misreporting dietary data of this study had been removed using Golbert equation, Black (2000) after considering stable weight. Hence, the dietary data in this study was reliable.

5.3 Recommendation

There are several recommendations to be improved in future research. Firstly, the study can be duplicate by using primary data. This is because by using primary data only, the researcher will be able to conduct the study by him/ herself and able to meet any study objective required. Moreover, the data obtained will be more accurate, consistent and present-time data. Hence, it will eventually enhance or approve the accuracy of current finding. Next, researcher should consider equal proportion of subjects from various study location and ethnicity, so that the result become more reliable. Lastly, in term of dietary data, future researcher may consider to use food infographic or food model during diet interview as current study did not implement the method yet. This may help improving patients' dietary recall. Last but not least, more researches regarding muscle strength among PD patients are recommended as more factors can be explored, for example, malnutrition status and physical activity in order to reduce patient mortality and morbidity rate.

REFERENCES

- Ahmad, G., Meng, O. L., Adnan, A. S., Khim, N. E., Thilaganathan, T. A., Tin, L. W., ... Leong, G. B. (2018). 24th Report of The Malaysian Dialysis & Transplant Registry 2016.
- Amparo, F. C., Cordeiro, A. C., Carrero, J. J., Cuppari, L., Lindholm, B., Amodeo, C., & Kamimura, M. A. (2013). Malnutrition-inflammation score is associated with handgrip strength in nondialysis-dependent chronic kidney disease patients. *Journal of Renal Nutrition*, 23(4), 283–287. <https://doi.org/10.1053/j.jrn.2012.08.004>
- As'Habi, A., Najafi, I., Tabibi, H., & Hedayati, M. (2018). Prevalence of sarcopenia and dynapenia and their determinants in iranian peritoneal dialysis patients. *Iranian Journal of Kidney Diseases*, 12(1), 53–60.
- Bataille, S., Serveaux, M., Carreno, E., Pardinielli, N., Darmon, P., & Robert, A. (2017). The diagnosis of sarcopenia is mainly driven by muscle mass in hemodialysis patients. *Clinical Nutrition*, 36(6), 1654–1660. <https://doi.org/10.1016/j.clnu.2016.10.016>
- Black, A. E. (2000). Critical evaluation of energy intake using the Goldberg cut-off for energy intake: basal metabolic rate. A practical guide to its calculation, use and limitations. *International Journal of Obesity*, 24(9), 1119–1130. <https://doi.org/10.1038/sj.ijo.0801376>
- Carrero, J. J., Johansen, K. L., Lindholm, B., Stenvinkel, P., Cuppari, L., & Avesani, C. M. (2016). Screening for muscle wasting and dysfunction in patients with chronic kidney disease. *Kidney International*, 90(1), 53–66. <https://doi.org/10.1016/j.kint.2016.02.025>
- Chan, Y., Mohd Shariff, Z., Lim, C., & Goh, B. (2019). Factors associated with poor nutritional status among hemodialysis patients in Malaysia. *Malaysian Journal of Medicine and Health Sciences*, 15(SP1), 77–83.
- Chang, Y. T., Wu, H. L., Guo, H. R., Cheng, Y. Y., Tseng, C. C., Wang, M. C., ... Sung, J. M. (2011). Handgrip strength is an independent predictor of renal outcomes in patients with chronic kidney diseases. *Nephrology Dialysis Transplantation*, 26(11), 3588–3595. <https://doi.org/10.1093/ndt/gfr013>
- Clinical practice guidelines for nutrition in chronic renal failure. K/DOQI, National Kidney Foundation. (2000). *American Journal of Kidney Diseases*, 35(6 SUPPL. 2).
- Constantin-Teodosiu, D., Young, S., Wellock, F., Short, A. H., Burden, R. P., Morgan, A. G., & Greenhaff, P. L. (2002). Gender and age differences in plasma carnitine, muscle strength, and exercise tolerance in haemodialysis patients. *Nephrology Dialysis Transplantation*, 17(10), 1808–1813. <https://doi.org/10.1093/ndt/17.10.1808>

- Couser, W. G., Remuzzi, G., Mendis, S., & Tonelli, M. (2011). The contribution of chronic kidney disease to the global burden of major noncommunicable diseases. *Kidney International*, 80(12), 1258–1270. <https://doi.org/10.1038/ki.2011.368>
- Fahal, I. H. (2014). Uraemic sarcopenia: Aetiology and implications. *Nephrology Dialysis Transplantation*, 29(9), 1655–1665. <https://doi.org/10.1093/ndt/gft070> LK - <http://sfx.cineca.it:9003/unito?sid=EMBASE&sid=EMBASE&issn=14602385&id=doi:10.1093%2Fndt%2Fgft070&atitle=Uraemic+sarcopenia%3A+Aetiology+and+implications&stitle=Nephrol.+Dial.+Transplant.&title=Nephrology+Dialysis+Transplantation&volume=29&issue=9&spage=1655&epage=1665&aualast=Fahal&aufirst=Ibrahim+H.&aunit=I.H.&aufull=Fahal+I.H.&coden=NDTRE&isbn=&pages=1655-1665&date=2014&aunit1=I&aunitm=H>
- Feldt-Rasmussen, B., Lange, M., Sulowicz, W., Gafter, U., Kar, N. L., Wiedemann, J., ... Thomas, M. (2007). Growth hormone treatment during hemodialysis in a randomized trial improves nutrition, quality of life, and cardiovascular risk. *Journal of the American Society of Nephrology*. <https://doi.org/10.1681/ASN.2006111207>
- Fouque, D., Kopple, J., Cano, N., Chauveau, P., Cuppari, L., Franch, H., & Division, R. (2008). A proposed nomenclature and diagnostic criteria for protein – energy wasting in acute and chronic kidney disease, 391–398. <https://doi.org/10.1038/sj.ki.5002585>
- Greenhall, G. H. B., & Davenport, A. (2017). Screening for muscle loss in patients established on peritoneal dialysis using bioimpedance. *European Journal of Clinical Nutrition*, 71(1), 70–75. <https://doi.org/10.1038/ejcn.2016.202>
- Gundmi, S., Maiya, A. G., Bhat, A. K., Ravishankar, N., Hande, M. H., & Rajagopal, K. V. (2018). Hand dysfunction in type 2 diabetes mellitus: Systematic review with meta-analysis. *Annals of Physical and Rehabilitation Medicine*. <https://doi.org/10.1016/j.rehab.2017.12.006>
- Heimbürger, O., Qureshi, A. R., Blarer, W. S., Berglund, L., & Stenvinkel, P. (2000). Hand-grip muscle strength, lean body mass, and plasma proteins as markers of nutritional status in patients with chronic renal failure close to start of dialysis therapy. *American Journal of Kidney Diseases*, 36(6), 1213–1225. <https://doi.org/10.1053/ajkd.2000.19837>
- Hirai, K., Ookawara, S., & Morishita, Y. (2016). Sarcopenia and physical inactivity in patients with chronic kidney disease. *Nephro-Urology Monthly*, 8(3). <https://doi.org/10.5812/numonthly.37443>
- Ho, L. L. L., Chan, Y. M., & Mat Daud, Z. 'Azuan. (2019). Serum potassium and handgrip strength as predictors of sleep quality among hemodialysis patients in Malaysia. *Asia Pacific Journal of Clinical Nutrition*, 28(2), 401–410. [https://doi.org/10.6133/apjcn.201906_28\(2\).0023](https://doi.org/10.6133/apjcn.201906_28(2).0023)
- Hooi, L. S., Ong, L. M., Ahmad, G., Bavanandan, S., Ahmad, N. A., Naidu, B. M., ... Yusoff, M. F.

- M. (2013). A population-based study measuring the prevalence of chronic kidney disease among adults in West Malaysia. *Kidney International*, 84(5), 1034–1040. <https://doi.org/10.1038/ki.2013.220>
- Hwang, S. H., Lee, D. H., Min, J., & Jeon, J. Y. (2019). Handgrip Strength as a Predictor of All-Cause Mortality in Patients With Chronic Kidney Disease Undergoing Dialysis: A Meta-Analysis of Prospective Cohort Studies. *Journal of Renal Nutrition*, 1–9. <https://doi.org/10.1053/j.jrn.2019.01.002>
- Isoyama, N., Qureshi, A. R., Avesani, C. M., Lindholm, B., Ba, P., Cederholm, T., ... Jesu, J. (2014). Article Comparative Associations of Muscle Mass and Muscle Strength with Mortality in Dialysis Patients, (16), 1–9. <https://doi.org/10.2215/CJN.10261013>
- Isoyama, N., Qureshi, A. R., Avesani, C. M., Lindholm, B., Bárány, P., Heimbürger, O., ... Carrero, J. J. (2014). Comparative associations of muscle mass and muscle strength with mortality in dialysis patients. *Clinical Journal of the American Society of Nephrology*, 9(10), 1720–1728. <https://doi.org/10.2215/CJN.10261013>
- Kim, J. K., Choi, S. R., Choi, M. J., Kim, S. G., Lee, Y. K., Noh, J. W., ... Song, Y. R. (2014). Prevalence of and factors associated with sarcopenia in elderly patients with end-stage renal disease. *Clinical Nutrition*. <https://doi.org/10.1016/j.clnu.2013.04.002>
- Kittiskulnam, P., Carrero, J. J., Chertow, G. M., Kaysen, G. A., Delgado, C., & Johansen, K. L. (2017). Sarcopenia among patients receiving hemodialysis: weighing the evidence. *Journal of Cachexia, Sarcopenia and Muscle*. <https://doi.org/10.1002/jcsm.12130>
- Lamarca, F., Carrero, J. J., Rodrigues, J. D. C., Bigogno, F. G., Fetter, R. L., & Avesani, C. M. (2014). Prevalence of sarcopenia in elderly maintenance hemodialysis patients: The impact of different diagnostic criteria. *The Journal of Nutrition, Health & Aging*. <https://doi.org/10.1007/s12603-014-0455-y>
- Leal, V. O., Mafra, D., Fouque, D., & Anjos, L. A. (2011). Use of handgrip strength in the assessment of the muscle function of chronic kidney disease patients on dialysis: A systematic review. *Nephrology Dialysis Transplantation*, 26(4), 1354–1360. <https://doi.org/10.1093/ndt/gfq487>
- Leal, V. O., Stockler-Pinto, M. B., Farage, N. E., Aranha, L. N., Fouque, D., Anjos, L. A., & Mafra, D. (2011). Handgrip strength and its dialysis determinants in hemodialysis patients. *Nutrition*, 27(11–12), 1125–1129. <https://doi.org/10.1016/j.nut.2010.12.012>
- Levin, A., & Zoccali, C. (2018). THE HIDDEN EPIDEMIC : WORLDWIDE , OVER 850 MILLION PEOPLE SUFFER FROM KIDNEY DISEASES.

- Lopes, A. A., Elder, S. J., Ginsberg, N., Andreucci, V. E., Cruz, J. M., Fukuhara, S., ... Port, F. K. (2007). Lack of appetite in haemodialysis patients - Associations with patient characteristics, indicators of nutritional status and outcomes in the international DOPPS. *Nephrology Dialysis Transplantation*. <https://doi.org/10.1093/ndt/gfm453>
- Lopes, M. B., Silva, L. F., Dantas, M. A. S., Matos, C. M., Lopes, G. B., & Lopes, A. A. (2018). Sex-age-specific handgrip strength and mortality in an incident hemodialysis cohort: The risk explained by nutrition and comorbidities. *International Journal of Artificial Organs*, 41(12), 825–832. <https://doi.org/10.1177/0391398818793088>
- Mahan, L. K., & Raymond, J. . (2011). *Krause's Food & The Nutrition Care Process*. ELSEVIER 14th Edition.
- Marini, A. C. B., & Pimentel, G. D. (2019). Is body weight or muscle strength correlated with the Malnutrition Inflammation Score (MIS)? A cross-sectional study in hemodialysis patients. *Clinical Nutrition ESPEN*, 33, 276–278. <https://doi.org/10.1016/j.clnesp.2019.07.009>
- Mohamad, N. L., Fen, H. S., Sulaiman, R., Kurupaiah, T., Abdullah, A., Yusof, B. N. M., & Yusof, N. A. M. (2005). *Medical Nutrition Therapy Guidelines Chronic Kidney Disease*. Malaysian Dietitians' Association.
- National Kidney Foundation. (2019). Clinical Practice Guideline for Nutrition in Chronic Kidney Disease: 2019 Update. *Academy of Nutrition and Dietetics*, (October), 55.
- Pinto, A. P., Ramos, C. I., Meireles, M. S., Kamimura, M. A., & Cuppari, L. (2015). Impact of hemodialysis session on handgrip strength. *Jornal Brasileiro de Nefrologia : 'orgao Oficial de Sociedades Brasileira e Latino-Americana de Nefrologia*. <https://doi.org/10.5935/0101-2800.20150072>
- Robinson BM, Akizawa T, Jager KJ, et al. (2016) Factors affecting outcomes in patients reaching end-stage kidney disease worldwide: differences in access to renal replacement therapy, modality use, and haemodialysis practices. *Lancet*, 388(10041):294-306.
- Rooyackers, O. E., Adey, D. B., Ades, P. A., & Nair, K. S. (1996). Effect of age on in vivo rates of mitochondrial protein synthesis in human skeletal muscle. *Proceedings of the National Academy of Sciences of the United States of America*, 93(26), 15364–15369. <https://doi.org/10.1073/pnas.93.26.15364>
- Sakkas, G. K., Kent-Braun, J. A., Doyle, J. W., Shubert, T., Gordon, P., & Johansen, K. L. (2006). Effect of Diabetes Mellitus on Muscle Size and Strength in Patients Receiving Dialysis Therapy. *American Journal of Kidney Diseases*, 47(5), 862–869. <https://doi.org/10.1053/j.ajkd.2006.01.013>

- Stenvinkel, P., Bárány, P., Chung, S. H., Lindholm, B., & Heimbürger, O. (2002). A comparative analysis of nutritional parameters as predictors of outcome in male and female ESRD patients. *Nephrology Dialysis Transplantation*, 17(7), 1266–1274. <https://doi.org/10.1093/ndt/17.7.1266>
- Stenvinkel, P., Carrero, J. J., Von Walden, F., Ikizler, T. A., & Nader, G. A. (2016). Muscle wasting in end-stage renal disease promulgates premature death: Established, emerging and potential novel treatment strategies. *Nephrology Dialysis Transplantation*, 31(7), 1070–1077. <https://doi.org/10.1093/ndt/gfv122>
- Stenvinkel, P., & Larsson, T. E. (2013). Chronic kidney disease: A clinical model of premature aging. *American Journal of Kidney Diseases*. <https://doi.org/10.1053/j.ajkd.2012.11.051>
- Supasynndh, O., Satirapoj, B., Aramwit, P., Viroonudomphol, D., Chaiprasert, A., Thanachatweij, V., ... Kopple, J. D. (2013). Effect of oral anabolic steroid on muscle strength and muscle growth in hemodialysis patients. *Clinical Journal of the American Society of Nephrology*. <https://doi.org/10.2215/CJN.00380112>
- Therrien, M., Byham-Gray, L., & Beto, J. (2015). A Review of Dietary Intake Studies in Maintenance Dialysis Patients. *Journal of Renal Nutrition*, 25(4), 329–338. <https://doi.org/10.1053/j.jrn.2014.11.001>
- TMCE. (2015). Clinical Laboratory Tests-Reference Values, 403-11
- Vogt, B. P., Borges, M. C. C., Goés, C. R. de, & Caramori, J. C. T. (2016). Handgrip strength is an independent predictor of all-cause mortality in maintenance dialysis patients. *Clinical Nutrition*, 35(6), 1429–1433. <https://doi.org/10.1016/j.clnu.2016.03.020>
- Wang, A. Y. M., Sea, M. M. M., Ho, Z. S. Y., Lui, S. F., Li, P. K. T., & Woo, J. (2005a). Evaluation of handgrip strength as a nutritional marker and prognostic indicator in peritoneal dialysis patients. *American Journal of Clinical Nutrition*, 81(1), 79–86. <https://doi.org/10.1093/ajcn/81.1.79>
- Wang, A. Y. M., Sea, M. M. M., Ho, Z. S. Y., Lui, S. F., Li, P. K. T., & Woo, J. (2005b). Evaluation of handgrip strength as a nutritional marker and prognostic indicator in peritoneal dialysis patients. *American Journal of Clinical Nutrition*, 81(1), 79–86. <https://doi.org/10.1093/ajcn/81.1.79>
- Wang, X. H., & Mitch, W. E. (2014). Mechanisms of muscle wasting in chronic kidney disease. *Nature Reviews Nephrology*, 10(9), 504–516. <https://doi.org/10.1038/nrneph.2014.112>

APPENDICES

Gantt Chart

No.	Year	2019				2020				
	Research activity	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Jun
1	Proposal writing									
2	Literature review									
3	Ethical approvals									
4	Research instrument preparation									
5	Research instrument pre-testing									
6	Data collection									
7	Data analysis									
8	Final report									

PARTICIPANT INFORMATION SHEET AND INFORMED CONSENT FORM

(for peritoneal dialysis subjects and interventional studies)

1. **Title of study:** Assessing Malnutrition among Dialysis Patients in Government Hospital using Malnutrition Inflammation Score.
2. **Name of investigator:** i) Nurul Syazlin Binti Anuar
ii) Nurul Saddiqah binti Adnan
iii) Nurul Syuhada binti Mohd Ridzuan

Name of supervisor: Zulfitri 'Azuan Bin Mat Daud

Name of institution: Universiti Putra Malaysia

3. **Name of sponsor:** -
4. **Introduction:**

You are invited to participate in this study. The details of the research are described in this document. Please take your time to read through this information sheet and informed consent form before making any decision. Please ask the researcher if anything is unclear or if you like more information. If you wish to participate, you need to sign this informed consent form.

Your participation in this study is voluntary. You may also refuse to answer any questions you do not want to answer. If you volunteer to be in this study, you may withdraw from it at any time. If you withdraw, any data collected from you up to your withdrawal will still be used for the study.

This study has been approved by the Medical Research and Ethics Committee, Ministry of Health Malaysia.

5. **What is the purpose of the study?**

The purpose of this study is to assess malnutrition among dialysis patients in Hospital Serdang and Hospital Kuala Lumpur and its association with socio-demographic background, medical history, anthropometric data, physical function, biochemical data, and dietary intake. This study is very important because the prevalence of malnutrition among dialysis patients is very high and it is closely related to the low quality of life and increased the mortality rate that may negatively impact the patients, the health care sectors and the economy. About 92 subjects from the hemodialysis and continuous ambulatory peritoneal dialysis clinic in Hospital Serdang and Hospital Kuala Lumpur will participate in this study. The whole study will last about 3 months and your participation will be about 40 minutes throughout the face to face interview session.

6. What kind of study procedures will I receive?

You will be required to complete a set questionnaire which includes information regarding socio-demographic background, medical history, anthropometric data, physical function, biochemical data, and dietary intake. Your dietary intake will be assessed through interview.

7. What will happen if I decide to take part?

You will be face to face interviewed, the researcher will fill the data collection form which includes information regarding to your socio-demographic background, medical history, anthropometric data, physical function, biochemical data, and dietary intake. Your malnutrition status will be determined by the MIS.

8. When will I be interviewed?

You will be interviewed as soon as possible after you give informed consent.

9. What are my responsibilities when taking part in this study?

It is important that you answer all of the questions asked by the study staff honestly during the interview session.

10. What kind of treatment will I receive after my participation in the trial?

This study does not involve any treatment or further medical references after your participation in this study.

11. What are the potential risks and side effects of being in this study?

There are no risks and side effects of being in this study.

12. What are the benefits of being in this study?

You will be informed with the malnutrition status based on the data from the MIS. You may be referred to dietitian for more information on malnutrition management.

13. What are my alternatives if I do not participate in this study?

You do not have to participate in this study to get treatment for your disease or condition.

14. Who is funding the research?

There is no sponsor funding for the research and you will not be paid to participate in this study. You will also not be charged to participate in this study.

15. Can the research or my participation be terminated early?

You may withdraw from the study at any time.

16. Will my medical information be kept private?

All your information obtained in this study will be kept and handled in a confidential manner, in accordance with applicable laws and/or regulations. When publishing or presenting the study results, your identity will not be revealed without your expressed consent. Individuals involved in this study and in your medical care, qualified monitors and auditors, the sponsor or its affiliates and governmental or regulatory authorities may inspect and copy your medical records, where appropriate and necessary. Data from the study will be archived but your identity will not be revealed at any time.

17. Who should I call if I have questions?

If you have any questions about the study or if you think you have a study related injury and you want information about treatment, please contact the researcher, Nurul Syazlin Binti Anuar at telephone number 013-9598327. You may also contact to our supervisor, Dr. Zulfitri 'Azuan Bin Mat Daud. If you have any questions about your rights as a participant in this study, please contact: The Secretary, Medical Research & Ethics Committee, and Ministry of Health Malaysia, at telephone number 03-2287 4032.

INFORMED CONSENT FORM

Title of Study: Assessing Malnutrition among Dialysis Patients at Government Hospital using Malnutrition Inflammation Score.

By signing below I confirm the following:

- I have been given oral and written information for the above study and have read and understood the information given.
- I have had sufficient time to consider participation in the study and have had the opportunity to ask questions and all my questions have been answered satisfactorily.
- I understand that my participation is voluntary and I can at any time free withdraw from the study without giving a reason and this will in no way affect my future treatment. I am not taking part in any other research study at this time. I understand the risks and benefits, and I freely give my informed consent to participate under the conditions stated. I understand that I must follow the study doctor's (investigator's) instructions related to my participation in the study.
- I understand that study staff, qualified monitors and auditors, the sponsor or its affiliates, and governmental or regulatory authorities, have direct access to my medical record in order to make sure that the study is conducted correctly and the data are recorded correctly. All personal details will be treated as STRICTLY CONFIDENTIAL
- I will receive a copy of this subject information/informed consent form signed and dated to bring home.
- I agree/disagree* for my family doctor to be informed of my participation in this study.
(*delete which is not applicable)

Subject:

Signature:

I/C number:

Name:

Date:

Investigator conducting informed consent:

Signature:

I/C number:

Name:

Date:

Impartial witness: *(Required if subject is illiterate and contents of participant information sheet is orally communicated to subject)*

Signature:

I/C number:

Name:

Date:



RISALAH MAKLUMAT PESERTA DAN BORANG PERSETUJUAN DAN KEIZINAN PESERTA

(untuk subjek pesakit dialisis dan penyelidikan intervensi)

- 6. Tajuk Penyelidikan:** Diagnosis malnutrisi dalam kalangan pesakit dialisi di Hospital Kerajaan dengan menggunakan Malnutrition Inflammation Score.
- 7. Nama Penyelidik:** i) Nurul Syazlin Binti Anuar
ii) Nurul Saddiqah binti Adnan
iii) Nurul Syuhada binti Mohd Ridzuan

Name Penilai: Zulfitri 'Azuan Bin Mat Daud

Nama Institusi: Universiti Putra Malaysia

- 8. Nama Penaja:** -

9. Pengenalan:

Anda dijemput untuk mengambil bahagian dalam kajian ini. Butiran penyelidikan akan diterangkan dalam dokumen ini. Sila baca dan pertimbangkan maklumat ini dengan teliti sebelum anda membuat keputusan. Sila minta daripada penyelidik jika ada sesuatu yang tidak jelas atau jika anda mahukan maklumat lanjut. Sekiranya anda ingin mengambil bahagian, anda perlu menandatangani borang persetujuan ini.

Penyertaan anda dalam kajian ini adalah secara sukarela. Anda berhak untuk tidak menjawab sebarang pertanyaan atau persoalan yang anda enggan jawab. Jika anda secara sukarela mengambil bahagian dalam kajian ini, anda boleh menarik diri pada bila-bila masa. Sekiranya anda melakukan sedemikian, sebarang data yang dikumpulkan daripada anda masih akan digunakan untuk kajian ini.

Penyelidikan ini telah mendapat kelulusan Jawatankuasa Etika dan Penyelidikan Perubatan, Kementerian Kesihatan Malaysia.

10. Apakah tujuan penyelidikan ini dilakukan?

Tujuan penyelidikan ini dilakukan adalah untuk mengetahui kelaziman malnutrisi dan hubungkaitnya dengan latarbelakang sosio-demografi, sejarah perubatan, ukuran anthropometri, fungsi fizikal, data biokimia, dan pengambilan diet yang berkaitan dengan kesihatan dalam kalangan pesakit dialisis di Hospital Serdang dan Hospital Kuala Lumpur. Penyelidikan ini diperlukan kerana kelaziman malnutritis adalah tinggi dalam kalangan pesakit dan ia berkait rapat dengan kualiti hidup yang rendah dan peningkatan risiko kematian yang mungkin memberikan impak negatif terhadap pesakit, serta memberi implikasi kepada status pusat kesihatan dan ekonomi negara. Sejumlah 92 pesakit dari klinik hemodialisis dan dialisis peritoneal berterusan di Hospital Serdang dan Hospital Kuala Lumpur akan menyertai penyelidikan ini. Penyelidikan ini akan berlangsung selama 3 bulan dan tempoh pembabitan anda dalam sesi temubual ini dianggarkan selama 40 minit.

6. Apakah prosedur penyelidikan yang akan saya terima?

Anda diminta untuk menjawab satu set soalan yang mengandungi maklumat mengenai latarbelakang sosio-demografi, sejarah perubatan, ukuran anthropometri, fungsi fizikal, data biokimia, dan pengambilan diet yang berkaitan dengan kesihatan.

7. Apakah yang terjadi sekiranya saya bersetuju untuk menyertai penyelidikan ini?

Anda akan ditemubual untuk melengkapkan borang pengumpulan data penyelidikan termasuk maklumat mengenai latarbelakang sosio-demografi, sejarah perubatan, ukuran anthropometri, fungsi fizikal, data biokimia, dan pengambilan diet yang berkaitan dengan kesihatan. Status malnutrisi anda akan diukur menggunakan MIS.

8. Bilakah saya akan ditemubual?

Anda akan ditemubual secepat mungkin selepas anda memberikan keputusan berkaitan persetujuan ini.

9. Apakah tanggungjawab saya sewaktu menyertai penyelidikan ini?

Adalah penting untuk menjawab semua soalan yang ditanya oleh penyelidik dengan jujur dan sepenuhnya.

10. Apakah jenis rawatan yang akan saya terima selepas menyertai penyelidikan ini?

Kajian ini tidak melibatkan apa-apa rawatan.

11. Apakah risiko dan kesan-kesan sampingan menyertai penyelidikan ini?

Tiada risiko atau kesan sampingan sekiranya anda menyertai penyelidikan ini.

12. Apakah manfaatnya saya menyertai kajian ini?

Anda akan dimaklumkan tentang status malnutrisi berdasarkan data daripada MIS. Anda juga mungkin dirujuk kepada pegawai dietetik untuk mendapatkan info yang lebih lanjut mengenai pengurusan malnutrisi.

13. Apakah rawatan alternatif lain sekiranya saya tidak menyertai penyelidikan ini?

Anda tidak perlu menyertai kajian ini untuk mendapatkan rawatan bagi penyakit atau masalah kesihatan anda.

14. Siapakah yang membiayai penyelidikan ini?

Tiada pihak yang membiayai penyelidikan ini dan anda tidak akan dibayar untuk terlibat dalam penyelidikan ini. Anda juga tidak perlu membayar untuk terlibat dalam penyelidikan ini.

15. Bolehkah penyelidikan ataupun penyertaan saya ditamatkan lebih awal daripada yang dirancang?

Anda dibenarkan untuk menarik diri daripada penyelidikan ini pada bila-bila masa.

16. Adakah maklumat perubatan saya akan dirahsiakan?

Segala maklumat anda yang diperolehi dalam penyelidikan ini akan disimpan dan dikendalikan secara sulit, bersesuaian dengan peraturan-peraturan dan/ atau undang-undang yang berkenaan. Sekiranya hasil penyelidikan ini diterbitkan atau dibentangkan kepada orang ramai, identiti anda tidak akan didedahkan tanpa kebenaran anda terlebih dahulu. Pihak- pihak tertentu seperti individu yang terlibat dalam penyelidikan dan rawatan perubatan anda, juruaudit dan jurupantau yang terlatih, pihak penaja atau pihak gabungannya, pihak berkuasa kerajaan atau undang-undang, boleh memeriksa dan membuat salinan laporan perubatan anda jika berkenaan dan diperlukan. Segala data yang berkaitan dengan penyelidikan ini akan diarkib, tetapi identiti anda tidak akan didedahkan sama sekali pada bila-bila masa.

17. Siapakah yang perlu saya hubungi sekiranya saya mempunyai sebarang pertanyaan?

Sekiranya anda mempunyai sebarang pertanyaan mengenai penyelidikan ini atau jika anda mengesyaki anda mengalami kecederaan yang terhasil daripada penyelidikan ini dan anda mahukan maklumat berkenaan rawatan, sila hubungi penyelidik, Nurul Syazlin Binti pada sambungan telefon 013-9598327. Anda juga boleh menghubungi pemantau penyelidikan ini iaitu Dr. Zulfitri 'Azuan Bin Mat Daud. Jika anda mempunyai sebarang pertanyaan berkaitan dengan hak-hak anda sebagai peserta dalam penyelidikan ini, sila hubungi: Setiausaha, Jawatankuasa Etika & Penyelidikan Perubatan, Kementerian Kesihatan Malaysia, melalui talian telefon 03-2287 4032.

BORANG PERSETUJUAN/ KEIZINAN PESERTA

Tajuk Penyelidikan: Diagnosis malnutrisi dalam kalangan pesakit dialisi di Hospital Kerajaan dengan menggunakan Malnutrition Inflammation Score.

Dengan menandatangani di bawah, saya mengesahkan bahawa:

- Saya telah diberi maklumat tentang penyelidikan di atas secara lisan dan bertulis and saya telah membaca dan memahami segala maklumat yang diberikan dalam risalah ini.
- Saya telah diberikan masa yang secukupnya untuk mempertimbangkan penyertaan saya dalam penyelidikan ini dan telah diberi peluang untuk bertanyakan soalan dan semua persoalan saya telah dijawab dengan sempurna dan memuaskan.
- Saya juga faham bahawa penyertaan saya adalah secara sukarela dan pada bila-bila masa saya bebas menarik diri daripada penyelidikan ini tanpa harus memberi sebarang alasan dan ianya sama sekali tidak akan menjejaskan rawatan perubatan saya pada masa akan datang. Saya tidak mengambil bahagian dalam mana-mana penyelidikan lain pada masa ini. Saya juga memahami tentang risiko dan manfaat penyelidikan ini dan saya secara sukarela memberi persetujuan untuk menyertai penyelidikan ini di bawah syarat-syarat yang telah dinyatakan di atas. Saya faham saya harus mematuhi nasihat dan arahan yang berkaitan dengan penyertaan saya dalam penyelidikan ini daripada doktor penyelidikan (penyelidik).
- Saya faham bahawa kakitangan penyelidikan, pemantau dan juruaudit terlatih, pihak penaja atau gabungannya, dan pihak berkuasa kerajaan atau undang-undang, mempunyai akses langsung dan boleh menyemak laporan perubatan saya bagi memastikan penyelidikan ini dijalankan dengan betul dan data direkodkan dengan betul. Segala maklumat dan data peribadi akan dianggap sebagai SULIT.
- Saya akan menerima satu salinan 'Risalah Maklumat Peserta dan Borang Persetujuan atau Keizinan Peserta' yang telah lengkap dengan tarikh dan tandatangan untuk dibawa pulang ke rumah.
- Saya bersetuju/ tidak bersetuju* untuk doktor yang merawat keluarga saya diberitahu tentang penyertaan saya dalam penyelidikan ini. (*Potong mana yang tidak berkenaan)

Subjek:

Tandatangan:

No. Kad Pengenalan:

Nama:

Tarikh:

Penyelidik yang mengendalikan proses menandatangani borang keizinan:

Tandatangan:

No. Kad Pengenalan:

Nama:

Tarikh:

Saksi tidak-berpihak/adil: *(Diperlukan; jika subjek adalah buta huruf dan kandungan risalah maklumat peserta disampaikan secara lisan kepada subjek)*

Tandatangan:

No. Kad Pengenalan:

Nama:

Tarikh:



CASE REPORT FORMS

ASSESSING PROTEIN ENERGY WASTING AMONG MALAYSIAN DIALYSIS PATIENTS USING BIO-ELECTRICAL IMPEDANCE ANALYSIS-DERIVED PHASE ANGLE

Subject Initials:

--	--	--	--	--

Subject Code:

--	--	--	--	--

Date (DD/MM/YY):

--	--	--	--	--	--	--	--

Study Location:

Hospital Serdang

☐

Hospital Kuala Lumpur

☐

Other study site: _____

Questionnaire

- A. Sociodemographic characteristics ☐
- B. Medical history ☐
- C. Anthropometry assessment ☐
- D. Bio-electrical impedance analysis (BIA) measurement ☐
- E. Biochemical data ☐
- F. Clinical data ☐
- G. SF-36 (Quality of Life) ☐
- H. Rapid Assessment of Physical Activity (RAPA) ☐
- I. Time Up and Go Test (TUG) ☐
- J. Dietary Intake (ADAT, FFQ, 3DDR) ☐

Subject criteria**Inclusion criteria**

Please tick (/) for subject's eligibility

1. Malaysian $\geq$ 18 years old. ☐
2. Undergoing regular dialysis treatment for at least 6 months. ☐

Exclusion criteria

Please cross (x) for subject's eligibility

1. No contraindications for BIA (i.e. limb amputations, implanted metallic devices and presence of pacemaker). ☐
2. Patients having vision, hearing and speaking issues. ☐
3. Patients with acquired immunodeficiency syndrome (AIDS), malignancy, peritonitis and underwent surgical procedure that interfere with nutritional status for the past 3 months. ☐
4. Patients with incomplete medical records. ☐

Questionnaire (Please tick or fill in the blanks as appropriate)**A. Sociodemographic characteristics**

1. Gender: ☐ Male ☐ Female 2. Date of birth: 3. Age: years old
DD MM YY
4. Telephone no (Mobile): _____ 5. Time to talk: _____ am/pm
6. Ethnicity: ☐ Malay ☐ Chinese ☐ Indian ☐ Other, please specify _____
7. Marital status: ☐ Single ☐ Married ☐ Other, please specify _____
8. Current living status: ☐ Alone ☐ Own family ☐ Parent ☐ Others, please specify _____
9. Education background: ☐ No formal education ☐ Primary ☐ Secondary ☐ College/University
10. Employment status: ☐ Employed ☐ Unemployed
11. Household income: ☐ <RM 500 ☐ RM 501 - RM 1000 ☐ RM 1001- RM 2000 ☐ RM 2001- RM 3000 ☐ RM 3001 - RM 4000 ☐ RM 4001 – RM 5000 ☐ >RM 5000
12. Have you been referred to a dietitian before? ☐ Yes ☐ No

B. Medical history

1. Date diagnosed with end-stage renal failure _____ (date/year).
2. Primary cause(s) of end-stage renal failure:

Unknown
Diabetes Mellitus
Hypertension
SLE
Kidney stone
Glomerulonephritis

Nephrophytosis
Adult polycystic kidney damage (APKD)
Gout nephropathy
Toxic nephropathy
HIV nephropathy
Others:

3. Dialysis modality: ☐ Hemodialysis ☐ Peritoneal dialysis

4. Year started hemodialysis/peritoneal dialysis: _____(year)

5. Duration on dialysis: _____(months)

6. Major co-morbidities

Diabetes Mellitus

Hypertension

Hyperlipidemia

Hepatitis B

Hepatitis C

HIV

Liver failure

Cardiovascular disease (CVD)

Gastropathy

Haemorrhoids

Anaemia

Secondary hyperparathyroidism

Cancer

Others:

7. Dentures: ☐ Yes ☐ No

8. Information regarding peritoneal dialysate (*only applicable for peritoneal dialysis patients*)

Beg No	Time	Concentration of dialysate solution (%)	Volume of dialysate In (ml)	Volume of dialysate Out (ml)	Duration (min)	Amount of dialysate absorbed (ml)	UF%

C. Anthropometry assessment

Height: _____ (m)

Current post-dialysis weight: _____ (kg)

Body Mass Index: _____ (kg/m²)

Current dry-weight: _____ (kg)

Dry-weight (3 months ago): _____ (kg)

Dry-weight (6 months ago): _____ (kg)

	Reading 1	Reading 2	Reading 3	Mean
Length from acromiale to radiale (cm)				
Midpoint between acromiale and radiale (cm)				
Mid-arm circumference (cm)				
Triceps skinfold (mm)				

Mid-arm muscle circumference, MAMC[MAC (cm) – ($\pi \times$ TSF (cm))] = _____ (cm)Mid-arm muscle area, MAMA = _____ (cm²)**Formula**MAMA (for male) = [(MAC (cm) – $\pi \times$ TSF (cm))²/4 π] – 10MAMA (for female) = [MAC (cm) – $\pi \times$ TSF (cm))²/4 π] – 6.5**Physical function**

(Measured on non-fistula hand/ dominant hand)

	Reading 1	Reading 2	Reading 3	Median
Handgrip strength (kg)				

Physical Examination

Decreased fat stores or loss of subcutaneous fat (below eye, triceps, biceps, chest)			
0 normal (no change)	1 mild	2 moderate	3 severe
Signs of muscle wasting (temple, clavicle, scapula, ribs, quadriceps, knee, interosseous)			
0 normal (no change)	1 mild	2 moderate	3 severe

D. Bio-electrical impedance analysis measurementGender: ☐ Male ☐ Female Age: _____ (years) Height: _____ (cm)

Pre-dialysis weight (hemodialysis patient): _____ (kg)

Weight with dialysate (peritoneal dialysis patient): _____ (kg)

Blood pressure: _____ mm/Hg

Parameter	Reading
OH (L)	
Dry weight (kg)	
Total Body Water (L)	
Extracellular Water (L)	
Intracellular Water (L)	
E/I ratio	
Body Mass Index (kg/m ²)	
Lean Tissue Mass (kg)	
Fat Tissue Mass (kg)	
Body Cell Mass (kg)	
% Lean Tissue Mass	
% Body fat	
PhA (50kHz)	
Quality of measurement (%)	

E. Biochemical data

Parameters	Blood test results	Normal range
	Current (Date)_____	
Renal profile		
Pre-urea (mmol/L)		
Post-urea (mmol/L)		
Creatinine (mmol/L)		
Serum phosphate (mmol/L)		
Liver function		
Serum albumin (g/L)		
Hematology		
Hemoglobin (g/L)		
Serum TIBC (μmol/L)		
Serum TIBC (mg/dL)		
≈5.587*TIBC (μmol/L)		
When TIBC reading not available (please fill the data below)		
Iron		
UIBC (μmol/L)		
Lipid profile		
Serum cholesterol (mmol/L)		
Miscellaneous		
Kt/V		
nPCR (g/kg/day)		

F. Clinical data

Average blood pressure/week: _____ (mm/Hg)

Malnutrition Inflammation Score

COMPREHENSIVE MALNUTRITION INFLAMMATION SCORE			
(A) Patients' related medical history:			
1- Change in end dialysis dry weight (overall change in past 3-6 months):			
0 No decrease in dry weight or weight loss <0.5 kg	1 Minor weight loss (>0.5 kg but <1 kg)	2 Weight loss more than one kg but <5%	3 Weight loss >5%
2- Dietary intake:			
0 Good appetite and no deterioration of the dietary intake pattern	1 Somewhat sub-optimal solid diet intake	2 Moderate overall decrease to full liquid diet	3 Hypo-caloric liquid to starvation
3- Gastrointestinal (GI) symptoms:			
0 No symptoms with good appetite	1 Mild symptoms, poor appetite or nauseated occasionally	2 Occasional vomiting or moderate GI symptoms	3 Frequent diarrhea or vomiting or severe anorexia
4- Functional capacity (nutritionally related functional impairment):			
0 Normal to improved functional capacity, feeling fine	1 Occasional difficulty with baseline ambulation, or feeling tired frequently	2 Difficulty with otherwise independent activities (e.g. going to bathroom)	3 Bed/chair-ridden, or little to no physical activity
5- Co-morbidity including number of years on Dialysis:			
0 On dialysis less than one year and healthy otherwise	1 Dialyzed for 1-4 years, or mild co-morbidity (excluding MCC*)	2 Dialyzed >4 years, or moderate co-morbidity (including one MCC*)	3 Any severe, multiple co-morbidity (2 or more MCC*)
(B) Physical Exam (according to SGA criteria):			
6- Decreased fat stores or loss of subcutaneous fat (below eyes, triceps, biceps, chest):			
0 Normal (no change)	1 mild	2 moderate	3 Severe
7- Signs of muscle wasting (temple, clavicle, scapula, ribs, quadriceps, knee, interosseous):			
0 Normal (no change)	1 mild	2 moderate	3 Severe
(C) Body mass index:			
8- Body mass index: BMI = Wt(kg) / Ht²(m)			
0 BMI>20 kg/m ²	1 BMI: 18-19.99 kg/m ²	2 BMI: 16-17.99 kg/m ²	3 BMI<16 kg/m ²
(D) Laboratory Parameters:			
9- Serum albumin:			
0 Albumin> 4.0 g/dL	1 Albumin: 3.5-3.9 g/dL	2 Albumin: 3.0-3.4 g/dL	3 Albumin: <3.0 g/dL
10- Serum TIBC (total Iron Binding Capacity): *			
0 TIBC> 250 mg/dL	1 TIBC: 200-249 mg/dL	2 TIBC: 150-199 mg/dL	3 TIBC: <150 mg/dL
Total Score = sum of above 10 components (0-30):			

*MCC (Major Comorbid Conditions) include CHF class III or IV, full blown AIDS, severe CAD, moderate to severe COPD, major neurological sequelae, and metastatic malignancies or s/p recent chemotherapy.

* Suggested equivalent increments for serum transferrin are: >200 (0), 170-199 (1), 140-169 (2), and <140 mg/dl

G. SF-36 Quality of Life

1. In general, would you say your health is:

Secara umum, kesihatan anda boleh dianggap berada ditahap:

- | | | | | |
|---|------------------------------------|------------------------|-----------------------------|-------------------------|
| 1. Excellent
<i>Sangat-sangat baik</i> | 2. Very good
<i>Sangat baik</i> | 3. Good
<i>Baik</i> | 4. Fair
<i>Sederhana</i> | 5. Poor
<i>Teruk</i> |
|---|------------------------------------|------------------------|-----------------------------|-------------------------|

- 2- Compared to ONE YEAR AGO, how would you rate your health in general
- NOW**
- ?

Berbanding dengan setahun yang lalu, bagaimana anda nilaikan kesihatan anda sekarang secara keseluruhan?

1. MUCH BETTER than one year ago
Jauh lebih baik dari setahun yang lalu
2. Somewhat BETTER now than one year ago
Lebih baik dari setahun yang lalu
3. About the SAME as one year ago
Sama dengan setahun yang lalu
4. Somewhat WORSE now than one year ago
Kurang baik dari setahun yang lalu
5. MUCH WORSE now than one year ago
Jauh lebih teruk dari setahun yang lalu

- 3- The following items are about activities you might do during a typical day. Does your health now
- limit you**
- in these activities? If so, how much?

Adakah kesihatan anda sekarang menghadkan anda daripada melakukan aktiviti berikut? Jika ya, berapa kerapkah?

	Yes, Limited a lot <i>Sangat terhad</i> (1)	Yes, Limited a Little <i>Sedikit terhad</i> (2)	No, Not limited at All <i>Tiada masalah melakukannya</i> (3)
a. Vigorous activities , such as running, lifting heavy objects, participating in strenuous sports <i>melakukan aktiviti-aktiviti berat? Contohnya berlari, mengangkat barang-barang berat, mengambil bahagian dalam acara sukan lasak</i>	1	2	3

b. Moderate activities , such as moving a table, pushing a vacuum cleaner, bowling, or playing golf <i>melakukan aktiviti-aktiviti sederhana ? Contohnya mengalihkan meja, menyapu sampah, bermain bowling, atau bermain golf</i>	1	2	3
c. Lifting or carrying groceries <i>mengangkat atau membawa barang-barang runcit</i>	1	2	3
d. Climbing several flights of stairs <i>menaiki beberapa tingkat tangga (contohnya dari tingkat 1 ke tingkat 3)</i>	1	2	3
e. Climbing one flight of stairs <i>menaiki satu tingkat tangga</i>	1	2	3
f. Bending, kneeling, or stooping <i>menghadkan anda daripada menunduk, melutut, atau membongkok</i>	1	2	3
g. Walking more than a mile <i>berjalan melebihi sebatu</i>	1	2	3
h. Walking several blocks <i>berjalan setengah batu</i>	1	2	3
i. Walking one block <i>berjalan 100 ela</i>	1	2	3
j. Bathing or dressing yourself <i>menghadkan anda daripada mandi atau memakai pakaian sendiri?</i>	1	2	3

4- During the **past 4 weeks**, have you had any of the following problems with your work or other regular activities *as a result of your physical health?*

*Sepanjang 4 minggu yang lalu, pernahkah anda mengalami masalah berikut akibat **kesihatan fizikal**?*

	Yes <i>Ya</i>	No <i>Tidak</i>
a. Cut down the amount of time you spent on work or other activities <i>terpaksa mengurangkan masa untuk melakukan sesuatu kerja atau aktiviti harian</i>	1	2
b. Accomplished less than you would like <i>mencapai kurang dari apa yang ingin anda lakukan</i>	1	2
c. Were limited in the kind of work or other activities <i>terpaksa menghadkan jenis aktiviti yang boleh dilakukan</i>	1	2
d. Had difficulty performing the work or other activities (for example, it took extra effort) <i>susah melakukan sesuatu kerja atau aktiviti (Contohnya, ia memerlukan lebih usaha)</i>	1	2

- 5- During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?

Sepanjang 4 minggu lepas, adakah anda mengalami sebarang masalah untuk melakukan sesuatu aktiviti disebabkan masalah emosi, seperti sedih atau gelisah?

	Yes <i>Ya</i>	No <i>Tidak</i>
a. Cut down the amount of time you spent on work or other activities <i>adakah anda terpaksa mengurangkan jumlah masa yang biasa digunakan untuk melakukan sesuatu aktiviti</i>	1	2
b. Accomplished less than you would like <i>adakah pencapaian aktiviti anda kurang daripada apa yang diharapkan</i>	1	2
c. Didn't do work or other activities as carefully as usual <i>adakah anda tidak dapat melakukan sebarang aktiviti dengan teliti/cermat seperti biasa</i>	1	2

- 6- During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

Sepanjang 4 minggu yang lepas, adakah pergaulan anda dengan keluarga, kawan-kawan, jiran dan masyarakat terganggu disebabkan kesihatan fizikal atau masalah emosi?

- | | | | | |
|--|---|--|---|--|
| 1. Not at all
<i>Langsung tidak terganggu</i> | 2. Slightly
<i>Sedikit terganggu</i> | 3. Moderately
<i>Agak terganggu</i> | 4. Quite a bit
<i>Sangat terganggu</i> | 5. Extremely
<i>Sangat-sangat terganggu</i> |
|--|---|--|---|--|

- 7- How much **bodily pain** have you had during the **past 4 weeks**?

Adakah anda mengalami sakit badan sepanjang 4 minggu yang lepas?

- | | | | | | |
|-------------------------|---------------------------------------|---------------------------|---------------------------------|---------------------------|---------------------------------------|
| 1. None
<i>Tiada</i> | 2. Very mild
<i>Sangat sedikit</i> | 3. Mild
<i>Sedikit</i> | 4. Moderate
<i>Sederhana</i> | 5. Severe
<i>Teruk</i> | 6. Very severe
<i>Sangat teruk</i> |
|-------------------------|---------------------------------------|---------------------------|---------------------------------|---------------------------|---------------------------------------|

- 8- During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)?

Sepanjang 4 minggu yang lepas, sejauh manakah aktiviti harian (termasuk kerja di luar dan di dalam rumah) anda terganggu akibat sakit badan?

- | | | | | |
|--|---|--|---|--|
| 1. Not at all
<i>Langsung tidak terganggu</i> | 2. Slightly
<i>Sedikit terganggu</i> | 3. Moderately
<i>Agak terganggu</i> | 4. Quite a bit
<i>Sangat terganggu</i> | 5. Extremely
<i>Sangat-sangat terganggu</i> |
|--|---|--|---|--|

- 9- These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the **past 4 week** ...
- Soalan-soalan ini adalah mengenai bagaimana keadaan dan perasaan anda selama 4 minggu yang lepas. Untuk setiap soalan berikut, sila berikan satu jawapan yang paling dekat dengan apa yang anda rasakan.*

	All of the time <i>Sepanjang masa</i>	Most of the time <i>Hampir sepanjang masa</i>	A good bit of the time <i>Agak kerap</i>	Some of the time <i>Kadang-kadang</i>	A little of the time <i>Jarang-jarang</i>	None of the time <i>Tidak pernah langsung</i>
a. Did you feel full of pep? <i>Adakah anda merasa cergas?</i>	1	2	3	4	5	6
b. Have you been a very nervous person? <i>Adakah anda merasa sangat gelisah?</i>	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up? <i>Adakah anda merasa sangat sedih sehingga tiada apa yang boleh menggembirakan anda?</i>	1	2	3	4	5	6
d. Have you felt calm and peaceful? <i>Adakah anda merasa tenang?</i>	1	2	3	4	5	6
e. Did you have a lot of energy? <i>Adakah anda merasa bertenaga?</i>	1	2	3	4	5	6
f. Have you felt downhearted and blue? <i>Adakah anda merasa sedih dan pilu?</i>	1	2	3	4	5	6
g. Did you feel worn out? <i>Adakah anda merasa letih lesu?</i>	1	2	3	4	5	6
h. Have you been a happy person? <i>Adakah anda merasa gembira?</i>		2	3	4	5	6
i. Did you feel tired? <i>Adakah anda merasa penat?</i>	1	2	3	4	5	6

- 10- During the **past 4 weeks**, how much of the time has your **physical health or emotional problems** interfered with your social activities (like visiting with friends, relatives, etc.)?

*Sepanjang 4 minggu yang lalu, selalukah pergaulan anda (seperti menziarahi kawan-kawan, sanak-saudara dan lain-lain) terganggu oleh **kesihatan fizikal atau masalah emosi**?*

1. All of the time
Sentiasa terganggu
2. Most of the time
Lebih baik dari setahun yang lalu
3. Some of the time
Kadang-kadang
4. A little of the time
Jarang-jarang
5. None of the time
Tidak pernah terganggu

- 11- How True or False is **each** of the following statements for you?
Sejauh mana setiap pertanyaan berikut Benar atau Tidak pada pandangan diri anda?

	Definitely true <i>Sangat benar</i>	Mostly true <i>Selalunya benar</i>	Don't know <i>Tidak tahu</i>	Mostly false <i>Selalunya tidak benar</i>	Definitely false <i>Tidak benar langsung</i>
a. I seem to get sick a little easier than other people <i>Saya lebih mudah mendapat penyakit berbanding orang lain</i>	1	2	3	4	5
b. I am as healthy as anybody I know <i>Saya sihat seperti mana orang lain</i>	1	2	3	4	5
c. I expect my health to get worse <i>Saya fikir kesihatan saya akan bertambah teruk</i>	1	2	3	4	5
d. My health is excellent <i>Kesihatan saya sangat baik</i>	1	2	3	4	5

H. Rapid Assessment of Physical Activity (RAPA)

Physical Activities are activities where you move and increase your heart rate above its resting rate, whether you do them for pleasure, work, or transportation.

The following questions ask about the amount and intensity of physical activity you usually do. The intensity of the activity is related to the amount of energy you use to do these activities.

Examples of physical activity intensity levels

Light activities • your heart beats slightly faster than normal • you can talk and sing	   Walking leisurely Stretching Vacuuming or Light Yard Work
Moderate activities • your heart beats faster than normal • you can talk but not sing	    Fast walking Aerobics class Strength training Swimming gently
Vigorous activities • your heart rate increases a lot • you can't talk or your talking is broken up by large breaths	   Stair machine Jogging/running Tennis, Racquetball, Pickleball/Badminton

How physically active are you? (Circle one answer on each line)

Does this accurately describe you?

RAPA 1	1	I rarely or never do any physical activities.	Yes	No
	2	I do some light or moderate physical activities, but not every week.	Yes	No
	3	I do some light physical activity every week.	Yes	No
	4	I do moderate physical activities every week, but less than 30 minutes a day or 5 days a week.	Yes	No
	5	I do vigorous physical activities every week, but less than 20 minutes a day or 3 days a week.	Yes	No
	6	I do 30 minutes or more a day of moderate physical activities, 5 or more days a week.	Yes	No
	7	I do 20 minutes or more a day of vigorous physical activities, 3 or more days a week.	Yes	No
RAPA 2 (3=both 1& 2)	1	I do activities to increase muscle strength , such as lifting weights or calisthenics, once a week or more.	Yes	No
	2	I do activities to improve flexibility , such as stretching or yoga, once a week or more.	Yes	No

I. Time Up and Go (TUG) Test

Directions: Patients wear their regular footwear and can use a walking aid if needed. Begin by having the patient sit back in a standard armchair and identify a line 3 meters, or 10 feet away, on the floor.

1. Instruct the patient; When I say "Go," I want you to:
 - a) Stand up from the chair.
 - b) Walk to the line on the floor at your normal pace.
 - c) Turn.
 - d) Walk back to the chair at your normal pace.
 - e) Sit down again.
2. On the word "Go," begin timing.
3. Stop timing after the patient sits back down.
4. Record time.

Timed up and Go (TUG) test (seconds)		
Reading 1	Reading 2	Mean
An older adult who takes ≥ 12 seconds to complete the TUG is at risk for falling.		

J. Dietary data

Tick “/” on the answer that best describes your appetite during last week.

(Tandakan “/” pada jawapan yang menggambarkan selera makan anda pada minggu lepas)

1	During the past week (7 days), how would you rate your appetite? <i>Dalam tujuh hari yang lepas, bagaimanakah selera makan anda</i> ☐ Very good/<i>Amat baik</i> ☐ Good/<i>Baik</i> ☐ Fair/<i>Kadang kala baik</i> ☐ Poor/<i>Kurang baik</i> ☐ Very poor/<i>Amat kurang baik</i>
2	Have you had a change in appetite in the past week (7 days) <i>Adakah anda mengalami perubahan selera makan dalam tujuh hari yang lepas?</i> ☐ No/<i>Tidak</i> ☐ Yes/<i>Ya</i>
3	If you answer “yes” to question number 2, how was your appetite changed? <i>Jika jawapan anda ialah “ya”, bagaimanakah selera makan anda berubah?</i> ☐ Increase/<i>Bertambah</i> ☐ Remain the same/<i>Seperti biasa</i> ☐ Decrease/<i>Berkurang</i>

NMRR-19-2501-50205

Subject code:

3-day diet records

Diet recall Day 1 (date): _____

HD patient: ☐ Dialysis day ☐ Non-dialysis day ☐ Weekend

PD patient: ☐ Weekday ☐ Weekday ☐ Weekend

Place eaten/Time	Description of food and drink	Portion size	Preparation method

NMRR-19-2501-50205

Subject code:

3-day diet records

Diet recall Day 2 (date): _____

HD patient: ☐ Dialysis day ☐ Non-dialysis day ☐ Weekend

PD patient: ☐ Weekday ☐ Weekday ☐ Weekend

Place eaten/Time	Description of food and drink	Portion size	Preparation method

NMRR-19-2501-50205

Subject code:

3-day diet records

Diet recall Day 3 (date): _____

HD patient: ☐ Dialysis day ☐ Non-dialysis day ☐ Weekend

PD patient: ☐ Weekday ☐ Weekday ☐ Weekend

Place eaten/Time	Description of food and drink	Portion size	Preparation method

Dialysis Specific Food-Frequency Questionnaire

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
Pelbagai Jenis Nasi										
1	Nasi putih							1 mangkuk kecil		
2	Nasi beras perang/Nasi beras padi							1 mangkuk kecil		
3	Nasi ayam/ Claypot (*Ayam goreng/pang ang/kukus)							1 sajian		
4	Nasi lemak (Set Biasa)							1 mangkuk kecil		
5	Nasi Goreng							1 mangkuk cina		
6	Nasi Minyak/ Beriani							1 mangkuk cina		
7	Bubur (Kosong/ Ayam/ Ikan/ Babi)							1 mangkuk cina		
Mee *Sila nyatakan jumlah kuah tambahan jika ada										
A Mee Beras/ Kanji (Mihun/ Kueh teow/ Loh shi fun/ Tang hoon)										
8	Goreng/ Kering							1 mangkuk cina		
9	Sup							1 mangkuk cina		
10	Kari							1 mangkuk cina		
11	Laksa/ Kantonis							1 mangkuk cina		
B Mee Gandum (Mee Kuning/ Mee Wantan/ Yee mee/ Pan mee/ Lor mee/ Ramen/ Misua/ Udon)										
12	Goreng/ Kering							1 mangkuk cina		
13	Sup							1 mangkuk cina		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
14	Kari/Rebus							1 mangkuk cina		
15	Kantonis/ Hokkien							1 mangkuk cina		
C Mee Segera										
16	Goreng/ Kering							1 paket (M)		
17	Sup							1 paket (M)		
D Pasta (Fettucini/ Spageti/ Makaroni)										
18	Goreng/ Sos* (*Putih; Karbonara / Merah; Bolognese)							1 mangkuk cina		
E Lain-lain										
19	Chee Cheong Fun (Kosong/ Char siew/ Udang)							1 keping		
Bijirin & Hasil Bijirin										
A Biskut										
20	Manis (Krim/ Marie/ Jem, dan lain2)							1 keping		
21	Masin (Krim kraker, dan lain2)							1 keping		
B Roti										
22	Putih							1 keping		
23	Bijirin Mil Penuh/ Tinggi Serat							1 keping		
C Bun/Croissant										
24	Kosong							1 biji		
25	Inti Manis/ Berperisa (Vanila/ coklat/ jagung/ kaya/ kacang merah/ mentega/ kopi, dan lain2)							1 biji		
26	Pedas/Masin (Inti Daging/Floss)							1 biji		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
	ayam/Ba kua/French toast/Inti cendawan, dan lain2)									
D	Lain-lain									
27	Roti canai (Kosong)							1 keping		
28	Roti canai (Telur/ Sardin)							1 keping		
29	Capati							1 keping		
30	Tosai							1 keping		
31	Idli							1 keping		
32	Oat/ Nestum							1 sudu makan		
33	Minuman Bijirin (Cth: Nestum, Kosong/ Susu pekat manis)							1 gelas		
34	Minuman Bijirin (Cth: Nestum, 3 dalam 1)							1 paket		
Ayam, Daging & Hasil Daging			*Sila nyatakan jumlah kuah tambahan jika ada							
35	Ayam		Goreng/ Kacau Goreng/ Panggang /					1 kotak mancis		
			Tumis/ Masak kicap							
			Kari/ Rendang/ Masak lemak/ Sambal/ Sate					1 kotak mancis		
			Kukus/ Sup					1 kotak mancis		
36	Lembu/ Kambing		Goreng/ Kari/ Rendang/ Masak lemak/ Kacau Goreng/ Masak					1 kotak mancis		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
			kicap/ Sate							
			Sup/ Masak pinang					1 kotak mancis		
37	Babi		Goreng / Kacau Goreng/ Panggang / Tumis/ Masak kicap					1 kotak mancis		
			Kukus/ Sup					1 kotak mancis		
38	Telur (Dengan telur kuning) (Ayam /Itik/ Burung Puyuh)		Goreng Mata Kerbau/ Dadar/ Goreng Hancur/ Sambal					1 biji		
			Kari/ Gulai					1 biji		
			Rebus					1 biji		
			Asin					1 biji		
			Kukus					1 biji		
			Awet/ Century					1 biji		
	Telur (Putih sahaja) (Ayam/ Itik/ Burung Puyuh)		Goreng Mata Kerbau/ Dadar/ Goreng Hancur/ Sambal					1 biji		
			Kari/ Gulai					1 biji		
			Rebus					1 biji		
			Asin					1 biji		
			Kukus					1 biji		
			Awet/ Century					1 biji		
Makanan Diproses										
39	Nugget/ Sosej/ Bebola Daging		Goreng/ Kacau goreng					1 keping		
	(Ayam/ Lap cheong/ Babi/ Ham/ Bacon)		Kukus/ Rebus/ Sup					1 keping		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
Organ Dalaman			*Sila nyatakan jumlah kuah tambahan jika ada							
40	Lembu/ Ayam/ Babi (Hempedal/ Hati/ Usus/ Paru/ Jantung)		Sambal/ Masak lemak/ Goreng/ Rebus					1 kotak mancis		
Ikan dan Makanan Laut			*Sila nyatakan jumlah kuah tambahan jika ada							
41	Ikan Bilis		Goreng/ Kacau goreng / Sambal					1 sudu makan		
42	Ikan Laut (Kembong/ Bawal/ Kerapu/ Kerisi/ Merah/ Parang/ Salmon/ Sardin/ Selar/ Siakap/ Tenggiri, dan lain2)		Goreng/ Kacau goreng/ Masak kicap					1 kotak mancis		
			Kari/ Sambal/ Masak lemak					1 kotak mancis		
			Kukus/ Sup/ Singgang					1 kotak mancis		
			Dalam Tin					1 kotak mancis		
43	Ikan Air Tawar (Keli/ Tilapia/ Haruan/ Patin, dan lain2)		Goreng/ Kacau goreng/ Masak kicap					1 kotak mancis		
			Kari/ Masak lemak/ Sambal					1 kotak mancis		
			Kukus/ Sup					1 kotak mancis		
44	Ketam/ Udang		Goreng/ Kacau goreng/ Masak kicap					1 kotak mancis		
			Kari/ Masak lemak/ Sambal					1 kotak mancis		
			Kukus/ Sup					1 kotak mancis		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukat isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
45	Sotong/ Kekarang* (Kerang/ Lala/ Abalone*)		Kacau goreng/ Masak kicap/ Rebus					1 kotak mancis		
			Kari/ Masak lemak/ Sambal					1 kotak mancis		
			Kukus/ Sup					1 kotak mancis		
Makanan Diproses										
46	Bebola Ikan/ Bebola Sotong/ Fishcake		Goreng/ Kacau goreng					1 biji		
			Rebus/ Kukus/ Sup					1 biji		
Kekacang Dan Hasilnya				*Sila nyatakan jumlah kuah tambahan jika ada						
47	Tauhu/Tau kua/ Fucuk		Goreng					1 keping		
48	Tauhu/ Tauhu pok/ Fucuk		Kacau goreng/ Rebus/ Masak kicap					1 keping		
			Sup/ Kukus/ Rebus					1 keping		
49	Tauhu		Sup/ Kukus/ Rebus					1 keping		
Sayur-sayuran				*Sila nyatakan jumlah kuah tambahan jika ada						
50	Sayuran Berdaun Hijau (Bayam/ Kailan/ Daun Keledek/ Sawi/ Kangkung/ Pucuk Paku/ Kuai dan lain2)		Kacau goreng/ Kari/ Sambal					1 sudu makan		
			Masak air/ Sup/ Rebus					1 sudu makan		
			Mentah/ Ulam					1 sudu makan		
51	Sayuran Cruciferous (Kobis/ Brokoli/ 		Kacau goreng/ Kari/ Masak lemak					1 sudu makan		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
	<i>Bunga Kobis/ Daun Salad/ Yau mak/ Bak choy dan lain2)</i>		Sup/ Rebus/ Tom yam					1 sudu makan		
			Mentah/ Ulam					1 sudu makan		
52	Sayuran Kekacang <i>(Kacang Buncis/ Panjang/ Botol/ Taugeh dan lain2)</i>		Kacau goreng/ Kari/ Masak lemak					1 sudu makan		
			Mentah/ Ulam					1 sudu makan		
53	Sayuran Berbuah <i>(Peria/ Timun/ Labu/ Babycorn/ Petola/ Bendi/ Terung/ Kundur/ Jantung Pisang/ Cili, dan lain2)</i>		Kacau goreng/ Kari/ Masak lemak/ Sambal					1 mangkuk kecil		
			Rebus/ Sup					1 mangkuk kecil		
			Mentah/ Ulam					1 mangkuk kecil		
54	Sayuran Berakar <i>(Kentang/ Keledek/ Keledek/ Lobak Merah/ Lobak Putih/ Beetroot/ Sengkuang/ Akar Teratai, dan lain2)</i>		Kacau goreng/ Rebus/ Kari/ Masak lemak/ Sambal/ Masak kicap					1 mangkuk kecil		
			Goreng					1 mangkuk kecil		
			Rebus/Ku kus/Sup					1 mangkuk kecil		
			Mentah/ Ulam					1 mangkuk kecil		
55	Acar							1 sudu makan		
Buah-buahan *Sila nyatakan jumlah perasa makanan yang digunakan jika ada (Contoh: Asam boi/ Garam dan lain2)										
56	Epal/Pir							1 biji		
57	Pisang							1 biji (M)		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
58	Kurma							1 biji		
59	Buahan bermusim (Duku/ Langsat/ Rambutan)							1 biji		
60	Durian							1 ulas		
61	Anggur							1 biji		
62	Jambu Batu							1 potong		
63	Mangga							1 potong		
64	Nangka							1 ulas		
65	Buah Sitrus (Oren/ Limau/ Mandarin)							1 biji		
66	Betik							1 potong		
67	Nenas							1 potong		
68	Melon (Tembikai/ Tembikai Susu)							1 potong		
69	Belimbing							1 biji		
Makanan Segera										
70	Ayam Goreng (KFC, McD, dan lain2)							1 keping		
71	Kentang Goreng/ Kentang 'wedges'							1 mangkuk kecil		
72	Pizza							1 kpg sederhana		
73	Burger (Daging Lembu/ Ayam/ Ikan)							1 biji sederhana		
74	Salad/ Coleslaw							1 mangkuk kecil		
Susu & Hasil Tenusu										
75	Susu tepung rendah lemak (Omega/ Anlene, dan lain2)							1 sudu makan		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
76	Susu tepung penuh krim (Fernleaf/ Dutchlady, dan lain2)							1 sudu makan		
Kuih Tradisional										
A Kuih Melayu										
77	Kuih Goreng (Pisang goreng/ Cucur udang/ Cucur bilis/ Cucur sayur/ Cekodok/ Roti jala/ Rempeyek/ Pau Sambal/ Karipap)							1 keping/biji		
78	Kuih Manis (Kuih bingka/ Lempeng/ Apam balik/ Kuih Bakar/ Kuih Ketayap/ Bahulu/ Kuih Kasui/ Seri Muka/ Kuih Koci/ Kuih Talam)							1 keping/biji		
B Kuih Cina										
79	Kuih Goreng (Yau Zha Kuih/ Ham Chi Ping)							1 keping/biji		
80	Kuih Kukus (Pau Babi/ Coklat/ Kaya/ Kelapa/ Bak Tong Gou/ Ang Koo Kueh)							1 keping/biji		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
81	Dumpling Kukus (Dumpling Nasi Bak Zang/ Loh mai kai/ Loh mai fan)							1 biji		
C Kuih India										
82	Kuih Goreng (Vadai/ Samosa)							1 keping/biji		
83	Kuih Kukus (Idiyappam/ Puttu)							1 keping/biji		
Konfeksi										
84	Kek (Biasa/ Kek Span)							1 potong		
85	Kek Krim/ Berperisa (Pisang / Lobak/ Coklat/ Red velvet/ Tiramisu/ Mentega/ Keju, dan lain2)							1 potong		
86	Donut (Biasa/ Gula/ Aising)							1 biji		
87	Jeli /Agar2/ Dadih							1 biji		
Makanan Ringan & Makanan Jejari										
88	Muruku							1 keping		
89	Keropok (Ikan/ Udang/ Lekor)							1 keping		
90	Popiah		Goreng					1 keping		
			Basah					1 keping		
91	Dim sum		Goreng					1 biji		
			Kukus					1 biji		
92	Sushi							1 keping		
93	Sandwic (Telur/ Ayam/ Ham/ Tuna)							1 set (2 kpg roti)		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan			Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)	
			Masakan	Sehari	Seminggu	Sebulan				Jarang
94	Yong tau foo (Bendi/ Peria/ Terung/Cili)		Goreng					1 biji		
			Rebus					1 biji		
95	Yong tau foo (Tauhu/ Tau pok)		Goreng					1 biji		
			Rebus					1 biji		
96	Kebab (Daging Lembu/ Ayam/ Ikan/ Kambing)							1 keping		
Jem & Sapuan Roti										
97	Mentega							1 sudu teh		
98	Jem Buah (Nenas/ Strawberry dan lain2)							1 sudu teh		
								1 sudu teh		
99	Kaya							1 sudu teh		
100	Marjerin		Masin					1 sudu teh		
			Tidak masin					1 sudu teh		
Minuman										
A Kopi/Teh										
101	'Tarik/ 'C/Tin/ Susu							1 gelas		
102	O (Dengan gula)							1 gelas		
103	3 dalam 1							1 paket		
104	2 dalam 1 (Dengan gula sahaja)							1 paket		
105	Dengan krimier bukan tenusu							1 gelas		
B Minuman Bermalt										
106	Susu Pekat Manis/ Gula/ Kosong							1 gelas		
107	3 dalam 1							1 paket		
C Lain-lain minuman										
108	Kordial/ Sirup							1 gelas		
109	Jus Segar/ Barli/ Minuman Herba							1 gelas		

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
110	Minuman Bergula (Air soya dan lain2)							1 gelas		
111	Air bergas/ Isotonik (100 plus/ Coke dan lain2)							1 tin		
Sos, Rempah & Sup										
112	Budu/ Cencalok							1 sudu makan		
113	Sos Botol (Cili/ Tomato)							1 sudu makan		
114	Chutney Kelapa							1 sudu makan		
115	Chutney Tomato/ Pudina							1 sudu makan		
116	Sambal tumis							1 sudu makan		
117	Sambal belacan							1 sudu makan		
118	Kicap (Cair/ Pekat)							1 sudu makan		
119	Cili (Jeruk/ Potong/ Dengan kicap)							1 sudu makan		
120	Dhal/ Kacang Hijau		Kari (Santan)					1 sudu makan		
			Kari (Tanpa santan)					1 sudu makan		
Sup (Sahaja)										
121	Sup Jernih (Herba/ Sup Sayuran/ Sup Ikan/ Sup Ayam/ Sup Bebola Daging/ Ikan, dan lain2)							1 mangkuk kecil		

NMRR-19-2501-50205

Subject code:

No.	Makanan/ Minuman	Diambil (Ya/Tidak)	Cara	Kekerapan				Sukatan isi rumah	Porsi Diambil	Kuah Tambah (1 Sudu Mkn)
			Masakan	Sehari	Seminggu	Sebulan	Jarang			
Produk Kesihatan (Makanan/minuman)										
122	Minuman Supplemen (Cecair) <i>Sila nyatakan:</i>							1 botol/ paket		
123	Minuman Supplemen (Tepung) <i>Sila nyatakan:</i>							1 sudu/ paket		
124	Lain-lain:									



JAWATANKUASA ETIKA & PENYELIDIKAN PERUBATAN
(Medical Research & Ethics Committee)
KEMENTERIAN KESIHATAN MALAYSIA
d/a Kompleks Institut Kesihatan Negara
Blok A, No 1, Jalan Setia Murni U13/52,
Seksyen U13, Bandar Setia Alam,
40170 Shah Alam, Selangor.



Tel: 03-3362 8888/8205

Ref : KKM/NIHSEC/ P19-2107 (6)
Date: 27- September -2019

Dr Nor Fadhlina binti Zakaria
UNIVERSITY PUTRA MALAYSIA (UPM)

Dr Zulfitri 'Azuan Bin Mat Daud
UNIVERSITY PUTRA MALAYSIA (UPM)

Dear Sir/ Mdm,

ETHICS INITIAL APPROVAL: NMRR-19-2501-50205 (IIR)

Assessing Protein Energy Wasting Among Malaysian Dialysis Patients Using Bio-electrical Impedance Analysis-Derived Phase Angle

This letter is made in reference to the above matter.

2. The Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (MOH) has provided ethical approval for this study. Please take note that all records and data are to be kept strictly **CONFIDENTIAL** and can only be used for the purpose of this study. All precautions are to be taken to maintain data confidentiality. Permission from the District Health Officer / Hospital Administrator / Hospital Director and all relevant heads of departments / units where the study will be carried out must be obtained prior to the study. You are required to follow and comply with their decision and all other relevant regulations, including the Access to Biological and Benefit Sharing Act 2017.

3. The investigators and study sites involved in this study are:

HOSPITAL KUALA LUMPUR

Dr Nor Fadhlina binti Zakaria (Penyelidik Utama)
Dr Zulfitri 'Azuan Bin Mat Daud (Penyelidik Utama)

HOSPITAL SERDANG

Dr Nor Fadhlina binti Zakaria (Penyelidik Utama)
Dr Zulfitri 'Azuan Bin Mat Daud (Penyelidik Utama)

4. The following study documents have been received and reviewed with reference to the above study:

Documents received and reviewed with reference to the above study:

1. Study Protocol Version 2, dated 18 -September- 2019
2. Patient information sheet (English) & Informed Consent Form (English) Version 1, dated 28 - August- 2019
3. Patient information sheet (Malay) & Informed Consent Form (Malay) Version 1, dated 28 - August- 2019
4. Questionnaire Version 1, dated 28 -August- 2019
5. Investigator's documents : Declaration of Conflict of Interest (COI), IA-HOD-IA, and CV:
 - a) Dr Nor Fadhlina binti Zakaria (Penyelidik Utama)
 - b) Dr Zulfitri 'Azuan Bin Mat Daud (Penyelidik Utama)



JAWATANKUASA ETIKA & PENYELIDIKAN PERUBATAN
(Medical Research & Ethics Committee)
KEMENTERIAN KESIHATAN MALAYSIA
d/a Kompleks Institut Kesihatan Negara
Blok A, No 1, Jalan Setia Murni U13/52,
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40170 Shah Alam, Selangor.



Tel: 03-3362 8888/8205

Ruj.Kami: KKM/NIHSEC/ P19-2107 (7)
Tarikh : 27-September-2019

Dr Nor Fadhlina binti Zakaria
UNIVERSITY PUTRA MALAYSIA (UPM)

Dr Zulfitri 'Azuan Bin Mat Daud
UNIVERSITY PUTRA MALAYSIA (UPM)

Dato'/ Tuan/ Puan,

SURAT KELULUSAN ETIKA: NMRR-19-2501-50205 (IIR)

Assessing Protein Energy Wasting Among Malaysian Dialysis Patients Using Bio-electrical Impedance Analysis-Derived Phase Angle

Dengan hormatnya perkara di atas adalah dirujuk.

2. Bersama dengan surat ini dilampirkan surat kelulusan saintifik dan etika bagi projek ini. Segala rekod dan data subjek adalah SULIT dan hanya digunakan untuk tujuan kajian dan semua isu serta prosedur mengenai *data confidentiality* mesti dipatuhi. Kebenaran daripada Pengarah Hospital / Institusi di mana kajian akan dijalankan mesti diperolehi terlebih dahulu sebelum kajian dijalankan. Dato' / Tuan / Puan perlu akur dan mematuhi keputusan tersebut dan undang-undang lain yang berkaitan, termasuklah Akta Akses Kepada Sumber Biologi dan Perkongsian Faedah 2017.

3. Penyelidik- penyelidik dan lokasi kajian yang terlibat ialah:

HOSPITAL KUALA LUMPUR

Dr Nor Fadhlina binti Zakaria (Penyelidik Utama)
Dr Zulfitri 'Azuan Bin Mat Daud (Penyelidik Utama)

HOSPITAL SERDANG

Dr Nor Fadhlina binti Zakaria (Penyelidik Utama)
Dr Zulfitri 'Azuan Bin Mat Daud (Penyelidik Utama)

4. Adalah dimaklumkan bahawa kelulusan ini adalah sah sehingga **26 - September-2020**. Tuan/Puan perlu menghantar dokumen-dokumen seperti berikut selepas mendapat kelulusan etika. Borang-borang berkaitan boleh dimuat turun daripada laman web Jawatankuasa Etika & Penyelidikan Perubatan (JEPP) (<http://www.nih.gov.my/mrec>).
 - i. **Continuing Review Form** selewat-lewatnya dalam tempoh 2 bulan (60 hari) sebelum tamat tempoh kelulusan ini bagi memperbaharui kelulusan etika.
 - ii. **Study Final Report** pada penghujung kajian.
 - iii. Mendapat kelulusan etika sekiranya terdapat pindaan ke atas sebarang dokumen kajian / lokasi kajian / penyelidik. Pihak JEPP mempunyai hak untuk menarik balik kelulusan etika sekiranya terdapat perubahan dokumen kajian yang tidak diisytiharkan.
5. Kajian tersebut hanya melibatkan pengumpulan data melalui:

- i. **Temu Bual**
- ii. **Rekod Perubatan**
- iii. **Prosedur Rawatan Perubatan Rutin**



JAWATANKUASA ETIKA & PENYELIDIKAN PERUBATAN
(Medical Research & Ethics Committee)
KEMENTERIAN KESIHATAN MALAYSIA
d/a Kompleks Institut Kesihatan Negara
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Ref : KKM/NIHSEC/ P19-2107 (9)

Date: 02-January-2020

DR ROSNAWATI YAHYA
HOSPITAL KUALA LUMPUR

DR NOR FADHLINA BINTI ZAKARIA
UNIVERSITY PUTRA MALAYSIA (UPM)

DR ZULFITRI 'AZUAN BIN MAT DAUD
UNIVERSITY PUTRA MALAYSIA (UPM)

Dear Sir/ Mdm,

AMENDMENTS FOR STUDY: NMRR-19-2501-50205 (IIR)

Protocol No :

Assessing Protein Energy Wasting Among Malaysian Dialysis Patients Using Bio-electrical Impedance Analysis-Derived Phase Angle

Your amendment submission dated 23-December-2019 is referred.

2. Amendments of the following have been received and reviewed with reference to the above study:

Documents received and reviewed with reference to the above study:

1. Addition of new investigators:

Investigators	Study Sites	Investigators' role	Investigator's document
Dr. Rosnawati Yahya	Hospital Kuala Lumpur	Principal Investigator at the site	CV, GCP Certificate, IA-HOD-IA Form
Cordelia Lim Kheng May	Hospital Serdang, Hospital Kuala Lumpur	Co / Sub Investigator at the site	CV
Nurul Syuhada binti Mohd Ridzuan	Hospital Serdang, Hospital Kuala Lumpur	Co / Sub Investigator at the site	CV
Nurul Syazlin binti Anuar	Hospital Serdang, Hospital Kuala Lumpur	Co / Sub Investigator at the site	CV
Nurul Saddiqah binti Adnan	Hospital Serdang, Hospital Kuala Lumpur	Co / Sub Investigator at the site	CV

2. Declaration conflict of interest