UNIVERSITI PUTRA MALAYSIA

RISK OF SARCOPENIA AND ITS ASSOCIATED FACTORS AMONG HEMODIALYSIS PATIENTS IN SELECTED DIALYSIS CENTERS

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A project submitted as partial fulfillment of the requirement for the degree of Bachelor of Science in Dietetics with honours from the Faculty Medicine and Health Sciences, Universiti Putra Malaysia

This project entitled "Risk of sarcopenia and its associated factors among hemodialysis patients in selected dialysis centers" was prepared by Low Siao Jou and submitted to the Faculty of Medicine and Health Sciences as partial fulfillment of the requirement for the degree of Bachelor of Science in Dietetics with honours from Faculty of Medicine and Health Science, Universiti Putra Malaysia.

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ABSTRACT

RISK OF SARCOPENIA AND ITS ASSOCIATED FACTORS AMONG HEMODIALYSIS PATIENTS IN SELECTED DIALYSIS CENTRES

Low Siao Jou

Sarcopenia is a well-known muscle disease of the elderly, and its prevalence in hemodialysis patients was revealed to be high. Despite its importance and growing clinical recognition, the issue of sarcopenia has not been fully addressed in the Chronic Kidney Disease (CKD) literature, with no relevant research in Malaysia. Therefore, this cross-sectional study aimed to determine the risk of sarcopenia and its associated factors in hemodialysis patients. In response to the difficulty of face-to-face interviews during the pandemic, physical copies of questionnaires were posted to the selected dialysis centers. Anthropometric and biochemical parameters were obtained as secondary data via dialysis records, with the supports of the dialysis center managers. Mini Nutrition Assessment (MNA), Depression subscale of the Hospital Anxiety and Depression Scale (HADS-D), Pittsburgh Sleep Quality Index (PSQI), and SARC-F questionnaire were used to assess nutritional status, depression, sleep quality, and risk of sarcopenia in the subjects, respectively. IBM SPSS version 25 was used in the statistical analysis, with a significance level was set at $p < 0.05$. A total of 102 subjects were recruited from three dialysis centers in Kinta District, Perak. The mean age of the subjects was 56 years. Hypertension was most prevalent (83.3%), followed by diabetes (43.1%), with nearly all of the subjects (94.1%) had polypharmacy. The prevalence of hypoalbuminemia and hyperphosphatemia was 56.9% and 52.9%, respectively. While a majority of the subjects experienced no weight loss in the past three months and had a mean BMI of 25.5 kg/m^2, more than 60% of them were either at risk of malnutrition or were malnourished. Meanwhile, a total of 42.1% and 80.4% of the subjects had depression and poor sleep quality, respectively. There were 4 out of 10 subjects were at risk of sarcopenia, with Malays having the highest risk. In the bivariate analysis, risk of sarcopenia was significantly correlated with ethnicity ($p=0.013$), diabetes ($p<0.001$), serum albumin ($r=-0.295$, $p=0.003$), nutritional status ($r=-0.450$, $p<0.001$), depression ($r=0.552$, $p<0.001$) and sleep quality ($r=0.198$, $p=0.046$). In terms of sleep components, subjects with frequent sleep disturbances ($r=0.210$, $p=0.034$) and daytime dysfunctions ($r=0.344$, $p<0.001$) had significantly higher risk of sarcopenia. Despite methodological limitations, this study presented some important findings that may help policy makers and healthcare professionals in planning appropriate interventions to improve the sarcopenic status of hemodialysis patients.

ABSTRAK

RISIKO SARKOPENIA DAN FAKTOR-FAKTOR YANG BERKAITAN DALAM KALANGAN PESAKIT HEMODIALISIS DI PUSAT DIALISIS TERPILIH

Low Siao Jou

Sarkopenia adalah penyakit otot yang umum terjadi pada usia senja, dan prevalensinya didapati tinggi pada pesakit hemodialisis. Walau bagaimanapun, masalah sarkopenia tidak diberi perhatian sepenuhnya dalam literatur penyakit buah pinggang kronik (CKD), dan tidak ada penyelidikan yang berkaitan di Malaysia. Oleh itu, kajian rentas ini bertujuan untuk mengenal pasti risiko sarkopenia dan faktor-faktor yang berkaitan dalam kalangan pesakit hemodialisis di Malaysia. Borang soal selidik dihantar ke pusat dialisis terpilih setelah mempertimbangkan kesukaran mengadakan wawancara tatap muka semasa pandemik. Parameter antropometrik dan biokimia diperoleh melalui rekod dialisis dengan bantuan pengurus dialisis pusat serta kakitangan jururawat. Penilaian Pemakanan Mini (MNA), Skala Kecemasan dan Depresi Hospital untuk sub skala depresi (HADS-D), Indeks Kualiti Tidur Pittsburgh (PSQI) dan SARC-F digunakan untuk menentukan status pemakanan, kemurungan, kualiti tidur, dan risiko sarkopenia. IBM SPSS versi 25 digunakan dalam analisis statistik, dengan tahap signifikansi ditetapkan pada p <0,05. Dari tiga pusat dialisis di Daerah Kinta, Perak, seramai 102 orang subjek dengan purata usia 56 tahun mengambil bahagian dalam kajian ini. Hipertensi adalah paling biasa (83.3%) diikuti oleh diabetes (43.1%), dan hampir semua subjek (94.1%) mempunyai masalah polifarmasi. Peratusan subjek dengan paras serum albumin yang rendah (hypoalbuminemia) dan serum fosforus yang tinggi (hyperphosphatemia) adalah 56.9% dan 52.9% masing-masing. Walaupun majoriti subjek tidak mengalami penurunan berat badan dalam tiga bulan terakhir dan mempunyai purata BMI 25.5, 52.0% daripadanya berisiko malnutrisi sedangkan 9.8% mengalami masalah malnutrisi. Sebanyak 42.1% subjek mengalami kemurungan dan 80.4% subjek mengalami kualiti tidur yang buruk. Sebanyak 4 daripada 10 subjek berisiko sarcopenia, dengan orang Melayu mempunyai risiko tertinggi. Dalam analisis bivariat, risiko sarkopenia berkorelasi dengan etnik (p=0.013), diabetes (p<0.001), albumin serum (r=-0.295; p=0.003), status pemakanan (r=-0.450; p <0.001), kemurungan (r =0.552; p<0.001) dan kualiti tidur (r=0.198; p=0.046). Dari segikomponen tidur, subjek yang mengalami gangguan tidur (r=0.210, p=0.034) dan disfungsi siang hari (r=0.344, p<0.001) dengan kerap mempunyai risiko sarkopenia yang lebih tinggi. Di samping kekurangan metodologi yang wujud, kajian ini mengemukakan beberapa penemuan penting yang diharapkan dapat membantu pembuat dasar dan profesional kesihatan dalam merancang intervensi yang sesuai untuk meningkatkan status sarcopenia pesakit hemodialisis.

CHAPTER 1

INTRODUCTION

1.1 Background

Chronic Kidney Disease (CKD) is a term that encompasses all degrees of renal function impairment, ranging from mild damage in stage 1 to complete kidney failure in stage 5. Diagnosis of CKD is made with the presence of abnormal kidney structure or function, as demonstrated by the markers of kidney damage and an estimated glomerular filtration rate (eGFR) of less than 60 ml/min/1.73 m^2 for more than three months (Perez-Gomez et al., 2018).

Globally, an estimated 1 in 10 people is suffering from CKD (Rateb et al., 2017). With an unabated growth of its prevalence over the past decades, CKD has been recognized as a global public health problem (Kassebaum et al., 2016). This is corroborated by the Global Burden of Disease 2017 study, highlighting the dramatic rise of 29.3% in the global all-age CKD prevalence between 1990 and 2017 (Bikbov et al., 2020). Likewise, a concerning spike was observed in the numbers of CKD cases in Malaysia, with 15.5% of Malaysians having CKD in 2018 (Saminathan et al., 2020). The number is on the rise by leaps and bounds compared to 2011 when the prevalence rate was staggering at approximately 9% (Hooi et al., 2013; Saminathan et al., 2020). A similar trend was observed for the prevalence of end-stage renal disease (ESRD) (Bujang et al., 2017), which draws attention to the healthcare system and monitoring needs of renal replacement therapy (RRT). It is worth noting that Malaysia is one

of the countries with the highest average annual increases in ESRD incidence rates from 2003 to 2016, attributed to the diabetes epidemic (2018 USRDS Annual Data Report: Executive Summary, 2019). Considering the substantial increase of the aging population and non-communicable diseases namely hypertension and diabetes mellitus, the incidence and prevalence of CKD and ESRD are expected to grow (Bujang et al., 2017), should no appropriate action be taken.

Despite kidney transplantation has been available in Malaysia for more than three decades, the transplant rate remains low at three patients per million due to organ shortage (National Renal Registry, n.d; Ministry of Health, 2018). Conversely, hemodialysis (HD) remains the most common treatment modality in Malaysia, with its prevalence increased by approximately 90% from 2008 to 2018 (National Renal Registry, n.d). The rapid growth of the hemodialysis population can be attributed to the increase in the provision of private hemodialysis services and easier access to public financial assistance or subsidies. The government's willingness in engaging the private sector in the provision of care and reform the financial mechanism allows public sector organizations to offer financial supports to qualified hemodialysis patients at private centers (Lim et al., 2010). This reform has brought a positive impact on the participation of the private sectors in hemodialysis services, thereby helping to alleviate the burden on the public sector. Given that the proportion of new hemodialysis patients accepted in private dialysis centers continues to rise (from 43.2% in 2008 to 56.2% in 2018) (National Renal Registry, n.d), it is worthwhile to investigate nutrition-related issues among patients receiving hemodialysis treatments at private dialysis centers.

Hemodialysis is a life-saving therapy for patients with ESRD and alleviates kidney failure symptoms. Nevertheless, chronic hemodialysis may likely induce or worsen complications (Cabrera et al., 2017), including exacerbating the progress of sarcopenia (Fahal, 2014; Mori et al., 2019). Sarcopenia, which derived from the Greek words sarx for “muscle,” and –penia for

"loss", was the first pathological concept proposed by Rosenberg in 1989 (Rosenberg, 1989). It is worth noting that this concept has been altered over time, and is no longer representing its etymological origin. More recently, the revised operational definition for sarcopenia focuses not only on muscle mass loss but also muscle strength decline (grip strength) and poor physical function (gait speed) (Akishita et al., 2018; Cruz-Jentoft et al., 2019). These definitions and diagnostic criteria have been generally accepted and used in the research on geriatric sarcopenia, with cut-off values were absent for sarcopenia in the context of CKD (Moorthi & Avin, 2017). On the other hand, given that profound muscle loss can occur in patients with hemodialysis at a younger age (Domaski & Ciechanowski, 2012), it was speculated that the magnitude of sarcopenia in CKD might differ from age-related sarcopenia due to the independent effects of CKD disease on the muscle (Sabatino et al., 2020), indicating the current proposed geriatric sarcopenia criteria may not be suitable or applied to patients with CKD (Sabatino et al., 2020), and hence warrant more research on sarcopenia in CKD literature.

The prevalence of sarcopenia in HD patients was slightly higher than that of the elderly in the community, ranging from 29.3% to 40% (Kim et al., 2014; Mori et al., 2019). In the CKD context, the importance of sarcopenia lies in its impacts on mortality and morbidity, including elevated risk for falls (Aly et al., 2019), reduced functional capacity (De Souza et al., 2017), and increased cardiovascular risk (Kim et al., 2019). In addition, patients with CKD often exhibit reduced physical functions, such as slow gait speed and weak hand grip strength, and poor prognosis in terms of mortality (Kittiskulnam et al., 2017). Recently, CKD patients with sarcopenia were 2-5 times more likely to die than those without sarcopenia (Wilkinson et al., 2020). It is generally accepted that sarcopenia is potentially reversible, and its components (muscle mass, gait speed, and strength) can be improved through proper diet and exercise (Wilson et al., 2017). Therefore, an earlier screening of CKD patients for the risk of sarcopenia and identification of its associated factors is of paramount importance.

1.2 Problem statement

The granting action of an ICD-10-CM code in 2016 highlighted the clinical importance of sarcopenia (Anker et al., 2016), making it a global concern for healthcare practitioners and researchers. However, sarcopenia is under-studied in Asia as compared to Europe and America. The prevalence of sarcopenia among Asian people is contentious due to the absence of consistent diagnostic criteria over the past decades (Limpawattana et al., 2015).

In Malaysia, available studies on sarcopenia were merely focused on the aging population. Although older people are more susceptible to sarcopenia, it is increasingly recognized that sarcopenia may also affect those at a younger age (Sayer et al., 2008). On the other hand, studies that attempted to characterize sarcopenia in patients undergoing hemodialysis are relatively scarce. To the best of knowledge, no study has focused on sarcopenia among patients with dialysis-dependent CKD in Malaysia.

The etiologies of sarcopenia among patients undergoing hemodialysis are multifactorial. Sarcopenia is widely regarded as an age-related disease. The development of sarcopenia however may be associated with other contributing factors beyond aging, such as malnutrition and comorbidity (Cruz-Jentoft et al., 2019; Santilli et al., 2014). Recently, in the context of CKD, increased proteolysis from the illness itself and the dialysis procedure, as well as the low protein and energy intake were determinants of sarcopenia (Sabatino et al., 2020). Other potential factors including body mass index, educational level, smoking, comorbidity of chronic disease, serum phosphorus, and malnutrition may correlate with sarcopenia (Liu et al., 2020; Ren et al., 2016a), with such evidence is scarce in the local context.

Apart from the factors listed above, polypharmacy had been associated with sarcopenia in the aging population without dialysis (König et al., 2017). Given that polypharmacy is pervasive among CKD patients, identification of the potential association between

polypharmacy and sarcopenia is worthy. Several studies reported that sleep parameters (sleep duration and sleep latency) were associated with the risk of sarcopenia in community-dwelling older adults (Chien et al., 2015; Hu et al., 2017; Lucassen et al., 2017). However, such data is highly scarce among the CKD population. Given that poor sleep quality is evident among the CKD population (Ling et al., 2019), this further ignites the need to clarify the possible association between these two parameters (sleep quality and risk of sarcopenia).

Depression is a relatively important yet under-recognized psychiatric disorder among hemodialysis patients (Khan et al., 2019). Evidence is growing that a complex and likely bidirectional association between sarcopenia and depression exists in the elderly population (Demakakos et al., 2013; Smith et al., 2019). Despite depression and sarcopenia share some common risk factors, such as physical inactivity, dysregulation of the endocrine as well as an altered inflammatory system (Budui et al., 2015; Hughes et al., 2016), the association between the two is under-studied, especially among HD patients. Hence, further studies are warranted to clarify the correlation between depression and risk for sarcopenia among HD patients, especially in the local context.

Overall, most of the sarcopenia studies were focused on the community-dwelling older adults, and the results may not be generalized to dialysis-dependent patients in view of the independent effects of the disease itself and dialysis procedure on muscle. Furthermore, studies on sarcopenia-associated factors in patients undergoing hemodialysis are limited in South East Asia, with none is available in Malaysia. Therefore, this study aims to identify the risk of sarcopenia and its associated factors among hemodialysis patients in selected dialysis centers in Malaysia.

The research questions to be answered within this study framework are:

1. What is the magnitude of sarcopenia in hemodialysis patients?

2. Are socio-demographic factors, clinical factors (polypharmacy and comorbidities), anthropometry parameters, biochemical parameters, nutritional status, depression, and sleep quality associated with the risk of sarcopenia among hemodialysis patients?

1.3 Significance of study

In Malaysia, studies on sarcopenia are scarce and dialysis-related sarcopenia remains unclear. Therefore, this study is designed to close the research gap in the scientific literature regarding the risk of sarcopenia among hemodialysis patients. It is hoped that this study will be able to generate more information on sarcopenia and its associated factors among hemodialysis patients in Malaysia.

In addition, the study can also serve as a benchmark for future research. The findings from this study may encourage further research to determine factors associated with sarcopenia in hemodialysis patients. Identifying the modifiable factors of sarcopenia is worthwhile as it allows the policymaker and healthcare professionals to plan for appropriate intervention strategies that improve the quality of life (QoL) and functional status of hemodialysis patients. Research on the risk of sarcopenia and its related factors in the multi-ethnic population of Malaysia can provide more information toward a better understanding of this musculoskeletal disease among Asians.

1.4 Objectives

General Objective

To determine the risk of sarcopenia and its associated factors among hemodialysis patients in selected dialysis centers in Malaysia.

Specific Objective

1. To determine the socio-demographic factors, clinical factors (polypharmacy and comorbidities), anthropometry parameters, biochemical parameters, nutritional status, depression, and sleep quality among hemodialysis patients.
2. To determine the risk of sarcopenia among hemodialysis patients in Malaysia.
3. To determine the associations between socio-demographic factors, clinical factors, anthropometry parameters, biochemical parameters, nutritional status, depression, sleep quality, and risk of sarcopenia among hemodialysis patients.

1.5 Null hypothesis

There are no significant associations between socio-demographic factors, clinical factors, anthropometry parameters, biochemical parameters, nutritional status, depression, sleep quality, and risk of sarcopenia among hemodialysis patients.

1.6 Conceptual Framework

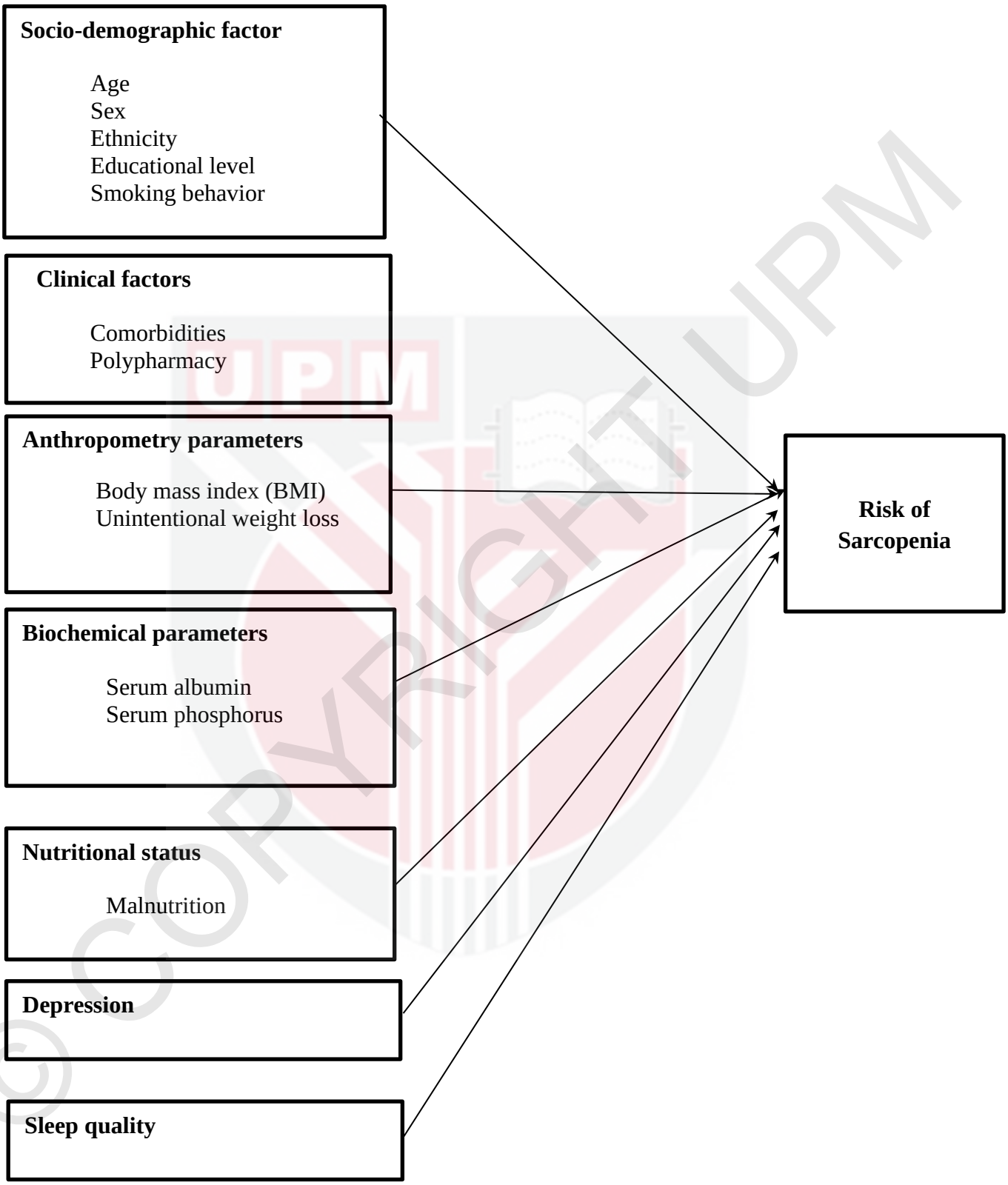

Figure 1.1. Conceptual framework

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of sarcopenia

The world is maturing faster, with an estimation of one out of six people who are expected to be over 65 by 2050 (United Nations Department of Economic and Social Affairs Population Division, 2017). With the unprecedented aging of the world's population, the craze for age-related diseases including sarcopenia is developing significantly. Sarcopenia, a typical geriatric disease that involves diminished muscle volume and capacity, has been associated with unfavorable outcomes, including physical disability, low quality of life, and increased death rates (Benjumea et al., 2018; Gingrich et al., 2019).

The aging cycle is represented by the progressive changes in various organs and frameworks, and one of its striking effects is the loss of muscle tissue (Larsson et al., 2019). Skeletal muscle mass declines incipiently in a linear fashion and can be as early as 30 years old (English & Paddon-Jones, 2010; Volpi et al., 2004), with up to 50% of mass being lost by the 8^{th} - 9^{th} decade of life (Wilkinson et al., 2018). Interestingly, muscle strength and physical performance are also found to decrease rapidly with advancing age. In particular, a decrease in muscle strength is significantly greater and is accounted for 1.5% every year between 50 and 60 years and 3% thereafter (Amarya et al., 2018; Morley et al., 2001). Individuals over 75 years old are likely to lose 60% of their muscle mass and 30% of their physical functions (Francesco

Landi et al., 2017), and are often associated with higher disabilities and mortalities (Bachettini et al., 2020). Hence, sarcopenia should not be limited to only muscle loss, whereby the three segments, namely low muscle mass, lack of muscle strength, and poor physical function (Cruz-Jentoft et al., 2010) are of equal importance. The revised diagnosis criteria of sarcopenia are therefore based on low muscle strength (primary parameter) and low muscle mass, whereas the physical performance determines its severity, and an individual is diagnosed as "probable sarcopenia" when low muscle strength is detected (Cruz-Jentoft et al., 2019).

The European Working Group on Sarcopenia in the Elderly (EWGSOP) is the most recognized definition for sarcopenia. However, considering the ethnic differences in body size and lifestyles, how the diagnostic criteria of sarcopenia apply to the European population may pertain to Asians had been questioned, which had brought to different diagnostic criteria of sarcopenia for Asians (Chen et al., 2014). According to the Asian Working Group for Sarcopenia (AWGS), low muscle strength or physical performance is the diagnostic criteria for possible sarcopenia, and the cut-offs threshold for slow gait speed (GS) was raised from 0.8 to 1.0 m/s and low handgrip strength (HGS) for men from 26 to 28 kg (Chen et al., 2020; Pang et al., 2020).

The prevalence of geriatric sarcopenia varies depending on the communities. Earlier systematic reviews showed the prevalence of sarcopenia was higher among long-term care home residents (14-68%) as compared to community-dwelling older adults (1-29%) (Cruz-Jentoft et al., 2014). More recent study supported that the prevalence of sarcopenia was high among nursing home residents (Shen et al., 2019). In Asia, the estimated prevalence of sarcopenia was between 4.1- 11.5% in the general older population (Chen et al., 2016). In the local context, there have been several studies on sarcopenia in the older population, with prevalence ranging from 28.7-59.8% dependent upon the diagnostic algorithm used (Norshafarina et al., 2013; Rosli et al., 2018; Yap et al., 2020). Despite the high heterogeneity

of prevalence estimates across studies, it is evident that a substantial proportion of older adults suffer from sarcopenia.

2.2 Sarcopenia in hemodialysis patients

A study of sarcopenia in Asian HD patients found that the prevalence of sarcopenia was 37% in men and 29.3% in women (Kim et al., 2014). In addition, a recent study revealed that 40.0% of hemodialysis patients in Japan were sarcopenic (37% in males and 45% in females) (Mori et al., 2019), while approximately 30% of the hemodialysis patients in the European region of the Russian Federation were sarcopenic (Rumyantsev et al., 2019). In chronic hemodialysis patients, sarcopenia is common and its prevalence was inevitably higher than the general geriatric population in international studies. Given the scarcity of data on sarcopenia in hemodialysis patients in the local context, it is unclear whether the same trend can be observed.

2.3 Screening for sarcopenia

With the growing evidence that sarcopenia is prevalent among CKD patients (Foley et al., 2007; Moon et al., 2015), it is important to know more about the interplay between these two conditions. It is worth mentioning that screening of sarcopenia is arbitrary, and is not routinely included as part of a screening program for CKD patients. Previous studies showed early detection of sarcopenia allows better management and can be delayed by proper nutrition and exercise (Law et al., 2016; Robinson et al., 2018; Vikberg et al., 2019). Accordingly, earlier screening for sarcopenia in patients, notably for those on the hemodialysis treatment, is worthwhile.

A wide range of methods is available to screen for sarcopenia. These include anthropometric prediction equation (Yu et al., 2015), Ishii's score chart (Ishii et al., 2014), screening grid from Goodman et al (Goodman et al., 2013), Short Portable Sarcopenia Measure (SPSM) (Miller et al., 2009), and SARC-F questionnaire (Malmstrom & Morley, 2013).

Among the sarcopenia screening measures, the SARC-F questionnaire is recommended by EWGSOP attribute to its ease of use and low cost (Cruz-Jentoft et al., 2010). Evidence is growing that the SARC-F questionnaire is a fairly reliable tool for screening sarcopenia in busy clinical settings (Bahat et al., 2018; Gade et al., 2020; Nguyen et al., 2020). The SARC-F questionnaire was initially meant as a screening tool for sarcopenia in elderly patients. In lieu of the majority of HD patients who are chronically ill with advancing ages, this instrument is considered to be pertaining to the CKD population. Several studies have attempted to investigate its utilization among hemodialysis patients. A recent study conducted in Japan reported that the SARC-F questionnaire portrayed a good discriminatory ability in identifying HD patients with physical limitations (Yamamoto et al., 2019). The predictive validity for mortality in the hemodialysis population was proved to be good (Lin et al., 2020).

There are many tools available to screen for sarcopenia, and the choice chosen depends mainly on the purpose of the evaluation (clinical practice, research, or community research) including screening grid (Goodman et al., 2013) or use of anthropometric prediction equation (Yu et al., 2016). Screening grid is limited to the age range of 65-85 years, while the anthropometric prediction equation has not been validated in non-Caucasian populations as well as in care facility residents or hospital inpatients (Yu et al., 2016). Although Ishii's score chart was reported as the best performing tool (highest sensitivity rate) of all available screening tools (Locquet et al., 2018), its utilization was limited in view of the coronavirus pandemic where physical contact for measuring grip strength is prohibited. This is also true for short-term portable sarcopenia (SPSM), whose use is hampered by its need for grip strength measurement and a 5-minute chair test (Morley & Sanford, 2019). With the simple structure of the SARC-F questionnaire (comprising five questions), it is a preferred tool for self-assessment in the pandemic.

2.4 Factors affecting sarcopenia

2.4.1 Socio-demographic factors

2.4.1.1 Age

It is inevitable that the prevalence of sarcopenia in the general population increases with age (Yazar & Olgun Yazar, 2019). Age-related physiological changes including capillary rarefaction (Prior et al., 2016), mitochondrial dysfunction (Coen et al., 2019; Ferri et al., 2020), muscle fatty infiltration (Marcus et al., 2010; Ponti et al., 2020) and a decline in hormones (McKee et al., 2017; Messier et al., 2011) will exacerbate muscle mass and function loss. For disease-induced sarcopenia, as in CKD, diminished muscle mass and strength may be more related to increased protein degradation and decreased protein synthesis (Cohen et al., 2014). However, given that the elderly with CKD are more likely to have muscle changes than the young population (D'alessandro et al., 2018; Çelik et al., 2011), and the incidence of sarcopenia in hemodialysis patients gradually increases with age (Furtado et al., 2020; Ren et al., 2016), it is generally believed that old age is one of the factors leading to sarcopenia in CKD patients.

2.4.1.2 Gender

The differences between men and women, especially the endocrine (hormonal) system, can have different effects on muscle physiology at the cellular level (Haizlip et al., 2015). Men generally have a higher lean muscle ratio than women due to their elevated testosterone levels leading to significant muscle fiber hypertrophy (Bredella, 2017; Vingren et al., 2010). Gender may also influence the risk of sarcopenia in hemodialysis patients. However, findings on the relationship between gender and sarcopenia had been inconsistent. While an earlier study suggested a possible correlation between sarcopenia and gender in hemodialysis patients (Yoowannakul et al., 2018), other studies failed to support the above finding (Kim et al., 2019; Mori et al., 2019). Intriguingly, emerging evidence suggests that only male patients undergoing hemodialysis were associated with sarcopenia (Hortegal et al., 2020) and have more

pronounced lean muscle deterioration (Visser et al., 2020). With the discrepancies in results regarding the association between gender and sarcopenia in hemodialysis, more studies are warranted.

2.4.1.3 Ethnicity

In anthropology, ethnicity is commonly understood as a group identity, where membership is determined based on shared attributes (for example, a common set of traditions, ancestry, language, and history) (Meneses, 1994). Different ethnic groups may have different living environments, lifestyles, and eating habits. Compared with blacks and whites, Asians are more likely to have lower muscle mass, weaker grip strength, and a greater tendency to slower gait speed (Auyeung et al., 2014; Wu et al., 2016). Hence, ethnicity seems to be one of the factors affecting the risk of sarcopenia. On the other hand, the prevalence of sarcopenia among Asians was slightly higher than that of the Caucasian and Hispanic populations, regardless of the diagnostic criteria used (Beaudart et al., 2014; Chen et al., 2020; Jeng et al., 2018). These findings were echoed by a recent cohort study, whereby Asian HD patients were twice as likely to have sarcopenia than Black and White (Yoowannakul et al., 2018). However, considering that Asia is made up of a great number of ethnicities, many challenges remained to be resolved. In the local context, little is known about the correlation between sarcopenia and ethnicity among HD patients. Malaysia is one of the unique countries with a complex multi-ethnic population, predominantly defined by three main ethnic groups: Bumiputera (Malays and indigenous peoples - 69.6%), Chinese (22.6%), and Indian (6.8%) (Department of Statistics Malaysia., 2020). Given that sarcopenia was reported to be more prevalent in Indians than Chinese and Malay in non-CKD populations (Lim et al., 2020; Sazlina et al., 2020), this ignites the curiosity whether the same scenario is observed among HD patients.

2.4.1.4 Education level

A higher educational level can be associated with better health management, including adequate diet, exercise, and compliance with medications (Kim et al., 2012; Taibanguay et al., 2019; Wong et al., 2011). Several studies have reported an inverse association between education level and sarcopenia in community-dwelling older adults (Mijnarends et al., 2016; Moreira et al., 2019; Volpato et al., 2014). A multi-continent study demonstrated that higher education level confers a protective effect on the risk of sarcopenia among older adults in China, Mexico, Poland, and South Africa (Tyrovolas et al., 2016). Similar findings were reported earlier among 112 middle-aged women in Finland (Rantanen et al., 1992) and a recent study (Brennan-Olsen et al., 2020), whereby the later study reported that highly educated older adults have greater handgrip strength (HGS) and appendicular lean mass (ALM) than their less-educated counterparts. As such, speculation about the possible protective effects of educational level in hemodialysis populations arose. On the other hand, functional capacity was found to be higher in hemodialysis patients with better education (Garcia et al., 2017). Nevertheless, the relationship between educational level and sarcopenia risk in hemodialysis patients has not yet been clearly elucidated in Malaysia.

2.4.1.5 Smoking behavior

Cigarette smoking is a lifestyle risk factor for a variety of chronic disorders, including sarcopenia (Shimokata & Ando, 2012; Steffl et al., 2014). One plausible explanation is that cigarette smoke constituents could induce the systemic inflammatory mediators that enhance proteolysis, capillary regression, and altered myofiber calcium kinetics (Nogueira et al., 2018; Degens et al., 2015), thereby increasing the risk of impaired muscle function. A study among the general population in Columbia had demonstrated a significant association between smoking and sarcopenia (Gonzalez-Gonzalez et al., 2019). This finding was echoed by another study (Lee et al., 2018), with the later study emphasized smoking as a reversible risk factor for

sarcopenia. However, how smoking may pertain to those with CKD remains under-studied. A recent case-control study showed that sarcopenic and robust CKD patients did not differ with regards to smoking status (Aly et al., 2019). Nevertheless, this study was limited by its small sample size that may reduce the power of the study. Putting all together, how smoking behavior may correlate with the risk of sarcopenia in hemodialysis patients remains unclear and deserves further investigation.

2.4.2 Clinical factors

2.4.2.1 Polypharmacy

The concurrent use of multiple drugs, namely polypharmacy (Masnoon et al., 2017), is a common problem among hemodialysis patients. Defined as at least five medications, the prevalence of polypharmacy was extremely high among HD patients in Saudi Arabia (Alshamrani et al., 2018) and Canada (Battistella et al., 2018). Numerous studies have established a strong relationship between polypharmacy and its unfavorable clinical outcomes, including falls, malnutrition, cognitive impairment, reduced physical capability (Dhalwani et al., 2017; Khezrian et al., 2019; Rahi et al., 2020). Interestingly, polypharmacy is also tightly associated with the increased likelihood of sarcopenia (Tanaka et al., 2018). Likewise, the Berlin Aging Study II, which included 2,502 older adults, had also observed a similar result, with the addition of the association between polypharmacy and exhaustion (König et al., 2017). A reasonable explanation for these findings is that polypharmacy may affect and interfere with various metabolic processes and circulatory homeostasis, which are believed to play an important role in the development of sarcopenia, including mitochondrial dysfunction (Will et al., 2019), decreased blood flow (Ramot et al., 2013), as well as the electrolyte, and acid-base abnormalities (Dhondup & Qian, 2017). More studies were conducted in the past few years, which advanced understanding of the relationship between polypharmacy and sarcopenia (Sazlina et al., 2020; Su et al., 2019). However, in hemodialysis

patients, there is a paucity of data that focuses on such association. As polypharmacy is common among hemodialysis patients, its association with sarcopenia deserves further investigation.

2.4.2.2 Presence of comorbidities

Sarcopenia can be considered as 'primary' (or age-related) when it develops with only aging without other reasons. Secondary sarcopenia, on the other hand, is often caused by factors other than (or in addition to) aging (Cruz-Jentoft et al., 2010). With regard to secondary sarcopenia, studies have found that it is often associated with malnutrition, immobility, and comorbidities (Mijnarends et al., 2016; Vandewoude et al., 2012). Comorbidities are often used to express the concept of two or more diseases that occur simultaneously (Valderas et al., 2009). The presence of comorbidities such as organ failure, malignancy, and endocrine diseases can induce sarcopenia (Saggini et al., 2017). Other comorbidity factors, such as diabetes and hypertension, are also associated with the risk of sarcopenia (Han et al., 2017; Wang et al., 2016). In a cohort study of Japanese HD patients, the prevalence of sarcopenia was reported to be high (40%), among which diabetes was an important cause (Mori et al., 2019b). On the other hand, sarcopenia rises as HbA1c increases, and this was mainly driven by the decline in skeletal muscle mass (Sugimoto et al., 2019).

The presence of comorbidities is most likely to invoke some inflammatory processes, with elevated levels of serum CRP and TNF-α and therefore, favoring the loss of muscle mass (Eloueyk et al., 2019; Wang et al., 2016). With the expected rise in the prevalence and incidences of non-communicable diseases and considering a large proportion of the CKD population is of advanced age and suffering from non-communicable diseases (Lee et al., 2018), the potential relationships between risk of sarcopenia and comorbidities are worth investigating.

2.4.3 Anthropometric Parameters

2.4.3.1. BMI

Chronic Kidney Disease patients with higher BMI are often described as having survival advantages, which is called the "obesity paradox" (Jialin et al., 2013; Naderi et al., 2018). Data on the reverse epidemiology of obesity also showed that lower BMI (< 24 kg/m²) is associated with a higher risk of sarcopenia (Bravo-José et al., 2018; Yu et al., 2014), whereas higher BMI acts as a protective buffer by offsetting the decline in muscle performance in the elderly (Han et al., 2016). These findings were echoed by several studies on hemodialysis patients, indicating that there is a negative association between overweight/obesity (defined by high BMI) and sarcopenia (Dierkes et al., 2018; Hortegal et al., 2020; Saitoh et al., 2019).

While most studies have proposed that high BMI confers protection against sarcopenia, a recent study in Israel failed to reach a consensus on this (Lutski et al., 2020). In the above study, subjects with a higher BMI (≥25.0 kg/m²) were 5.31 times more likely to be sarcopenic than those with a lower BMI (Lutski et al., 2020). This finding may sound reasonable in view of the complex interplay of common pathophysiological mechanisms and decreased physical activity between sarcopenia and obesity. Individuals with sarcopenia may have difficulty moving and performing physical activity due to low muscle quality, thereby leading to obesity (Hunter et al., 2019). Conversely, an increase in visceral fat causes inflammation and insulin resistance, which in turn promotes muscle loss and leads to a high risk of sarcopenia (Meex et al., 2019; Pellegrinelli et al., 2015). Hence, a high BMI does not necessarily protect against sarcopenia. As the number of hemodialysis patients with BMI ≥25.0 kg/m² is on the rise (from 30% in 2007 to 40% in 2016) (National Renal Registry, 2018), more research is needed to clarify the protective (or deleterious) influence of high BMI on sarcopenia risk.

2.4.3.2 Unintentional weight loss

The prognostic impact of unintentional weight loss on survival is renowned. The risk of death in hemodialysis patients who lost ≥5% of their weight within six months has increased threefold (Campbell & MacLaughlin, 2010). In a large contemporary cohort of hemodialysis patients, patients lost weight rapidly in the first 5 months after starting dialysis, and the trends varied with baseline BMI (Chang et al., 2017). Unintentional weight loss or weight loss without trying, particularly if it is significant or persistent, may indicate an underlying medical condition. Chronic Kidney Disease itself and the dialysis process create an environment that may be characterized by inflammation, loss of appetite (anorexia), hormonal imbalance, and increased resting energy expenditure, which makes patients prone to malnutrition and weight loss (Zha & Qian, 2017). Less frequently, unintentional weight loss may be the result of the side effects of certain medications (Pettitt et al., 2017).

There is no known study investigating the association or correlation between unintentional weight loss and sarcopenia. A recent study discovered that the subjects with unintentional weight loss have a greater decline in annual functional status (measured by a 6-min walk test) as compared to those who have stabilized weight or intentional weight loss (Polonsky et al., 2019). Similar results were demonstrated in an earlier cohort study, whereby subjects who experienced weight loss or fluctuations had more difficulty in activities of daily living (ADL) and mobility (Arnold et al., 2010). These findings suggest that there may be a link between unintentional weight loss and sarcopenia, which requires further investigations.

2.4.4 Biochemical parameters

Serum albumin has been widely used as an indicator of malnutrition in clinical settings (Cabrerizo et al., 2015; Friedman & Fadem, 2010), as hypoalbuminemia often proved to be a risk factor for poor prognosis in hemodialysis patients (Alves et al., 2018; Antunes et al., 2016; Heidari et al., 2015). Serum albumin concentration has been related to muscle

characteristics (i.e. muscle mass and function), which may explain the association with sarcopenia (Snyder et al., 2012). In addition, serum albumin is a carrier of many hormones, among which androgens can increase the number of muscle myonuclei and satellite cells (Seo et al., 2019). A review of the previous literature shows that limited research has been conducted in determining the association or correlation between serum albumin and sarcopenia in CKD, in addition to inconsistent and mixed findings. While sarcopenic patients were reported to have significantly lower serum albumin in comparison to their non-sarcopenic counterparts (Mori et al., 2019a), inconsistency in findings existed in other studies (De Souza et al., 2017; Marini et al., 2018). In a 3-year longitudinal study among HD patients in Taiwan, patients with low handgrip strength and slow gait speed were found to have lower serum albumin (Lin et al., 2020). The discrepancies of these findings could be attributed to the methodological factors (different diagnostic criteria used to define sarcopenia) as well as the demographic, clinical, and other differences in the studied subjects.

Apart from serum albumin, serum phosphorus has been proposed as a risk factor for sarcopenia. Serum phosphorus may affect muscle function through certain potential pathways, including altered energy metabolism. The presence of muscle weakness in mice models was found to be attributed to the decrease in ATP synthesis flux caused by hypophosphatemia (Pesta et al., 2016). On the other hand, serum phosphorus in CKD patients was independently associated with inflammatory markers (Navarro-González et al., 2009), while phosphate overload can directly cause inflammation, malnutrition, and vascular calcification (Yamada et al., 2014). In a population-based study of US citizens, there was a significant inverse association observed between serum phosphorus and muscle strength (Chen et al., 2018). Another novel finding suggested that hyperphosphatemia plays an important role in muscle atrophy, where the connection could be driven by the up-regulation of myostatin expression (Sonou et al., 2020). With these in mind, it raised the possibility that high serum phosphorus

levels could induce or exacerbate the progress of sarcopenia. However, this hypothesis was rejected by the study on hemodialysis subjects, reporting that the serum phosphorus level of the sarcopenic group was significantly lower than the non-sarcopenic group (Ren et al., 2016). On the other hand, a recent study in Egypt depicted no significant difference in serum phosphorus between sarcopenic and non-sarcopenic HD patients (Zaky & Abdallah., 2019). Nevertheless, this study was limited by its small sample size (n=37), which may lead to cases of bias. More systematic and rigorous studies are needed to be conducted in the future to further address the correlations between serum phosphorus and sarcopenia risk among hemodialysis patients, especially in the local context.

2.4.5 Nutritional status (malnutrition)

Defined as a condition of an imbalance of energy, protein, and other nutrients that eventually cause a wide range of adverse health outcomes (Elia, 2000), malnutrition is highly prevalent in hemodialysis patients. More than half of the patients receiving hemodialysis in Palestine were moderately malnourished (Omari et al., 2019). This is consistent with the results of a previous local study, showing that approximately two-thirds of hemodialysis patients were malnourished (Chan et al., 2019). A recent longitudinal study also reported that HD sarcopenic patients were more malnourished than their non-sarcopenic counterparts (Giglio et al., 2018), The high prevalence of malnutrition might relic a substantial problem to patients, as it is always linked to the onset of sarcopenia. A review of previous studies showed poor nutritional status was significantly associated with the incidence of sarcopenia (Hai et al., 2017; Velázquez-Alva et al., 2019). These results are in line with a recent cohort study, in which malnutrition was found to be a strong predictor of sarcopenia in community-dwelling older adults (Beaudart et al., 2019). These findings can be explained by the fact that lack of intake or uptake of certain nutrients (such as proteins, vitamin D, and calcium) can aggravate skeletal muscle loss and, therefore, contribute to the onset of sarcopenia (Landi et al., 2019). Although evidence is

growing that sarcopenia was associated with poor nutritional status in community-dwelling adults, there is a paucity of data on hemodialysis patients.

2.4.6 Depression

Depression is defined as a mood disorder characterized by episodes of profound sadness, sleeplessness, tiredness, poor appetite and concentration as well as the loss of interest in usual activities (WHO, 2012). Among patients undergoing hemodialysis, depression is considered the most common type of psychiatric disorder and has been closely associated with impaired quality of life (QoL) (Goyal et al., 2018; Vasilopoulou et al., 2016). The reported prevalence of depression in HD patients varies widely across studies, which may partly be attributed to geographical variations. Approximately half of the hemodialysis patients were reported to be depressed (43.6%) in Saudi Arabia (Othayq & Aqeeli, 2020). Depressive is prevalent among the CKD population in Malaysia (Bujang et al., 2015). Two recent local studies using the Hospital Anxiety and Depression Scale (HADS) tool documented that 56.8-84.9% of HD patients were depressed (Khan et al., 2019; Khan et al., 2020). Acknowledging the magnitude, it is important for the early detection of depression symptoms among hemodialysis patients in Malaysia, as the high prevalence of this psychiatric disorder might be a substantial problem for patients.

Numerous cross-sectional studies have demonstrated that sarcopenia was significantly associated with depressed mood in the elderly population (Chen et al., 2020; Lee et al., 2018). Preliminary support for the role of sarcopenia components as a predictor of depression has also been evidenced by a few longitudinal studies (Sanders et al., 2012; Zhao et al., 2020). However, there is a paucity of studies examining such relationships in the patient receiving hemodialysis. While an earlier study reported a possible association between depression and sarcopenia in HD patients (Kim et al., 2014), the recruited subjects were from a single hospital and restricted to age 50 or older. This may lead to a generalization problem as the sample body cannot

represent the entire population. On the other hand, a recent cross-sectional study found that the appendix muscle mass of HD patients was negatively correlated with self-reported depression (Alston et al., 2018). The mechanism of this interaction is unclear; however, the development of depression, along with its up-regulated inflammatory responses (Kim et al., 2014), may contribute to the loss of muscle mass in an individual. Concerning this, it is speculated that the treatment of depression can slow, stop, or even reverse the sarcopenia progression in HD patients, which remains to be determined.

The intricate bidirectional relationship between sarcopenia and depression has made the study more challenging (Demakakos et al., 2013; Smith et al., 2019). The question as to which diseases might occur first in patients with comorbid depression and sarcopenia remain incompletely understood. However, whether the onset of depression occurred before the sarcopenia or the loss of muscle quantity and quality resulted in a depressive mood, screening for these two conditions among HD patients is critical as an early treatment plan may improve their wellbeing. As both sarcopenia and depression confer an increased risk for adverse outcomes in HD populations (Chan et al., 2017; Lin et al., 2020), the relationship between these two variables deserves further investigation.

2.4.7 Sleep quality

While sleep requirements vary from one person to another, healthy adults need at least 7 to 9 hours of good quality sleep per night to reach their best physical and mental state (Hirshkowitz et al., 2015). Evidence is emerging on the high prevalence of poor sleep quality among hemodialysis patients. In Malaysia, poor sleep quality was evident among HD patients, with more than 50% of HD patients had poor sleep quality (Ho et al., 2019; Ng et al., 2020). Numerous scientific studies have linked poor sleep quality to a variety of adverse health outcomes, including obesity (Park et al., 2018), hypertension (Lo et al., 2018), type 2 diabetes

(Zhu et al., 2014), and all-cause mortality (Rod et al., 2011). Interestingly, the risk of sarcopenia may also be associated with sleep quality, and the relationship was mainly driven by short or long sleep duration. Several studies have shown that those who habitually sleep beyond the normal range (≥ 9 h/d) exhibit signs or symptoms of sarcopenia (Fex et al., 2012; Kim et al., 2018). This was in agreement with a study on community-dwelling older adults in Taiwan, whereby short sleep length was also found to be associated with the risk of sarcopenia (Chien et al., 2015), reflecting a U-shaped relationship between sleep duration and the prevalence of sarcopenia. Similar results were obtained from a Chinese cross-sectional study, in which older adults with short or long sleep lengths were more likely to be sarcopenic than those with normal sleep duration (Hu et al., 2017). Although the underlying mechanisms that mediate this association are not yet fully understood (Hu et al., 2017), several hypotheses were proposed. Hormonal regulation may be different for people with insufficient sleep, where the up-regulation of catabolic hormones (cortisol) and the down-regulation of anabolic hormones (IGF-1 and testosterone) could lead to a trend of decreased muscle protein synthesis (Lamon et al., 2020; Leproult & Van Cauter, 2011; Reynolds et al., 2012). This possible causal relationship between sleep deprivation and disrupted protein metabolism has also been proposed in rodent studies, which suggested that sleep deprivation may attenuate the protein synthesis pathways and increase muscle proteolytic activity, thereby resulting in a decrease in muscle fiber cross-sectional area (Dattilo et al., 2012; De Sá Souza et al., 2016). In addition, both long and short sleep duration may induce low-grade inflammation (Fernandez-Mendoza et al., 2017; Lee et al., 2020; Patel et al., 2009), which has been shown to be related to sarcopenia through oxidative and proteolytic pathways.

Apart from sleep duration, sleep latency may also be associated with sarcopenia (Lucassen et al., 2017; Locquet et al., 2018), with each unit increase in sleep latency score was associated with a 14% increased risk of sarcopenia, and stronger association in women

than in men (Lucassen et al., 2017). On the other hand, the association of other sleep parameters with the risk of sarcopenia remains unclear. More study is warranted to allow a better understanding of the impact of sleep quality and its component on the risk of sarcopenia in HD patients.

CHAPTER 3

METHODOLOGY

3.1 Study design

This was a cross-sectional study that aimed to determine the risk of sarcopenia and its association with socio-demographic factors, clinical factors (polypharmacy and comorbidities), anthropometry parameters, biochemical parameters, nutritional status, depression, and sleep quality among hemodialysis patients.

3.2 Study location

This study was conducted using the self-administered questionnaire due to the worldwide pandemic of Covid-19. The questionnaire was distributed to the selected hemodialysis centers in Perak after considering the restriction applied to travel between states. Perak is located on the economically developed west coast of Peninsular Malaysia, where most of the patients undergo dialysis in the private sector (National Renal Registry, n.d). Perak has a total of twelve districts, with the state capital Ipoh located at Kinta. In terms of dialysis acceptance rate, Perak rose to the top six with 312 per million population (pmp) and ranked higher than other states (Selangor, Pulau Pinang, Perlis, Pahang, Kedah, Kelantan, Sarawak, and Sabah) (National Renal Registry, n.d). Kinta district was selected as the location of study in lieu of transportation constraints imposed by the pandemic. Given the proximity of the Kinta district to the research

team, it was more comvenient to retrieve medical records and physical copies of the questionnaires from staff nurses in the hemodialysis centers. In addition, there are more centers (n=22) and HD capacity in the Kinta district as compared to other districts in Perak, which made it the first choice for study locations.

3.3 Sample size determination

The sample size needed for the study was calculated using the following formula (Hulley et al., 2013):-

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

Where,

N= number of subjects needed

The standard normal deviate for α (Zα) = 1.96

The standard normal deviate for β (Zβ) = 0.84 (80%)

C = 0.5 × ln [(1+r)/ (1-r)]

r = the expected correlation coefficient

Table 3.1: Summary of sample size calculation

Sample size calculation based on correlation studies		
Correlation studies	Correlation, r	Sample size, n
Socio-demographic factors Age and risk of sarcopenia (Yamamoto et al., 2019)	r=0.346	n = 63
Anthropometry parameters BMI and risk of sarcopenia (Zasadzka et al., 2020)	r=−0.355	n=60
Biochemical markers Serum albumin and risk of sarcopenia (Santos et al., 2020)	r=-0.3	**n=85**

Table 3.1(Cont.) Summary of sample size calculation

Sample size calculation based on correlation studies		
Correlation studies	**Correlation, r**	**Sample size, n**
Malnutrition Malnutrition and risk of sarcopenia (Zasadzka et al., 2020)	r=−0.642	n=28
Depression Depression score and risk of sarcopenia (Soares et al., 2019)	r=0.320	n=74
Sleep Quality Sleep Quality and risk of sarcopenia (Tuna et al., 2019)	r=0.327	n=71

As shown in Table 3.1, the highest sample size needed was 85 subjects. To address the possibility of missing data and non-response rate, an additional 20% of the sample size was included. Hence, the total sample size required after adjustment was 102.

3.4 Sampling design

Multistage sampling was used as the sampling design in this study. In light of the COVID-19 pandemic condition, the Kinta district was selected using purposive sampling. The list of hemodialysis centers in this region was obtained from the National Renal Registry website (n=18). With an estimation of approximately 40 hemodialysis patients in each dialysis center (National Renal Registry, n.d), a total of three dialysis centers was randomly selected to meet the desired sample size. Hemodialysis subjects who fulfilled the inclusion criteria were invited to participate in this study.

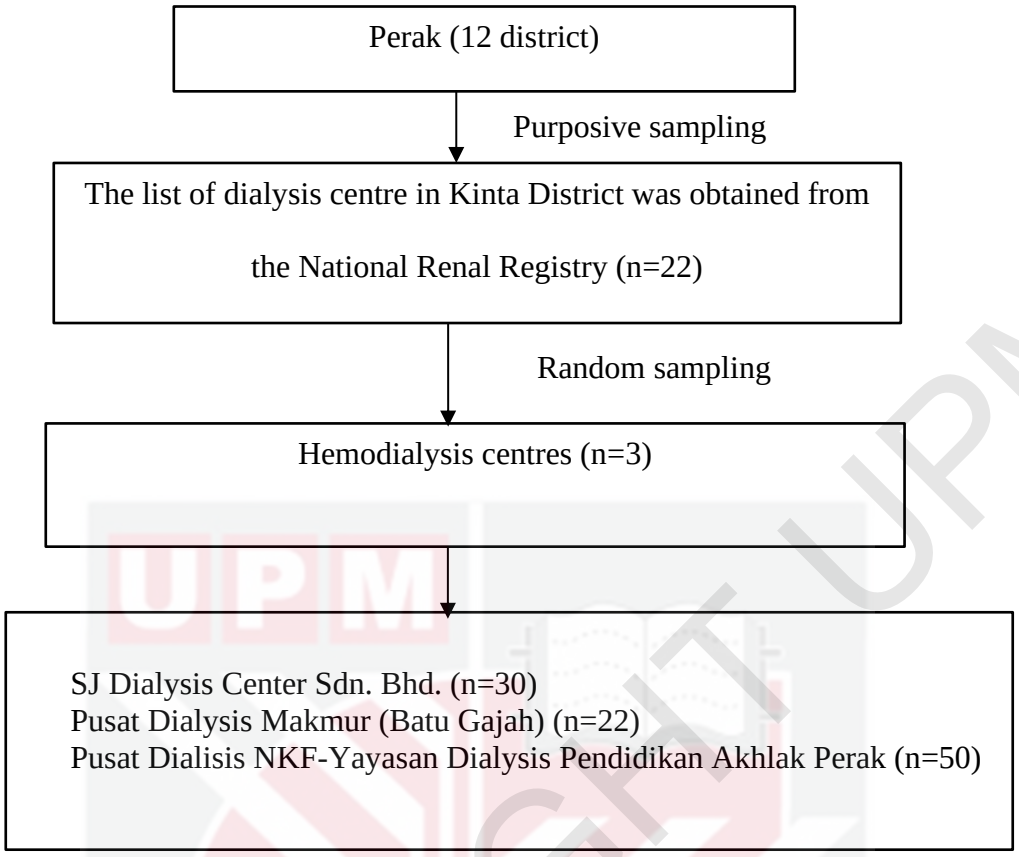

Figure 3.1. Flow of Sample Sampling procedures

3.5 Subjects

The eligibility of subjects was determined based on the inclusion and exclusion criteria as listed in Table 3.2 below.

Table 3.2: Inclusion and exclusion criteria for selection of respondents

Inclusion criteria	Exclusion criteria
Malaysian (all ethnicity)	Non-Malaysian
Male or female	Unstable condition, being hospitalized in past three months
Age 18 years and above	Diagnosed with Hepatitis B or C
Dialyzed for at least 3 months	Diagnosed with specific health issues (e.g., dementia, inflammatory illness, lung or heart failure, or liver diseases)

3.6 Instrumentation

A set of self-administered questionnaires was used as the research instrument in this study as it provided an inexpensive means to obtain information from a large number of subjects. Also, this method was chosen after considering the difficulty to have face-to-face interviews with patients during the Covid-19 pandemic. The questionnaire used in this study was locally adapted (translated into three local languages) and comprised both open-ended and closed-ended questions to obtain information on socio-demographic backgrounds, clinical factors, anthropometric parameters, nutritional status, and sleep quality of the subjects. As face-to-face interviews were restricted during the pandemic, upon the request of the coordinators from the dialysis centers, physical copies of the questionnaire were provided to the eligible subjects to facilitate answering. To increase the response rate, support from staff nurses was obtained to identify eligible subjects and their caregivers. The subjects were not paid for participating in this study but a small gift (foldable recycle bag) was given as a token of appreciation. The physical copies of the questionnaire and small gifts were posted to the selected dialysis centers.

3.6.1 Socio-demographic factors

Socio-demographic backgrounds of the subjects included age, gender, race, educational attainment, and smoking behavior were ascertained in this study. The highest education level attained by the subjects was recorded. Data on the smoking status of subjects was collected (non-smoker, past smoker, and current smoker). Past smokers are defined as individuals who have smoked in their lifetime but quit at the time of the interview, while current smokers are individuals who are still smoking at the time of data collection, and a non-smoker is defined as an individual who does not smoke or smokes less than 100 cigarettes in his/her lifetime (National Center for Health Statistics, 2017).

Subjects who self-reported themselves as past smokers or current smokers were required to provide information on the number of cigarettes per day and the total number of years of

smoking. Pack-year, a measure of smoking intensity, was calculated by multiplying the number of packs of cigarettes smoked per day (20 cigarettes define a pack) by the number of years the person has smoked. Based on pack-years of smoking, subjects were divided into three groups, namely light smoking (≤11.3 pack-years), medium smoking (> 11.3 to 24.5 pack-years), and heavy smoking (> 24.5 pack-years) (Lee et al., 2018).

3.6.2 Clinical factors

The presence of comorbidities (such as diabetes, hypertension, and hyperlipidemia) and polypharmacy was retrospectively collected from the subject's medical records. There is no concrete definition for polypharmacy; however, it is most often referred to as using five or more drugs daily (Masnoon et al., 2017). In order to protect the privacy of patients, the researcher personally went to hemodialysis centers to retrieve medical records. While at the dialysis centers, the researcher followed the strict standard of operation (SOP) amid of Covid pandemic.

3.6.3 Anthropometric parameters

The height and body weight (dry weight) of the subjects were ascertained from dialysis records as secondary data, while body mass index (BMI) was calculated by using the subject's height and dry weight. The metric formula for BMI is weight in kilograms divided by height in meters squared (kg/m2). The subjects were divided into the respective categories: <23 kg/m^2 for protein-energy malnutrition (PEM); 23–29.9 kg/m^2 for ideal weight; and ≥30 kg/m^2 for obese (Hooi et al., 2017). On the other hand, information about the weight changes of the subjects over the past three months was retrieved from the self-administered MNA questionnaire.

3.6.4 Biochemical parameters

The most recent readings for serum albumin and serum phosphorus were obtained via the medical record as secondary data. The subjects were classified as normal or low serum albumin

(using a cut-off value of 40 g/L), and normal or high serum phosphorus (normal range is 0.8 to 1.6 mmol/L) (Massry et al., 2003; Medical Nutrition Therapy, 2005).

3.6.5 Nutritional status

The nutritional status of subjects was initially planned to be assessed using a 7-point Subjective global assessment (SGA) or Malnutrition Inflammation Score (MIS) (Ikizler et al., 2020). However, to adhere to the measures taken by the government in response to Covid-19 which restricted data collection methods that require physical touch or examination, the presence of malnutrition in the subjects was determined by using the Mini Nutritional Assessment (MNA). Mini Nutritional Assessment was initially designed for elderly patients. Since the majority of hemodialysis patients are chronically ill people with advancing age, the MNA was considered as the preferred tool in this study. Two versions of the MNA are available, namely short (6 items) and long forms (18 items). In spite of being more time-consuming, long-form MNA is highly reliable to detect the nutritional risk of hemodialysis patients (kappa = 0.734 and 0.666) (Tsai & Chang, 2011). In addition, the MNA-long form is more comprehensive and quantitative, with additional information available on the causes of malnutrition. The questions in the MNA-long form are structured to provide separate scores on anthropometric assessment (body mass index (BMI), weight loss, arm, and calf circumferences); general assessment (lifestyle, medication, mobility, and presence of depression or dementia); short dietary assessment (number of meals, food, and fluid intake and autonomy of feeding); and subjective assessment (self-perception of health and nutrition) (Guigoz, 2006). By using the MNA questionnaire, the unintentional weight loss of the subjects can be ascertained, and this information was used as an independent variable. Information on BMI was retrieved from the subjects' medical records. Arm and calf circumference were self-measured by the subjects. Instructional videos were created and embedded with a QR code in the printed questionnaires so that subjects could obtain step-by-step instructions on how to

perform these measurements. Despite the use of non-stretchable fiberglass measuring tape is ideal, in light of such tape being not widely available by patients, a non-elastic tailor tape was used to measure mid-arm and calf circumferences.

The computation of the total score (0-30) for the MNA-long form was based on the summation of all 18 items' scores. Subjects were classified as malnourished when a total MNA score of <17 is evident. In distinguishing between normal nutritional and risk of being malnourished, a threshold value of 22 (instead of the original cut-off value of 23.5) was used as it yielded better discriminative ability in dialysis patients (Holvoet et al., 2020). Hence, subjects with a total MNA score of 17-22 were defined as having a risk of malnutrition. Table 3.3 shows the classifications of nutritional status.

Table 3.3: MNA cut-off scores for classification of nutritional status

Nutritional Status	MNA-Depression cut-off score
Malnourished	<17
Risk of malnutrition	17-22
Normal	>22

3.6.6 Depression

The presence of depression among the subjects was ascertained using the depression subscale of the Hospital Anxiety and Depression Scale (HADS-D). The use of the HADS-D with medically ill patients is widespread; being reported in numerous published studies investigated its prediction accuracy for depression (Meader et al., 2014; Meader et al., 2011). It involves a total of 7-item self-report questions, each with four severity levels, ranging from zero (normal) to three (highest depressive level). The sum of all seven components ranged from 0 to 21, with the higher the score, the more severe depression is expected. It had been locally translated and validated for the Malay and Chinese languages, with good internal consistency

of a mean coefficient alpha of 0.73 and 0.70 for the Malay version and Chinese version, respectively (Yong et al., 2016). Table 3.4 showed the classification of depression levels.

Table 3.4: HADS-D cut-off scores for classification of depression level

Level of depression	HADS-Depression cut-off score
Normal	0-7
Borderline abnormal (borderline case)	8-10
Abnormal (case)	11-21

With the emergence of the COVID-19 outbreak, studies conducted through close, face-to-face interactions had been suspended in general. It is worth noting that an online self-assessment of depressive symptoms using HADS-D had proven track records previously (Andersson et al., 2003; Cronly et al., 2018), making its use feasible in the current pandemic condition.

3.6.7 Sleep quality

The sleep quality of the subjects was assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire (Buysse et al., 1989). There are 19 self-reported questions to reflect the important parameters of sleep quality. Besides sleep quality, PSQI assesses the seven domains of sleep quality namely sleep latency, habitual sleep efficiency, sleep duration, subjective sleep quality, use of sleep medications, sleep disturbances, and daytime dysfunction (Buysse et al., 1989). Each of which has a range of 0-3 and these scores were summed to yield a total global PSQI score of 0-21. A higher score on this measure indicates poorer sleep quality. On the other hand, a cut-off of 5 was used to classify poor and good sleepers (Buysse et al., 1989).

PSQI scale is a simple and user-friendly instrument that can be used for the assessment of sleep quality. It has good reliability with a Cronbach's coefficient alpha of 0.75 for global score (Buysse et al., 1989). In addition, the Malay-translated version of PSQI was recently validated

in the local context (Farah et al., 2019; Musa et al., 2018) and used as the Bahasa version in this study.

3.6.8 Risk of Sarcopenia

Assessment of sarcopenia risk among the participants was conducted in a manner that respects the Covid-19 social distancing measure, with the use of the SARC-F questionnaire. It is a simple evaluation tool that needs no physical examination with patients. The online use of the SARC-F questionnaire was known to be feasible in identifying the geriatric syndromes among Malaysian older adults (Alex et al., 2021). Classification using the SARC-F questionnaire was also found to be comparable to classification using European Working Group on Sarcopenia in Older People (EWGSOP), International Working Group on Sarcopenia (IWGS), and the Asian Working Group for Sarcopenia criteria (Woo et al., 2014). This questionnaire has been translated and validated in other languages for use in the screening of sarcopenia (Drey et al., 2020; Kim et al., 2018; Nguyen et al., 2020). More recently, it was reported to have fairly high accuracy in identifying the risk of physical disabilities in hemodialysis patients (all AUCs > 0.75) (Yamamoto et al., 2019). A recent local study also discovered that the SARC-F questionnaire was associated with quadriceps muscle status and 60-day mortality in critically ill patients, suggesting that it is a potentially simple and indirect method for measuring pre-morbid muscle status at ICU admission (Lee et al., 2020).

The SARC-F questionnaire consists of five questions distributed across the following components: strength, assistance with walking, rise from chairs, climb stairs, and falls (Malmstrom & Morley, 2013). For each component of the scored SARC-F, points (0–2) are awarded depending on the functional status of the subjects. The sum of all five components was ranged from 0 to 10. Regarding the threshold value of SARC-F, a subject with a score of ≥ 4 was classified as at risk for sarcopenia.

3.7 Pre-testing

A pre-testing was conducted online among five hemodialysis patients who fulfilled the inclusion criteria of the study. Subjects who have taken the pre-test were excluded from the actual data collection process. This pre-testing was designed to assess the suitability of the data collection tools for the subjects. The clarity of instructions as well as the subject's ability to comprehend the questionnaires was evaluated. Besides, pre-testing also provided an opportunity to estimate the time required for subjects to complete the questionnaires. The total duration required to complete the questionnaire in the pre-test was expected to be within 25-30 minutes. Problems that arose during the pretesting process were evaluated and corrected based on the feedback given.

3.8 Procedures

Ethical approval was granted from the Ethics Committee for Research Involving Human Subjects Universiti Putra Malaysia (JKEUPM-2021-017) (Appendix A). On the other hand, approvals were obtained from the respective hemodialysis centers (Appendix B). Data collection for this study was carried out from March to May 2021. Information sheets (Appendix C) were distributed to subjects informing the nature of the study and their rights of participation. Written informed consents (Appendix C) were obtained from all subjects prior to study commencement. The medical record of the subjects was reviewed in advance to obtain information regarding the clinical background and biochemical readings of the subjects. A self-administered questionnaire was used to collect the data for this study while physical copies were posted to dialysis centers upon request.

3.9 Statistical Analysis

All the data in this study were analyzed using the IBM SPSS Statistics version 25, with a significance level set at $p<0.05$. Univariate analysis was used to carry out analysis on the descriptive data. The results for categorical variables were presented as frequencies and

percentages, whereas the results for continuous variables were presented as means and standard deviations. Pearson product-moment correlation was used to determine the association between continuous variables and SARC-F scores. In addition, the dependent variable (risk of sarcopenia), was presented as a categorical variable, where "risk of sarcopenia" was referred to as those having a total score of ≥ 4 in SARC-F, while those who have a score of less than 4 were grouped as "no sarcopenia". Correlations between the independent variables and the risk of sarcopenia were tested using the Chi-Square test for independence. For data requiring a non-parametric test (not normally distributed), Spearman's rank-order correlation and Fisher's exact test were performed.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Social-demographic factors

Table 4.1 showed the distribution of subjects according to socio-demographic characteristics. A total of 102 subjects were recruited, comprised of 59.8% males and 40.2% females. There are distinct gender differences in the number of CKD patients receiving hemodialysis as a treatment modality, where there was a global trend towards fewer women than men treated with HD for RRT of end-stage renal disease (Hecking et al., 2014). A similar trend was observed in Malaysia, where the ratio of males to females (both incident and prevalent dialysis ratio) has remained around 55% to 45% in the past 10 years (National Renal Registry, n.d.). The gender-specific differences in hemodialysis practices can be partially explained by the psycho-socioeconomic factors (caregiving responsibilities and lower disease awareness) that hindered women from initiating dialysis treatment (Cobo et al., 2016). On the other hand, women undergoing maintenance hemodialysis have substantially higher risks of hospitalization and 30-day readmission than men (Adams et al., 2017), which may further influence the decision-making of the nephrologists prior to treatment modality. The mean age of the subjects was 56.4 ± 12.4 years old, with approximately 60% of them aged below 60 years old. This finding was comparable to national data, where most hemodialysis patients were between 55 and 64 years old (National Renal Registry, n.d). In terms of ethnic composition, there was a slight over-representation of patients of Chinese ethnicity (41.2%), and an under-representation of patients who were of Malay ethnicity (45.1%). The apparent difference may

be due to the uneven population distribution in Malaysia, where more Chinese residents are concentrated in Kinta, Perak (Malaysia & Department of Statistics Malaysia, 2010). In terms of the educational level, more than half of the subjects attained secondary education, while only 10.8 % of subjects possessed tertiary qualifications. Majority of the subjects do not smoke, which was congruent with the recent local study on hemodialysis patient of similar mean age (Khan et al., 2019). Among those who smoked, 60.9% of them were light smokers (smoking ≤11.3 pack-years), and the rest were medium smokers (smoking > 11.3 to 24.5 pack-years). Besides increasing the risk of respiratory disorders, active smoking is highly correlated with cardiovascular and infection-related events in hemodialysis patients (Mc Causland et al., 2012). As such, HD patients are highly recommended to cease smoking.

Table 4.1: Distribution of subjects according to sociodemographic characteristics (n = 102)

Variables	n (%)	Mean ± SD	Range
Age (years)		56.4 ± 12.4	31-81
<60 years old	58 (56.9)		
≥60 years old	44 (43.1)		
Gender			
Male	61 (59.8)		
Female	41 (40.2)		
Ethnicity			
Malay	46 (45.1)		
Chinese	42 (41.2)		
Indian	14 (13.7)		
Education level			
No formal education	7 (6.9)		
Primary education	26 (25.5)		
Secondary education	58 (56.9)		
Tertiary education	11 (10.8)		
Smoking behavior			
Smoking status			
Non-smoker	79 (77.5)		
Past smoker	13 (12.7)		
Current smoker	10 (9.8)		
Smoking level	79 (77.5)		
No smoking	14 (13.7)		
Light smoking	9 (8.8)		
Medium smoking	0 (0)		
Heavy smoking			

4.2 Clinical factors

Table 4.2 showed the distribution of subjects according to clinical factors. The information was obtained through dialysis records with the help of the dialysis center managers and dialysis staff. Hypertension was found to be the most common comorbid among the hemodialysis subjects (83.3%), followed by diabetes (43.1%), which was congruent with several recent local studies (Chan et al., 2019; Ng et al., 2020). Hypertension and diabetes are the recognized risk factors for ESRD and co-morbidities among CKD patients globally. Earlier local studies. Polypharmacy was highly prevalent among subjects, with eight types of medications prescribed to the patients on average. This was comparable to a previous study on medication use among hemodialysis patients (Jyotsna, 2019), and can be explained by the existence of comorbidities that increase the use of multiple drugs (Alshamrani et al., 2018). Also, healthcare providers may prescribe multiple drugs to patients without knowing other related parties, thereby resulting in a high incidence of polypharmacy (Peter, 2015). Future studies focusing particularly on optimal clinical targets and lenient treatment strategies (Ng et al, 2020) are of paramount importance for the dialysis population.

Table 4.2: Distribution of subjects according to clinical factors (n = 102)

Variables	n (%)	Mean ± SD	Range
Comorbidities *			
Diabetes mellitus	44 (43.1)		
Cardiovascular Disease	4 (3.9)		
Hypertension	85 (83.3)		
Dyslipidemia	3 (2.9)		
Anemia	1 (1.0)		
Cancer	0 (0)		
Bone disease	2 (2.0)		
Number of medications		7.9 ± 2.5	2-17
Polypharmacy (no. of medication used ≥5)			
No	6 (5.9)		
Yes	96 (94.1)		

Note.
*Multiple responses

4.3 Anthropometric parameters

The anthropometry parameters of the subjects were shown in Table 4.3.1. The mean BMI of subjects was 25.50 ± 4.0 kg/m2, which was slightly higher than the value of 24.4 kg/m2 as reported in the 24th Report of the Malaysian Dialysis and Transplant Registry 2016. However, approximately three out of ten subjects had a BMI value below 23 kg/m2. In view of the "obesity paradox" that overweight or obesity (BMI 25-28) could have a protective effect on the survival rate of HD patients (Ikizler et al., 2020; Medical Nutrition Therapy, 2005), appropriate nutritional interventions should be introduced to these subjects. Obesity paradox is a medical hypothesis developed from contrasting the long-term and short-term consequences of obesity. While obesity increases long-term cardiovascular-related mortality, it may attenuate short-term mortality associated with malnutrition, inflammation, and protein-energy wasting in patients with CKD(Jialin et al., 2013; Rhee et al., 2016).

On the other hand, despite the magnitude of weight loss being small (with an average loss of 0.39 kg), it is worth noting that 26.5% of the study subjects experienced unexplained weight loss in the past three months. Among the subjects who lost weight, most belonged to the normal BMI category (63.0%), with only five had low BMI while the remaining five were obese (Figure 4.1). Due to the lack of local and international studies documenting the exact prevalence of unintentional weight loss in hemodialysis populations, a direct comparison cannot be made. Unintentional weight loss should be avoided among hemodialysis patients in lieu of its association with unfavorable clinical outcomes including a lower rate of survival (Capizzi et al., 2017). However, obese dialysis patients with BMI > 30kg/m2 or on the transplant waiting list are encouraged to intentionally lose weight in order to increase the access for transplantation (Kittiskulnam & Johansen, 2019; Medical Nutrition Therapy, 2005). It is worth noting that the unintentional weight loss in the current study was self-reported by the subjects, which may limit the data accuracy. Future studies should assess the objective measures of weight.

Table 4.3.1: Distribution of subjects according to anthropometric parameters (n = 102)

Variables	n (%)	Mean ± SD	Range
BMI (kg/m^2)		25.5± 4.0	16.3-39.4
Low (<23)	30 (29.4)		
Normal (23-29.9)	59 (57.8)		
High (≥ 30)	13 (12.7)		
Unintentional weight loss (kg)		0.39 ± 0.54	0-2.9
No weight loss	75 (73.5)		
weight loss 1-3 kg	27 (26.5)		
weight loss > 3kg	0 (0)		

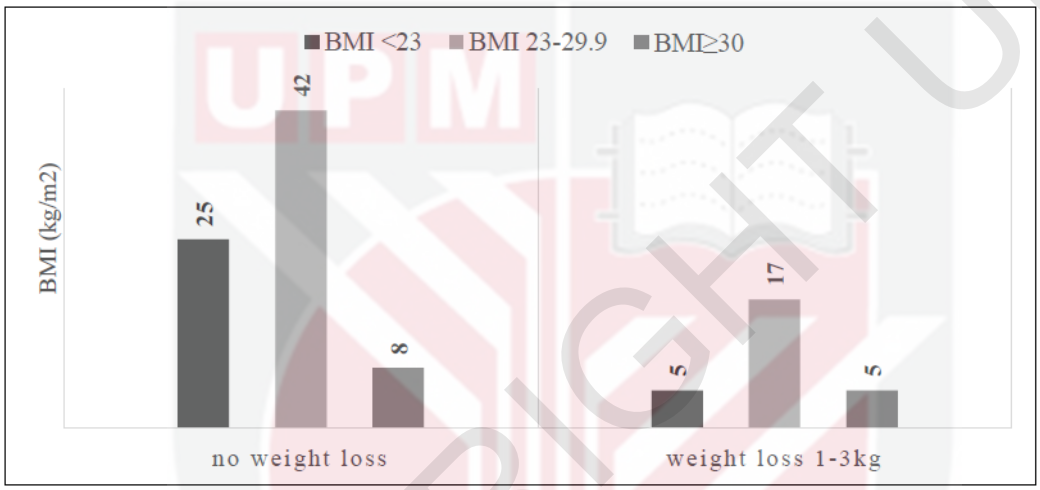

Figure 4.1. Distribution of subjects according to anthropometric parameters (n = 102)

Table 4.3.2: Distribution of subjects according to BMI, calf circumference (CC) and mid-upper arm circumference (MUAC) and risk of sarcopenia (n=102)

	Low CC n (%)	Normal CC n (%)	Low MUAC n (%)	Normal MUAC n (%)	No Risk of Sarcopenia	At Risk of Sarcopenic
BMI (kg/m^2)						
Low (<23)	21 (20.6%)	9 (8.8%)	17 (16.6%)	13 (12.7%)	19 (18.6%)	**11 (10.8%)**
Normal (23-29.9)	30 (29.4%)	29 (28.4%)	35 (34.3%)	24 (23.5%)	35 (34.3%)	**24 (23.5%)**
High (≥ 30)	5 (4.9%)	8 (7.8%)	4 (3.9%)	9 (8.8%)	9 (8.8%)	**4 (3.9%)**

Note. Data for calf circumference (CC) and upper arm circumference (MUAC) of the subjects were retrieved from the MNA questionnaire.
Low CC <31cm, Normal CC = 31 cm or greater
Low MUAC ≤ 22cm, Normal MUAC >22cm

As shown in Table 4.3.2, the issue of sarcopenic obesity was presented among approximately 4% of the subjects. The prevalence of sarcopenic obesity was lower than that in prior studies of patients with HD, which varied from 8 to 57% according to different definitions (Malhotra et al., 2017; Saitoh et al., 2019). Several factors may explain the different prevalence of

sarcopenia obesity, including a different cut-off for defining low muscle mass between studies as well as different methodologies, diagnostic definitions, and clinical characteristics of the study populations. Body Mass Index was self-reported by subjects in this study which may partly explain the discrepancies. In addition, few comparative studies showed the prevalence of obesity in patients with Type 2 Diabetes Mellitus or HD, defined as % fat mass or BMI ≧ 30 kg/m^2, is low in most Asian countries compared with that in Caucasian populations (Park et al., 2013; Yoon et al., 2006). On the other hand, despite the overall sarcopenic obesity was low, it is worth noting that one in three of the obese subjects had sarcopenia (30.8%). The decreased muscle quality as in sarcopenia accompanied by high abdominal fatness may put HD patients at a greater risk of CVD events (Kato, 2015), which is the leading cause of death in this population (Tong et al., 2016). Therefore, further attention is needed to screen hemodialysis patients for both sarcopenia and sarcopenic obesity.

4.4 Nutritional status

In general, the nutritional status of the subjects was not satisfactory, with approximately 10% were malnourished while another 50% were at risk of malnutrition. The current finding was comparable to a previous local study using the same tool (Arshad et al., 2020). It is interesting to note that the subjectively rated risk of malnutrition (based on MNA total score) was comparable to self-view or self-perceived nutritional status by the subjects. On the other hand, approximately one-third of the subjects perceived their health status was worse than their counterparts. Most subjects presented with good mental states and could perform self-care tasks such as feeding and mobility without assistance. A total of 46.1% of the subjects skipped meals, which was consistent with the findings of a recent local study on hemodialysis patients (Ho et al., 2021). Dialysis shift may affect the usual meal time, thereby causing the patients to choose to have snacks instead of the main meal (Ho et al., 2021). A quarter of the subjects also reported experiencing a decrease in food intake over the past three months in the current study. The

reason behind this is not yet clear, but may be due to lack of nutritional knowledge, socioeconomic barriers (needs help in buying groceries and cooking), and dietary restrictions at the expense of overall appetite and depression, which eventually contribute to insufficient dietary intake (Ekramzadeh et al., 2014).

The dietary patterns of hemodialysis patients could also be altered due to treatment and the disease itself. Several studies found that the intake of certain food groups (such as dairy products, vegetables, and fruits) in hemodialysis patients was lower than the recommended value for the general population (Saglimbene et al., 2019; Vaz et al., 2014). The same scenario had been observed in the current findings. More than 60% of the hemodialysis subjects did not take dairy products on a daily basis, probably because they knew that these foods are rich in phosphates, and excessive intake can lead to hyperphosphatemia, which is a serious complication that should be avoided. In addition, 62.7% of the subjects consumed less than two servings of fruits and vegetables per day, which was comparable to a recent longitudinal study conducted in India (Maurya et al., 2019). This finding is expected when considering the fact that the intake of certain fruits and vegetables is generally discouraged in hemodialysis patients on the basis of preventing hyperkalemia.

More than half the subjects had low MUAC (≤ 22cm) and calf circumference (<31cm), respectively. Among them, 4 out of 10 subjects were found to have both MUAC and calf circumference lower than the recommended value (as shown in Figure 4.2). It is worth noting that the values reported in the current study were remarkably higher than the local studies of the non-dialysis elderly population with a higher mean age (Ngoh et al., 2011; Suzana & Siti Saifa, 2007; Tatt et al., 2019). Hence, it can be speculated that the nutritional status of hemodialysis patients was worse than that of elderly patients, which deserves more attention.

Table 4.4: Distribution of subjects according to MNA components (n = 102)

Components	n (%)	Mean ± SD	Range
Declined in food intake			
severe decrease in food intake	1 (1.0)		
moderate decrease in food intake	39 (38.2)		
no decrease in food intake	62 (60.8)		
Weight loss in the past 3 months		0.39 ± 0.54	0-2.9
no weight loss	75 (73.5)		
weight loss 1-3 kg	27 (26.5)		
weight loss > 3kg	0 (0)		
Mobility			
bed or chair bound	2 (2.0)		
able to get out of bed or chair but does not go out	7 (6.9)		
goes out	93 (91.2)		
Psychological stress or acute disease in the past 3 months			
yes	11 (10.8)		
no	91 (89.2)		
Neuropsychological problems			
severe dementia or depression	4 (3.9)		
mild dementia	9 (8.8)		
no psychological problems	89 (87.3)		
BMI		25.5± 4.0	16.3-39.4
less than 19	2 (2.0)		
19 to less than 21	8 (7.8)		
21 to less than 23	20 (19.6)		
23 or greater	72 (70.6)		
Living independently			
yes	58 (56.9)		
no	44 (43.1)		
Takes more than 3 drugs per day			
yes	98 (96.1)		
no	4 (3.9)		
Pressure sore or skin ulcers			
yes	15 (14.7)		
no	87 (85.3)		
Number of meals per day			
1 meal	10 (9.8)		
2 meals	37 (36.3)		
3 meals	55 (53.9)		
Protein intake			
at least one serving of dairy products per day			
yes	39 (38.2)		
no	63 (61.8		

Table 4.4 (Cont.): Distribution of subjects according to MNA components (n = 102)

Components	n (%)	Mean ± SD	Range
Protein intake (Cont.)			
two or more servings of legumes/eggs per week	64 (62.7)		
yes	38 (37.3)		
no			
meat, fish, or poultry every day	89 (87.3)		
yes	13 (12.7)		
no			
Two or more servings of fruit or vegetable per day			
yes			
no	38 (37.3)		
	64 (62.7)		
Fluid (water, juice, coffee, tea, milk) consumed per day			
less than 3 cups			
3 to 5 cups	44 (43.1)		
more than 5 cups	44 (43.1)		
	14 (13.7)		
Mode of feeding			
unable to eat without assistance	0 (0)		
self-fed with some difficulty	7 (6.9)		
self-fed without any problems	95 (93.1)		
Self-view of nutritional status			
views self as being malnourished	10 (9.8)		
is uncertain of nutritional state	51 (50.0)		
views self as having no nutritional problem	41 (40.2)		
Self-compare health status with other people			
not as good	36 (35.3)		
does not know	30 (29.4)		
as good	33 (32.4)		
better	3 (2.9)		
Mid-upper arm circumference (MUAC)			
less than 21 cm	29 (28.4)		
21-22 cm	27 (26.5)		
>22 cm	46 (45.1)		
Calf circumference (CC)			
< 31 cm	56 (54.9)		
31 cm or greater	46 (45.1)		
MNA total score		21.3 ± 2.9	13.0-26.5
Malnutrition (<17)	10 (9.8)		
At risk of malnutrition (17-22)	53 (52.0)		
No malnutrition (23-30)	39 (38.2)		

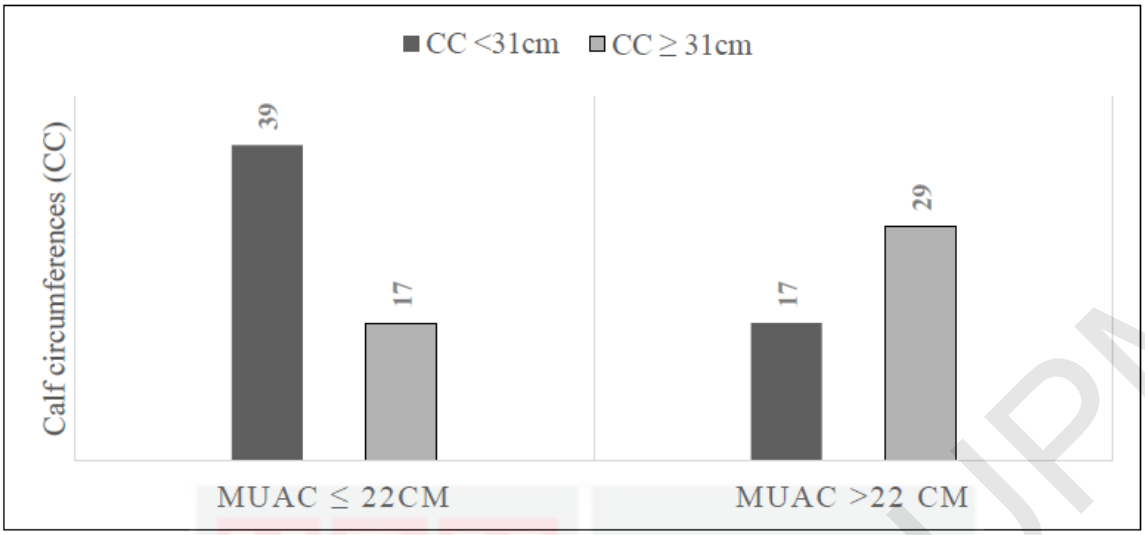

Figure 4.2. Distribution of subjects according to MUAC and calf circumference (n = 102)

4.5 Biochemical parameters

Table 4.5 depicted the distribution of subjects according to serum albumin and serum phosphorus level. Using the KDOQI threshold of albumin (40.0 g/L) (Massry et al., 2003), hypoalbuminemia was common, accounting for more than half of the subjects. The mean albumin value recorded was slightly lower as compared to national data of 38.0 g/L and the previous local studies (Khor et al., 2018; Izzaty et al., 2019). Possible factors include the suboptimal nutritional status of subjects as shown in the MNA questionnaire (slightly more than half of subjects were at risk of malnutrition), inflammation, hormonal alterations, and dialysis-related albumin loss, all of which may disrupt albumin homeostasis (Kalantar-Zadeh et al., 2021).

On the other hand, approximately 5 out of 10 subjects had elevated serum phosphorus levels (hyperphosphatemia), which was comparable with previous local study (Yusop et al., 2013). Several recent local studies have reported a higher incidence of elevated serum phosphorus (77.4-82.9%) (Mohd Isa et al., 2020; Ng et al., 2020), indicating poor compliance of dialysis patients on dietary and or phosphate binders. A possible contributing factor to these findings may be the rigidity of the low-phosphorus diet plan that greatly reduces the pleasure of eating,

makes it difficult for most patients to comply, and causes their serum phosphorus levels to soar (Kalantar-Zadeh et al., 2010). Poor compliance with phosphate binders due to sociodemographic and psychosocial factors (for example. patients' health beliefs about side effects and lack of social support) may also be one of the factors leading to high serum phosphate readings in hemodialysis subjects (Umeukeje et al., 2018).

Table 4.5: Distribution of subjects according to biochemical parameters (n = 102)

Variables	n (%)	Mean ± SD	Range
Serum albumin		37 ± 5	24-48
Low (<40 g/L)	58 (56.9)		
Normal (≥40 g/L)	44 (43.1)		
Serum phosphorus		1.8± 0.6	0.9-3.8
Normal (0.8-1.6 mmol/L)	48 (47.1)		
High (>1.6 mmol/L)	54 (52.9)		

4.6 Depression

Table 4.6 presented the distribution of subjects according to HADS-D components and depression status. Overall, the average score of HADS-D was 6.3, indicating that most of the study subjects did not perceive negative thoughts or depression. In terms of the degree of depression, 33.3% of the subjects had mild depression (with borderline abnormality scores), while approximately 9% had severe depression. The prevalence of depression was comparable to studies in other populations (Najafi et al., 2016; Othayq & Aqeeli, 2020). It was however inconsistent with that of previous studies, which reported a relatively high depression rate in HD patients ranging from 56.8% to 84.9% (Khan et al., 2019; Khan et al., 2020). The discrepancy between the studies may be attributed to different cut-offs used. The differences in subjects' demographic may partially influence the perceived depression of the subjects. In addition, the difference (perceived support from the dialysis centers, dialysis management, and others) in study settings may also partially influence the level of depression among the dialysis population.

Table 4.6: Distribution of subjects according to HADS-D components and total score (n = 102)

Components	n (%)	Mean ± SD	Range
I still enjoy the things I used to enjoy			
definitely as much	38 (37.3)		
not quite so much	40 (39.2)		
only a little	19 (18.6)		
hardly at all	5 (4.9)		
I can laugh and see the funny side of things			
as much as I always could	58 (56.9)		
not quite so much now	23 (22.5)		
definitely not so much now	14 (13.7)		
not at all	7 (6.9)		
I feel cheerful			
not at all	5 (4.9)		
not often	19 (18.6)		
sometimes	56 (54.6)		
most of the time	22 (21.6)		
I feel as if I am slowed down			
nearly all the time	3 (2.9)		
very often	16 (15.7)		
sometimes	65 (63.7)		
not at all	18 (17.6)		
I have lost interest in my appearance			
definitely	6 (5.9)		
I don't take as much care as i should	24 (23.5)		
I may not take quite as much care	34 (33.3)		
I take just as much care as eve	38 (37.3)		
I look forward with enjoyment to things			
as much as I ever did	52 (51.0)		
rather less than I used to	33 (32.4)		
definitely less than I used to	17 (16.7)		
hardly at all	0 (0)		
I can enjoy a good book or radio or TV program			
often	35 (34.3)		
sometimes	42 (41.2)		
not often	18 (17.6)		
very seldom	7 (6.9)		
HADS-D total score		6.3 ± 3.1	0-13
Level of Depression			
Normal (0-7)	59 (57.8)		
Borderline abnormal (8-10)	34 (33.3)		
Abnormal (11-21)	9 (8.8)		

The most common psychological symptoms identified by the subjects were feeling tired or slowed down (82.4%), less cheerful (78.4%), loss of interest in personal appearance (62.7%),

and loss of the feeling of enjoying the things they liked before (62.7%). This is expected when considering the fact that fatigue is one of the frequent complaints of hemodialysis patients (Picariello et al., 2018) - the consequences of which may hinder patients from participating in even simple physical and mental activities. On the other hand, more than half of the subjects were still looking forward with enjoyment to things as before and being able to discover the funny side of things. A considerable number of subjects (75.5%) often or sometimes feel enlightened by reading a good book or TV show, which indicates that preparing a book or watching videos and TV shows during dialysis treatment may help relieve negative emotions and this requires further research.

4.7 Sleep quality

Table 4.7 depicted the distribution of subjects based on sleep quality and its domains. The overall average global PSQI score of subjects was 7.3 ± 3.2, and poor sleep quality was observed in 8 out of 10 of the subjects. This once again reaffirmed the results of the previous local studies, that poor sleep quality is prevalent in the hemodialysis population (Ho et al., 2019; Ho et al., 2021; Ng et al., 2020). Although sleep disturbance (92.2%) and daytime dysfunction (68.6%) were among the most common symptoms reported by the study subjects, it is interesting that most of them still perceived that their quality of sleep was good (72.5%). There was also not much difference between sleep efficiency on HD and non-HD days, and almost half of them reported a normal sleep efficiency of 85% or above.

On the other hand, sleep latency was found to have the greatest impact on subjects (accounting for the highest mean of PSQI sub-score), whereas sleep medication had the lowest, which was in agreement with the recent local study on hemodialysis patients (Ling Ho et al., 2019). The average sleep latency reported by the normal population is between 10 to 20 minutes (Kushida, 2013). A considerable number (53.9%) of the subjects were reported to take more than 30 minutes to fall asleep. The underlying mechanism is not clear, but it may be attributed

to the common use of beta-blockers in hemodialysis patients that inhibits the secretion of nocturnal melatonin, and possibly the presence of restless leg syndrome, which causes them difficult to fall asleep (Berry & Wagner, 2014). In the current study, the use of sleep medication was relatively higher than other local studies reporting prevalences of 1.5% - 4.3% (Ho et al., 2019; Rehman et al., 2019). The discrepancies may be due to the differences in demographic characteristics and stress imposed by the Covid-19 pandemic (Mandelkorn et al., 2021), which should be delineated in future studies.

The current findings also revealed that only 18.6% of subjects slept more than 7 hours a day, which was comparable to the prevalence of 11.7 to 23.9% reported by the previous local studies (Ng et al., 2020; Rehman et al., 2019). These findings may likely be explained by the longer time it takes for the patient to fall asleep and morning dialysis shifts that often require a rise time of 3 to 4 am in the morning, which results in a shorter total sleep time among them (Cukor et al., 2021). This could be a worrying scenario when considering that most subjects did not meet the recommended sleep duration of 7 to 9 hours per night proposed by the National Sleep Foundation for an optimal physical and mental state (Hirshkowitz et al., 2015).

Table 4.7: Distribution of subjects according to sleep quality components (n = 102)

Components	n (%)	Mean ± SD	Range
Subjective sleep quality		1.2 ± 0.7	0-3
Very good	15 (14.7)		
Fairly good	59 (57.8)		
Fairly bad	24 (23.5)		
Very bad	4 (3.9)		
Sleep latency		1.5 ± 0.7	0-3
15 minutes	11(10.8)		
16-30 minutes	36 (35.3)		
31-60 minutes	51 (50.0)		
>60 minutes	4 (3.9)		
Sleep duration (hours)		1.3 ± 0.9	0-3
> 7 hours	19 (18.6)		
6-7 hours	50 (49.0)		
5-6 hours	21 (20.6)		
<5 hours	12 (11.8)		
Habitual sleep efficiency on HD day		1.1 ± 1.1	0-3
>85%	44 (43.1)		
75-84%	24 (23.5)		
65-74%	19 (18.9)		
<65%	15 (14.7)		
Habitual sleep efficiency on non-HD day		1.0 ± 1.1	0-3
>85%	46 (45.1)		
75-84%	23 (22.5)		
65-74%	17 (16.7)		
<65%	16 (15.7)		
Sleep disturbances		1.2 ± 0.6	0-2
Not during the past month	8 (7.8)		
Less than once a week	63 (61.8)		
Once or twice a week	31 (30.4)		
Three or more times a week	0 (0)		
Use of sleeping medication		0.3 ± 0.8	0-3
Not during the past month	83 (81.4)		
Less than once a week	10 (9.8)		
Once or twice a week	4 (3.9)		
Three or more times a week	5 (4.9)		
Daytime dysfunction		0.8± 0.6	0-3
Not during the past month	32 (31.4)		
Less than once a week	59 (57.8)		
Once or twice a week	10 (9.8)		
Three or more times a week	1(1.0)		
Global PSQI total score		7.3 ± 3.2	2-18
Sleep Quality			
Good sleeper (score 0-4)	20 (19.6)		
Poor sleeper (score 5-21)	82 (80.4)		

4.8 Risk of sarcopenia

Data on the risk of sarcopenia for patients undergoing hemodialysis in Malaysia are scarce. Approximately 4 out of 10 subjects were at risk of sarcopenia in the current findings, which was comparable to other studies among Asian HD patients (Kim et al., 2014; Mori et al., 2019). In local studies, there was not much difference in the prevalence of sarcopenia between dialysis and non-dialysis subjects, even if there were differences in socio-demographic characteristics and the diagnostic algorithm used (Norshafarina et al., 2013; Rosli et al., 2018; Yap et al., 2020). However, a majority of the subjects in the current study had lower functional capacity for daily activities (such as facing more difficulties in climbing stairs and carrying a weight of 4.5 kg) than the elderly without dialysis treatment (Krzymińska-Siemaszko et al., 2020; Marincolo et al., 2021). The reported functional deficits may be partly due to the suboptimal readings of their mid-arm and calf circumference (as shown in Table 4.6), as these two parameters are always linked to appendicular muscle strength and mass (Bin et al., 2016; Tsai & Chang, 2017; Ukegbu et al., 2018). It is also worth mentioning that 51% of the subjects had a fall in the past 12 months, which was higher than the previous local cross-sectional study on the non-dialysis elderly population (aged ≥ 60 year old) (Leong et al., 2020; Sahril et al., 2020). This was in agreement with a cohort study that revealed a high risk of falls after the dialysis initiation, which may be explained by the kidney disease and the treatment itself that promotes muscle loss, lower blood pressure prior to dialysis session, as well as the higher number of medications and antidepressant use (Plantinga et al., 2017).

Table 4.8: Distribution of subjects according to risk of sarcopenia (n = 102)

Components	n (%)			Mean ± SD	Range
	None	Some difficulties	A lot or unable		
Strength How much difficulty do you have in lifting and carrying 4.5 kg?	26 (25.5)	41 (40.2)	35 (34.3)		
Assistance in walking How much difficulty do you have walking across a room?	66 (64.7)	32 (31.4)	4 (3.9)		
Rise from a chair How much difficulty do you have transferring from a chair or bed?	66 (64.7)	34 (33.3)	2 (2.0)		
Climb stair How much difficulty do you have in climbing a flight of 10 stairs?	31 (30.4)	37 (36.3)	34 (33.3)		
Fall How much times have you fallen in the past year?	50 (49.0)	49 (48.0)	3 (2.9)		
SARC-F total score				3.2 ± 2.3	0 - 8
At risk of sarcopenia					
No (score <4)		63 (61.8)			
At risk (score ≥ 4)		39 (38.2)			

4.9 Hypothesis testing

$H_0$1: There were no significant correlations between risk of sarcopenia with socio-demographic characteristics among hemodialysis patients.

Correlations between socio-demographic characteristics with risk of sarcopenia were presented in Table 4.9.1. Sarcopenia occurs primarily in the elderly and its incidence usually increases exponentially with age. This statement has been reiterated by a number of studies (Furtado et al., 2020; Ren et al., 2016), suggesting that advanced age may be one of the risk factors for sarcopenia in patients with renal failure. However, the correlation between age and risk of sarcopenia in this study was not significant ($r=0.121$, $p>0.05$), which supports the claim that the magnitude of sarcopenia in CKD could differ from age-related sarcopenia (Sabatino et

al., 2020). For disease-induced sarcopenia, as in CKD, the diminished muscle mass and strength is not necessarily related to age, but may be due to other pathological conditions, including CKD and dialysis itself (Sabatino et al., 2020), chronic low-grade inflammation, and altered protein homeostasis (Cohen et al., 2014; Sabatino et al., 2020).

On the other hand, it is interesting to note that there were significant differences between ethnicity and risk of sarcopenia ($\chi 2 = 8.540$, $p<0.05$). Malays were most likely to be at risk of sarcopenia, followed by Chinese and Indians. Nevertheless, this finding was inconsistent with recent studies of non-CKD populations (Lim et al., 2020; Sazlina et al., 2020), which reported a higher prevalence of sarcopenia in Indians. The difference between the findings may be due to the heterogeneity of sociodemographic characteristics, whereby previous studies focused exclusively on sarcopenia in elderly subjects. It might also be possible that the existence of CKD disease and its treatment bring varying degrees of impact on the lifestyle, eating habits, and mental health of various ethnic groups, thereby leading to a different sarcopenia trend from studies in non-CKD populations. The small proportion of Indians in the current study may also constitute a limitation. The findings however deserve further research.

There were no significant correlations for other sociodemographic factors with sarcopenia risk, namely gender and educational level. This was in contradiction with other studies among hemodialysis patients in Brazil (Garcia et al., 2017) and London (Yoowannakul et al., 2018). The discrepancy may be subjected to racial heterogeneity, so it is worthy of further study in the local context of a complex multi-ethnic population. There was also no correlation between smoking status and the risk of sarcopenia, which was in agreement with a recent case-control study reporting that sarcopenic and robust CKD patients did not differ with regards to smoking status (Aly et al., 2019). Given that the current study is limited by the small sample size that may reduce the statistical power, further research with a larger sample size is warrant.

Table 4.9.1: Correlation between socioeconomic factors and sarcopenia risk of the subjects (n=102)

Variable	Sarcopenia risk		$\chi 2$	*r-value*	*p-value*
	No (n= 63)	At risk (n= 39)			
Age				0.121[c]	0.226
<60 years old	38 (37.3%)	20 (19.6%)	0.802[a]		0.415
≥60 years old	25 (24.5%)	19 (18.6%)			
Gender			0.018[a]		1.000
Male	38 (37.3%)	23 (22.5%)			
Female	25 (24.5%)	16 (15.7%)			
Ethnicity					
Malay	23 (22.5%)	23 (22.5%)	8.540[a]		0.013*
Chinese	33 (32.4%)	9 (8.8%)			
Indian	7 (6.9%)	7 (6.9%)			
Educational level					
No formal education	5 (4.9%)	2 (2.0%)			0.985[b]
Primary education		10 (9.8%)			
Secondary education	16 (15.7%)	23 (22.5%)			
Tertiary education	35 (34.3%)	4 (3.9%)			
	7 (6.9%)				
Smoking behavior					
Smoking status					
Non-smoker	47 (46.1%)	32 (31.4%)			0.557[b]
Past smoker	10 (9.8%)	3 (2.9%)			
Current smoker	6 (5.9%)	4 (3.9%)			
Smoking level (pack-years)			1.994[a]		0.368
No smoking	47 (46.1%)	32 (31.4%)			
Light smoking	11 (10.8%)	3 (2.9%)			
Medium smoking	5 (4.9%)	4 (3.9%)			

Note: Data were presented as n (%)

[a] Pearson Chi-square test

[b] Fisher's Exact test

[c] Pearson's Product-Moment Correlation

*Correlation is significant at $p < 0.05$

$H_0$2: There were no significant correlations between comorbidities and polypharmacy with sarcopenia risk among hemodialysis patients.

As shown in Table 4.9.2, there was no significant correlation between comorbidities and risk of sarcopenia, with the exception of diabetes ($\chi 2=14.252$, $p<0.001$). This finding was consistent with other studies (Han et al., 2017; Wang et al., 2016), where a cohort study

revealed that the presence of diabetes was an independent cause of sarcopenia in hemodialysis patients (Mori et al.,2019). The relationship between diabetes and sarcopenia has been well documented in the past literature, of which the likelihood of sarcopenia increases as HbA1c increases (Sugimoto et al., 2019). The presence of diabetes is most likely to invoke some inflammatory processes, with an elevated level of oxidative stress, serum CRP and TNF-α and therefore, favoring the development of sarcopenia (Mesinovic et al., 2019).

On the other hand, the correlation between polypharmacy (defined as taking at least five drugs) and sarcopenia risk was not evident in the current study. This finding was supported by the GLISTEN study on hospitalized elderly patients (Agosta et al., 2019) but contradicted the study done by Tanaka et al. (2018) and König et al. (2017) which the elderly subjects studied were healthier with a lower prevalence of polypharmacy and sarcopenia reported. It could be partially explained by the subjects in both the current and GLISTEN study were presented with more severe diseases and poorer nutritional status, thereby diluting the potential association between polypharmacy and sarcopenia risk. Since the previous three studies were only conducted in non-CKD elderly residents, it can be postulated that the association may vary depending on the health status of the subjects, which addresses the need for more research.

Table 4.9.2: Correlation between clinical factors and sarcopenia risk of the subjects (n=102)

Variable	Sarcopenia risk		$\chi 2$	*r-value*	*p-value*
	No (n= 63)	**At risk (n=39)**			
Comorbidities					
Diabetes mellitus	18 (17.6%)	26 (25.5%)	14.252[a]		0.000***
Cardiovascular Disease	1 (1.0%)	3 (2.9%)			0.155[b]
Hypertension	50 (49.0%)	35 (34.3%)	1.868[a]		0.274
Dyslipidemia	2 (2.0%)	1 (1.0%)			1.000[b]
Anemia	1 (1.0%)	0 (0.0%)			1.000[b]
Bone disease	1 (1.0%)	1 (1.0%)			1.000[b]
Number of medications				0.088[c]	0.379
Polypharmacy	58 (56.9%)	38 (37.3%)			0.403[b]

Note: Data were presented as n (%)
[a] Pearson Chi-square test
[b] Fisher's Exact test
[c] Pearson's Product-Moment Correlation
***Correlation is significant at p <0.001

$H_0$3: There were no significant correlations between anthropometric parameters with sarcopenia risk among hemodialysis patients.

Given that there was no significant correlation between BMI and sarcopenia risk (r=-0.009, p=0.926), whereby higher BMI may not protect hemodialysis subjects against sarcopenia, "obesity paradox" phenomenon is not valid in this case. The current results were inconsistent with previous studies that reported a significant negative correlation between BMI and sarcopenia in hemodialysis patients (Dierkes et al., 2018; Hortegal et al., 2020; Saitoh et al., 2019). The discrepancy may likely be explained by the differences in the classification of BMI and the tools used to identify sarcopenia. Besides, the use of BMI has its limitations in distinguishing the body composition including muscle mass (Nuttall, 2015). This was reiterated in a large-scale, population-based study (NHANES), reporting that obese CKD people with sarcopenia were 97% more likely to be misclassified by BMI as non-obese (Sharma et al., 2014). Therefore, BMI should be used with caution to draw conclusions about its impact on sarcopenia among CKD populations.

There was no significant correlation between unintentional weight loss and the risk of sarcopenia. This finding was inconsistent with previous studies that documented an association between unintentional weight loss and poor functional status (Arnold et al., 2010; Polonsky et al., 2019). The disparity in finding may be explained by the differences in baseline characteristics of the subjects, of which none were on hemodialysis treatments in the previous studies. The small magnitude of weight changes in the current study may also limit the ability to establish a significant association. To date, this is the first study investigating the relationship between unintentional weight loss and the risk of sarcopenia among hemodialysis subjects. Further study is needed to draw a conclusion on this relationship.

Table 4.9.3: Correlation between anthropometric factors and sarcopenia risk of the subjects (n=102)

Variable	Sarcopenia risk		$\chi 2$	*r-value*	*p-value*
	No (n= 63)	At risk (n= 39)			
BMI values				-0.009[c]	0.926
<23	19 (18.6%)	11 (10.8%)	0.487[a]		0.807
23-29.9	35 (34.3%)	24 (23.5%)			
⩾30	9 (8.8%)	4 (3.9%)			
Unintentional weight loss				-0.069[c]	0.490
No weight loss	47 (46.1%)	28 (27.5%)	0.098[a]		0.819
weight loss between 1 and 3kg	16 (15.7%)	11 (10.8%)			

Note: Data were presented as n (%)
[a] Pearson Chi-square test
[c] Pearson's Product-Moment Correlation

$H_0$4: There were no significant correlations between biochemical parameters with sarcopenia risk among hemodialysis patients.

Studies on the association or correlation between serum albumin and sarcopenia in CKD were limited and yielded inconsistent and mixed findings. While the previous literature showed no association between these two variables (De Souza et al., 2017; Marini et al., 2018), a recent study among HD patients revealed that sarcopenia patients had significantly lower serum albumin in comparison to their counterparts (Mori et al., 2019). The discrepancies of these findings might be attributed to the methodological heterogeneity (diagnostic criteria used to define sarcopenia) as well as the differences in the baseline characteristic of the studied subjects. A weak negative correlation between serum albumin and sarcopenia risk was evident in the current study ($r=-0.295$, $p<0.01$), indicating that the lower the serum albumin, the higher the risk of sarcopenia. There were some possible explanations for this. Serum albumin exists as a carrier of many hormones, among which androgens can increase the number of myonuclei and satellite cells (Seo et al., 2019). In addition, hypoalbuminemia is often related to malnutrition and underlying inflammation in the CKD population, which are factors that cause sarcopenia (Mukai et al., 2018).

On the other hand, there was no significant correlation between serum phosphorus and risk of sarcopenia (r=0.156, p>0.05), which was consistent with the cross-sectional study of HD subjects in Egypt, despite different diagnostic criteria (i.e. EWGS criteria) was adopted and most of the studied subjects were relatively younger (Zaky & Abdallah., 2019). This finding was however inconsistent with Ren et al. (2016), and Sonou et al. (2020), at which the latter discussed the role of hyperphosphatemia in muscle atrophy, indicating that this connection could be driven by the up-regulation of myostatin expression. A large-scale, population-based study (National Health and Nutrition Examination Survey) revealed that the significant association between phosphate and muscle strength only existed in the age group over 65 (Chen et al., 2018). This may explain the differences between the studies, as the current study consisted of both young and old people. High quartile serum phosphorus is more likely to predict the presence of dynapenia (loss of muscle strength) rather than sarcopenia (Chen et al., 2018). More studies are needed in the future to delineate the relationship between serum phosphorus and sarcopenia risk among hemodialysis patients, especially in the local context.

Table 4.9.4: Correlation between biochemical factors and sarcopenia risk of the subjects (n=102)

Variable	Sarcopenia risk		$\chi 2$	*r-value*	*p-value*
	No (n= 63)	**At risk (n=39)**			
Serum albumin				-0.295[c]	0.003**
Low (<40 g/L)	32 (31.4%)	26 (25.5%)	2.474[a]		0.151
Normal (≥40 g/L)	31 (30.4%)	13 (12.7%)			
Serum phosphorus				-0.156[c]	0.117
Normal (1.13-1.78 mmol/L)	27 (26.5%)	21 (20.6%)	1.168[a]		0.312
High (>1.78 mmol/L)	36 (35.3%)	18 (17.6%)			

Note: Data were presented as n (%)

[a] Pearson Chi-square test

[c] Pearson's Product-Moment Correlation

**Correlation is significant at p <0.01

$H_0$5: There was no significant correlation between nutritional status with sarcopenia risk among hemodialysis patients.

A review of previous literature showed that nutritional status was significantly related to the incidence of sarcopenia (Beaudart et al., 2019; Giglio et al., 2018; Hai et al., 2017; Velázquez-Alva et al., 2019), which was consistent with the current findings. A moderate negative correlation between MNA total score and SARC-F score was documented (r=-0.450, p<0.001), indicating that the poorer the nutritional status of hemodialysis subjects, the higher the risk of sarcopenia. These findings may be explained by the fact that lack of intake or uptake of certain nutrients (such as proteins, vitamin D, and calcium) could aggravate skeletal muscle loss, thereby contributing to the onset of sarcopenia (Landi et al., 2019). Besides, considering that adverse consequences of increasing dietary protein intake in HD patients may increase the risk of hyperphosphatemia, this constitutes a greater obstacle for this population to achieve the recommended protein amount of 1.2 g/kg/day (Kalantar-Zadeh et al., 2021). This was supported by the current findings showing that a certain number of subjects did not eat meat or fish every day (12.7%), nor did they eat eggs or legumes twice a week (37.3%). Given that adequate protein intake plays an important role in maintaining good nutritional status and muscle quality (Hendriks et al., 2021), it is important to provide HD patients with appropriate nutritional measures while maintaining ideal serum phosphate levels.

Table 4.9.5: Correlation between nutritional status and sarcopenia risk among the subjects (n=102)

Variable	Sarcopenia risk		$\chi 2$	*r-value*	*p-value*
	No (n= 63)	**At risk (n=39)**			
MNA total score				-0.450[c]	0.000***
Malnutrition (<17)	2 (2.0%)	8 (7.8%)	11.421[a]		0.003**
At risk of malnutrition (17-22)	31 (30.4%)	22 (21.6%)			
No malnutrition (23-30)	30 (29.4%)	9 (8.8%)			

Note: Data were presented as n (%)
[a] Pearson Chi-square test
[c] Pearson's Product-Moment Correlation
**Correlation is significant at p <0.01
***Correlation is significant at p <0.001

$H_0$6: There was no significant correlation between depression with sarcopenia risk among hemodialysis patients.

There was a moderate positive association between the total HADS-D score and the risk of sarcopenia among the subjects (r = 0.552, p = 0.000). This was in congruence with a study conducted among Korean subjects over the age of 50, suggesting that depression could be another pathogenic factor of sarcopenia in patients with renal failure (Kim et al., 2014). Moreover, a recent cross-sectional study also found that depressed mood could significantly decrease the appendicular muscle mass of hemodialysis patients (Alston et al., 2018). While the mechanism of this interaction is unclear, it is likely that the development of depression, along with its altered inflammatory responses (Kim et al., 2014), may contribute to the loss of muscle mass in an individual. People with depression may also be engaged in high levels of sedentary behaviors, which could be a stumbling block to maintaining muscle quality (Stubbs et al., 2018).

Table 4.9.6: Correlation between depression and sarcopenia risk of the subjects (n=102)

Variable	Sarcopenia risk		$\chi 2$	*r-value*	*p-value*
	No (n= 63)	**At risk (n=39)**			
HADS-D total score				0.552[c]	0.000***
Level of Depression			20.063[a]		0.000***
Normal (0-7)	47 (46.1%)	12 (11.8%)			
Borderline abnormal (8-10)	14 (13.7%)	20 (19.6%)			
Abnormal (11-21)	2 (2.0%)	7 (6.9%)			

Note: Data were presented as n (%)
[a] Pearson Chi-square test
[c] Pearson's Product-Moment Correlation
***Correlation is significant at p <0.001

$H_0$7: There were no significant correlations between sleep quality and its components with sarcopenia risk among hemodialysis patients.

As shown in Table 4.9.7, there was a weak positive correlation between sleep quality and the risk of sarcopenia among hemodialysis subjects ($r=0.198$, $p<0.05$), indicating that the better the sleep quality, the lower the risk of sarcopenia. While study investigating this relationship is lacking in the hemodialysis population, the current findings were consistent with studies on both the non-CKD middle-aged (age range 45-65 years old) (Lucassen et al., 2017) and elderly subjects (age range 65-80 years old) (Tuna et al., 2019). The underlying mechanism of such association remains unclear but may be explained by several hypotheses. Hormonal regulation may be different in those with poorer sleep quality, where the up-regulation of catabolic hormones (cortisol) and the down-regulation of anabolic hormones (IGF-1 and testosterone) could lead to a trend of decreased muscle protein synthesis (Rusch et al., 2015; Séverine Lamon et al., 2021). In rodent studies, the possible causal relationship between sleep deprivation and protein metabolism disorders had been determined, suggesting that the presence of sleep deprivation may attenuate protein synthesis pathways and increase muscle proteolytic activity, thereby resulting in a decrease in muscle fiber cross-sectional area (Dattilo et al., 2012; De Sá Souza et al., 2016). In addition, impaired sleep quality may also activate pro-inflammatory processes, which has been shown to be related to sarcopenia through the proteolytic pathways (D'Antono & Bouchard, 2019; Lee et al., 2020).

Subjects with more frequent sleep disturbances were significantly correlated with a higher risk of sarcopenia ($r=0.210$, $p<0.05$). Given the limited resources available, the exact mechanism of how sleep disturbances may affect muscle quality is unclear. It is speculated that frequent sleep disturbances (such as feeling pain, having nightmares, urinating at night, etc.) may prevent the body from entering deeper sleep stages (stages III and IV) where the secretion of crucial muscle growth hormone typically occurs (Harding & Feldman, 2008), thereby

leading to a greater risk of sarcopenia. However, more research is warranted to confirm such speculation.

Daytime dysfunction was positively associated with sarcopenia risk ($r=0.344$, $p<0.001$). This finding was comparable with recent studies (Locquet et al., 2018; Soysal et al., 2021). One plausible explanation is the presence of daytime dysfunction (i.e. daytime sleepiness and fatigue) promotes sedentarism among the subjects and they spend more time in bed during the day, thereby increasing the risk of sarcopenia (Noda et al., 2017). To maintain better muscle quality, there must be an integration of physical activity and adequate protein intake; the lack of either could weaken the effect (Carbone & Pasiakos, 2019; Deutz et al., 2014).

On the other hand, sleep duration was not associated with the risk of sarcopenia, which was not in line with other studies. Similarly, there were no significant associations between subjective sleep quality, sleep latency, use of sleep medication, and habitual sleep efficiency (on HD and non-HD day) with the risk of sarcopenia. Earlier works showed that people with short or long sleep lengths were more likely to have signs or symptoms of sarcopenia (Chien et al., 2015; Fex et al., 2012; Kim et al., 2018; Hu et al., 2017). While the earlier study found that sleep latency was significantly associated with the incidence of sarcopenia, this association could be altered when different definitions of sarcopenia are adopted (Locquet et al., 2018). For this reason, the difference between the findings may be interpreted as different methods of diagnosis were used in literature which limits the direct comparison.

Table 4.9.7: Correlation between sleep quality components and sarcopenia risk of the subjects (n=102)

Components	Sarcopenia risk		χ2	*r-value*	*p-value*
	No (n=63)	At risk (n=39)			
Subjective sleep quality				0.141[c]	0.158
Good	45 (44.1%)	29 (28.4%)	0.104[a]		0.822
Bad	18 (17.6%)	10 (9.8%)			
Sleep latency				0.194[c]	0.051
Yes	54 (52.9%)	37 (36.3%)			0.198[b]
Sleep duration (hours)				0.033[c]	0.743
≤ 6 hours	38 (37.3%)	23 (22.5%)	0.018[a]		1.000
> 6 hours	25 (24.5%)	16 (15.7%)			
Habitual sleep efficiency (HD)				0.023[c]	0.816
≥ 85%	25 (24.5%)	19 (18.6%)	0.802[a]		0.415
< 85%	38 (37.3%)	20 (19.6%)			
Habitual sleep efficiency (non-HD)				0.032[c]	0.749
≥ 85%	28 (27.5%)	18 (17.6%)	0.028[a]		1.000
< 85%	35 (34.3%)	21 (20.6%)			
Sleep disturbances				0.210[c]	0.034*
Yes	56 (54.9%)	38 (37.3%)			0.150[b]
Use of sleeping medication				-0.048[d]	0.633
Yes	12 (11.8%)	7 (6.9%)	0.019[a]		1.000
Daytime dysfunction				0.344[c]	0.000***
Yes	39 (38.2%)	31 (30.4%)	3.459[a]		0.080*
Global PSQI total score				0.198[c]	0.046*
Sleep Quality					
Good sleeper (score 0-4)	16 (15.7%)	4 (3.9%)	3.503[a]		0.075
Poor sleeper (score 5-21)	47 (46.1%)	35 (34.3%)			

Note: Data were presented as n (%)

[\a] Pearson Chi-square test

[b] Fisher's Exact test

[c] Pearson's Product-Moment Correlation

[d] Spearman's Rank Correlation

*Correlation is significant at p <0.05

***Correlation is significant at p <0.001

CHAPTER 5

CONCLUSION, STRENGTHS, LIMITATIONS AND RECOMMENDATIONS

5.1 Conclusion

In conclusion, a considerable proportion of local hemodialysis patients were at risk of sarcopenia, which is an issue worthy of attention. The risk of sarcopenia varies by race/ethnicity, with Malays having the highest risk and Indians the lowest. Interestingly, there was no significant correlation between the risk of sarcopenia and age, which magnifies the difference between disease-related sarcopenia (secondary type) and senile sarcopenia (primary type). On the other hand, the current findings have drawn attention to the possible role of diabetes in the development of sarcopenia in hemodialysis patients, given the significant correlation found between the two variables. The same is true for serum albumin, an indicator of nutritional status and inflammatory responses. Hypoalbuminemia and hyperphosphatemia are common in hemodialysis patients, although the latter was not significantly associated with the risk of sarcopenia. Regular dietary consultations should be conducted to address possible nutritional problems or poor dietary compliance in hemodialysis patients to overcome the above-mentioned biochemical abnormalities.

Higher BMI may not protect hemodialysis patients from sarcopenia. However, considering that a substantial proportion of hemodialysis patients in this study had BMI lower than the recommendation, which may reduce their survival advantage, it should be regularly evaluated and monitored. The unintentional weight loss of hemodialysis patients is worthy of further attention. On the other hand, it is worth mentioning approximately one in three obese patients had sarcopenia. This is the first study documenting sarcopenia obesity among HD patients in Malaysia. In light of the possible consequences of sarcopenic obesity, more studies are warranted.

The correlation between nutritional status and the risk of sarcopenia was evident in the current study. Given that slightly more than half of the hemodialysis subjects were at risk of malnutrition, appropriate nutritional interventions should be introduced. The adequacy of dietary protein, fiber intake, and meal skipping practices should also be highlighted for dietitians when assessing the nutritional status of hemodialysis patients.

Besides, the risk of sarcopenia may vary depending on the presence of depression. The question as to which diseases occur first in patients with comorbid depression and sarcopenia is still not fully understood. However, whether it is depression that precedes sarcopenia or loss of muscle quantity and quality resulting in depression mood, screening of these two conditions is critical for HD patients as early treatment plans may improve their quality of life. It is worthwhile to further study how different types of dialysis sectors (public, NGO, or private) affect the incidence of depression in this population.

A majority of hemodialysis subjects were poor sleepers. The results of the current study indicate that the public should be made aware of the negative effects of poor sleep quality on sarcopenia, especially in hemodialysis patients. Few components of sleep quality are related to

the risk of sarcopenia; however, the mechanisms behind them have not yet been determined and should be delineated in future research.

To date, this was the first study identifying the risk of sarcopenia in the local hemodialysis patient. It is good to know that sarcopenia is partially reversible. Structural physical exercise during hemodialysis should be recommended to this population as it is easy to follow and helps maintain the quantity and quality of muscles.

5.2 Strength

Given that this was the first study in Malaysia to investigate the risk of sarcopenia in patients on hemodialysis, it has the merit of providing data on a domain for which little is known. The sociodemographic background of the subjects in this study was comparable to that of the national data, so it was able to reflect the situation of hemodialysis patients in Malaysia. Besides, instructional videos (for MUAC and calf circumference measurements) were made for data collection to minimize biases associated with self-administered questionnaires, which also highlighted the feasibility of telemedicine in future studies or during pandemics. Last but not least, the inclusion criteria and exclusion criteria of the subjects were well-considered and written clearly to ensure proper purposive sampling.

5.3 Limitations

There were several limitations to this study. First, owing to its cross-sectional design, the current study failed to identify the causal relationship between sarcopenia risk and the various influencing factors. Adjustments to confounding factors were also not taken into account in this study, which may obscure the actual association. Second, the use of self-administered matter in data collection is highly dependent on the subjects' honesty and literacy level, and there may be cases where subjects tend to provide socially desirable answers. Anthropometric parameters namely calf circumference and mid-upper arm circumferences were measured by family

members of patients in the absence of non-stretchable fiberglass measuring tape, which was another big challenge of the present study. However, this was the only possible and safest way to conduct a study during a pandemic in which social distancing measures were implemented. The creation of videos showing crystal clear step-by-step instructions on how calf circumference and mid-upper arm circumferences were intended to reduce the error of measurement. Third, the data was only collected from dialysis centers in one state (Perak), so the study outcomes may not be generalized to the entire hemodialysis population in Malaysia. Lastly, the existing cut-off point for screening sarcopenia in the elderly was used in this study as there is no specific cut-off for sarcopenia for the CKD population, this may constitute a limitation of this study.

5.4 Recommendations

A large-scale study involving subjects from different states should be conducted locally to confirm the findings of the current research. Moreover, the causal relationship between the putative risk factors and sarcopenia should also be investigated. In order to improve data quality and accuracy, it is more preferable to adopt methods such as telephone surveys or face-to-face interviews for data collection when conditions permit. The research field of CKD-related sarcopenia is still in its infancy, with currently no specific cut-off value defined for sarcopenia in the CKD population. As sarcopenia was found to be prevalent in hemodialysis patients, this study emphasized the need not only to develop appropriate guidelines to screen for sarcopenia in hemodialysis populations but also to formulate structured measures (i.e. combination of exercise and an adequate nutritional intake) for the prevention and treatment of sarcopenia. The problem of sarcopenic obesity is also worthy of more attention from healthcare providers and researchers considering that it may bring a higher risk of CVD events to patients.

REFERENCES

2018 USRDS Annual Data Report: Executive Summary. (2019). *American Journal of Kidney Diseases*. https://doi.org/10.1053/j.ajkd.2019.01.002

Adams, S. V., Rivara, M., Streja, E., Cheung, A. K., Arah, O. A., Kalantar-Zadeh, K., & Mehrotra, R. (2017). Sex differences in hospitalizations with maintenance hemodialysis. Journal of the American Society of Nephrology. https://doi.org/10.1681/ASN.2016090986

Adult Tobacco Use - Glossary. (2017). *National Center for Health Statistics.* Retrieved from https://www.cdc.gov/nchs/nhis/tobacco/tobacco_glossary.htm

Agosta, L., Bo, M., Bianchi, L., Abete, P., Belelli, G., Cherubini, A., Corica, F., Di Bari, M., Maggio, M., Manca, G. M., Rizzo, M. R., Rossi, A., Landi, F., Volpato, S., Brombo, G., Ortolani, B., Savino, E., Maietti, E., Fisichella, A., … Carrier, B. (2019). Polypharmacy and sarcopenia in hospitalized older patients: results of the GLISTEN study. *Aging Clinical and Experimental Research*. https://doi.org/10.1007/s40520-019-01136-3

Akishita, M., Kozaki, K., Iijima, K., Tanaka, T., Shibasaki, K., Ogawa, S., & Arai, H. (2018). Chapter 1 Definitions and diagnosis of sarcopenia. *Geriatrics and Gerontology International*. https://doi.org/10.1111/ggi.13311

Alex, D., Fauzi, A. B., & Mohan, D. (2021). Online Multi-Domain Geriatric Health

Screening in Urban Community Dwelling Older Malaysians: A Pilot Study . In *Frontiers in Public Health* (Vol. 8, p. 1021). https://www.frontiersin.org/article/10.3389/fpubh.2020.612154

Alshamrani, M., Almalki, A., Qureshi, M., Yusuf, O., & Ismail, S. (2018). Polypharmacy and Medication-Related Problems in Hemodialysis Patients: A Call for Deprescribing. *Pharmacy*. https://doi.org/10.3390/pharmacy6030076

Alston, H., Burns, A., & Davenport, A. (2018). Loss of appendicular muscle mass in haemodialysis patients is associated with increased self-reported depression, anxiety and lower general health scores. *Nephrology*. https://doi.org/10.1111/nep.13075

Alves, F. C., Sun, J., Qureshi, A. R., Dai, L., Snaedal, S., Bárány, P., Heimbürger, O., Lindholm, B., & Stenvinkel, P. (2018). The higher mortality associated with low serum albumin is dependent on systemic inflammation in end-stage kidney disease. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0190410

Aly, S., Tawfik, H., Bichari, W., El-Sadany, M., & El Banouby, M. (2019). Sarcopenia and Risk of Falls in Patients with Chronic Kidney Disease, a Meet of Three Geriatric Giants. *The Egyptian Journal of Geriatrics and Gerontology*. https://doi.org/10.21608/ejgg.2019.30889

Amarya, S., Singh, K., & Sabharwal, M. (2018). Ageing Process and Physiological Changes. In *Gerontology*. https://doi.org/10.5772/intechopen.76249

Andersson, G., Kaldo-Sandström, V., Ström, L., & Strömgren, T. (2003). Internet administration of the Hospital Anxiety and Depression Scale in a sample of tinnitus patients. *Journal of Psychosomatic Research*. https://doi.org/10.1016/S0022-3999(02)00575-5

Anker, S. D., Morley, J. E., & von Haehling, S. (2016). Welcome to the ICD-10 code for sarcopenia. In *Journal of Cachexia, Sarcopenia and Muscle*. https://doi.org/10.1002/jcsm.12147

Antunes, S. A., Canziani, M. E. F., Campos, A. F., & Vilela, R. Q. B. (2016). Hypoalbuminemia seems to be associated with a higher rate of hospitalization in hemodialysis patients. *Jornal Brasileiro de Nefrologia : 'orgao Oficial de Sociedades Brasileira e Latino-Americana de Nefrologia*. https://doi.org/10.5935/0101-2800.20160011

Arnold, A. M., Newman, A. B., Cushman, M., Ding, J., & Kritchevsky, S. (2010). Body weight dynamics and their association with physical function and mortality in older adults: The cardiovascular health study. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences*. https://doi.org/10.1093/gerona/glp050

Arshad, A. R., Jamal, S., & Amanullah, K. (2020). Agreement Between Two Nutritional Assessment Scores as Markers of Malnutrition in Patients with End-stage Renal Disease. *Cureus*. https://doi.org/10.7759/cureus.7429

Auyeung, T. W., Lee, S. W. J., Leung, J., Kwok, T., & Woo, J. (2014). Age-associated decline of muscle mass, grip strength and gait speed: A 4-year longitudinal study of 3018 community-dwelling older Chinese. *Geriatrics and Gerontology International*. https://doi.org/10.1111/ggi.12213

Bachettini, N. P., Bielemann, R. M., Barbosa-Silva, T. G., Menezes, A. M. B., Tomasi, E., & Gonzalez, M. C. (2020). Sarcopenia as a mortality predictor in community-dwelling older adults: a comparison of the diagnostic criteria of the European Working Group on Sarcopenia in Older People. European Journal of Clinical Nutrition.

https://doi.org/10.1038/s41430-019-0508-8

Bahat, G., Yilmaz, O., Kiliç, C., Oren, M. M., & Karan, M. A. (2018). Performance of SARC-F in Regard to Sarcopenia Definitions, Muscle Mass and Functional Measures. *Journal of Nutrition, Health and Aging*. https://doi.org/10.1007/s12603-018-1067-8

Battistella, M., Jandoc, R., Ng, J. Y., McArthur, E., & Garg, A. X. (2018). A Province-wide, Cross-sectional Study of Demographics and Medication Use of Patients in Hemodialysis Units Across Ontario. *Canadian Journal of Kidney Health and Disease*. https://doi.org/10.1177/2054358118760832

Beaudart, C., Rizzoli, R., Bruyère, O., Reginster, J. Y., & Biver, E. (2014). Sarcopenia: Burden and challenges for public health. *Archives of Public Health*, *72*(1), 1–8. https://doi.org/10.1186/2049-3258-72-45

Beaudart, C., Sanchez-Rodriguez, D., Locquet, M., Reginster, J. Y., Lengelé, L., & Bruyère, O. (2019). Malnutrition as a strong predictor of the onset of sarcopenia. *Nutrients*. https://doi.org/10.3390/nu11122883

Benjumea, A. M., Curcio, C. L., Duque, G., & Gómez, F. (2018). Dynapenia and sarcopenia as a risk factor for disability in a falls and fractures clinic in older persons. *Open Access Macedonian Journal of Medical Sciences*. https://doi.org/10.3889/OAMJMS.2018.087

Berry, R. B., & Wagner, M. H. (2014). Sleep Medicine Pearls. In Sleep Medicine Pearls. https://doi.org/10.1016/C2012-0-03542-9

Bikbov, B., Purcell, C. A., Levey, A. S., Smith, M., Abdoli, A., Abebe, M., Adebayo, O. M., Afarideh, M., Agarwal, S. K., Agudelo-Botero, M., Ahmadian, E., Al-Aly, Z., Alipour, V., Almasi-Hashiani, A., Al-Raddadi, R. M., Alvis-Guzman, N., Amini, S., Andrei, T., Andrei, C. L., … Murray, C. J. L. (2020). Global, regional, and national burden of

chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, *395*(10225), 709–733. https://doi.org/10.1016/S0140-6736(20)30045-3

Bravo-José, P., Moreno, E., Espert, M., Romeu, M., Martínez, P., & Navarro, C. (2018). Prevalence of sarcopenia and associated factors in institutionalised older adult patients. *Clinical Nutrition ESPEN*. https://doi.org/10.1016/j.clnesp.2018.05.008

Bredella, M. A. (2017). Sex differences in body composition. In *Advances in Experimental Medicine and Biology*. https://doi.org/10.1007/978-3-319-70178-3_2

Brennan-Olsen, S. L., Vogrin, S., Balogun, S., Wu, F., Scott, D., Jones, G., Hayes, A., Phu, S., Duque, G., Beauchamp, A., Talevski, J., Naureen, G., & Winzenberg, T. M. (2020). Education, occupation and operational measures of sarcopenia: Six years of Australian data. *Australasian Journal on Ageing*, *n/a*(n/a). https://doi.org/10.1111/ajag.12816

Budui, S. L., Rossi, A. P., & Zamboni, M. (2015). The pathogenetic bases of sarcopenia. In *Clinical Cases in Mineral and Bone Metabolism*. https://doi.org/10.11138/ccmbm/2015.12.1.022

Bujang, Mohamad A., Musa, R., Liu, W. J., Chew, T. F., Lim, C. T. S., & Morad, Z. (2015). Depression, anxiety and stress among patients with dialysis and the association with quality of life. *Asian Journal of Psychiatry*. https://doi.org/10.1016/j.ajp.2015.10.004

Bujang, Mohamad Adam, Adnan, T. H., Hashim, N. H., Mohan, K., Kim Liong, A., Ahmad, G., Bak Leong, G., Bavanandan, S., & Haniff, J. (2017). Forecasting the Incidence and Prevalence of Patients with End-Stage Renal Disease in Malaysia up to the Year 2040. *International Journal of Nephrology*, *2017*. https://doi.org/10.1155/2017/2735296

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The

Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*. https://doi.org/10.1016/0165-1781(89)90047-4

Cabrera, V. J., Hansson, J., Kliger, A. S., & Finkelstein, F. O. (2017). Symptom management of the patient with CKD: The role of dialysis. *Clinical Journal of the American Society of Nephrology*. https://doi.org/10.2215/CJN.01650216

Cabrerizo, S., Cuadras, D., Gomez-Busto, F., Artaza-Artabe, I., Marín-Ciancas, F., & Malafarina, V. (2015). Serum albumin and health in older people: Review and meta analysis. In *Maturitas*. https://doi.org/10.1016/j.maturitas.2015.02.009

Campbell, K. L., & MacLaughlin, H. L. (2010). Unintentional weight loss is an independent predictor of mortality in a hemodialysis population. *Journal of Renal Nutrition*. https://doi.org/10.1053/j.jrn.2010.04.003

Capizzi, I., Teta, L., Vigotti, F. N., Tognarelli, G., Consiglio, V., Scognamiglio, S., & Piccoli, G. B. (2017). Weight Loss in Advanced Chronic Kidney Disease: Should We Consider Individualised, Qualitative, ad Libitum Diets? A Narrative Review and Case Study. Nutrients. https://doi.org/10.3390/nu9101109

Çelik, G., Oc, B., Kara, I., Yilmaz, M., Yuceaktas, A., & Apiliogullari, S. (2011). Comparison of nutritional parameters among adult and elderly hemodialysis patients. *International Journal of Medical Sciences*. https://doi.org/10.7150/ijms.8.628

Chan, L., Tummalapalli, S. L., Ferrandino, R., Poojary, P., Saha, A., Chauhan, K., & Nadkarni, G. N. (2017). The Effect of Depression in Chronic Hemodialysis Patients on Inpatient Hospitalization Outcomes. *Blood Purification*. https://doi.org/10.1159/000452750

Chan, Y. M., Mohd Shariff, Z., Lim, C.T.S, & Goh, B. L. (2019). Factors associated with

poor nutritional status among hemodialysis patients in Malaysia. *Malaysian Journal of Medicine and Health Sciences*, *15*(SP1), 77–83.

Chang, T. I., Ngo, V., Streja, E., Chou, J. A., Tortorici, A. R., Kim, T. H., Kim, T. W., Soohoo, M., Gillen, D., Rhee, C. M., Kovesdy, C. P., & Kalantar-Zadeh, K. (2017). Association of body weight changes with mortality in incident hemodialysis patients. *Nephrology Dialysis Transplantation*. https://doi.org/10.1093/ndt/gfw373

Chen, L.-K., Liu, L.-K., Woo, J., Assantachai, P., Auyeung, T.-W., Bahyah, K. S., Chou, M.-Y., Chen, L.-Y., Hsu, P.-S., Krairit, O., Lee, J. S. W., Lee, W.-J., Lee, Y., Liang, C.-K., Limpawattana, P., Lin, C.-S., Peng, L.-N., Satake, S., Suzuki, T., … Arai, H. (2014). Sarcopenia in Asia: Consensus Report of the Asian Working Group for Sarcopenia. *Journal of the American Medical Directors Association*, *15*(2), 95–101. https://doi.org/https://doi.org/10.1016/j.jamda.2013.11.025

Chen, L. K., Lee, W. J., Peng, L. N., Liu, L. K., Arai, H., & Akishita, M. (2016). Recent Advances in Sarcopenia Research in Asia: 2016 Update From the Asian Working Group for Sarcopenia. In *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2016.05.016

Chen, L. K., Woo, J., Assantachai, P., Auyeung, T. W., Chou, M. Y., Iijima, K., Jang, H. C., Kang, L., Kim, M., Kim, S., Kojima, T., Kuzuya, M., Lee, J. S. W., Lee, S. Y., Lee, W. J., Lee, Y., Liang, C. K., Lim, J. Y., Lim, W. S., … Arai, H. (2020). Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2019.12.012

Chen, L., Sheng, Y., Qi, H., Tang, T., Yu, J., & Lv, S. (2020). Correlation of sarcopenia and

depressive mood in older community dwellers: A cross-sectional observational study in China. *BMJ Open*. https://doi.org/10.1136/bmjopen-2020-038089

Chen, Y. Y., Kao, T. W., Chou, C. W., Wu, C. J., Yang, H. F., Lai, C. H., Wu, L. W., & Chen, W. L. (2018). Exploring the Link between Serum Phosphate Levels and Low Muscle Strength, Dynapenia, and Sarcopenia. *Scientific Reports*. https://doi.org/10.1038/s41598-018-21784-1

Chien, M. Y., Wang, L. Y., & Chen, H. C. (2015). The Relationship of Sleep Duration with Obesity and Sarcopenia in Community-Dwelling Older Adults. *Gerontology*. https://doi.org/10.1159/000371847

Cobo, G., Hecking, M., Port, F. K., Exner, I., Lindholm, B., Stenvinkel, P., & Carrero, J. J. (2016). Sex and gender differences in chronic kidney disease: Progression to end-stage renal disease and haemodialysis. In *Clinical Science*. https://doi.org/10.1042/CS20160047

Coen, P. M., Musci, R. V., Hinkley, J. M., & Miller, B. F. (2019). Mitochondria as a target for mitigating sarcopenia. In *Frontiers in Physiology*. https://doi.org/10.3389/fphys.2018.01883

Cohen, S., Nathan, J. A., & Goldberg, A. L. (2014). Muscle wasting in disease: Molecular mechanisms and promising therapies. In *Nature Reviews Drug Discovery*. https://doi.org/10.1038/nrd4467

Cronly, J., Duff, A. J., Riekert, K. A., Perry, I. J., Fitzgerald, A. P., Horgan, A., Lehane, E., Howe, B., Chroinin, M. N., & Savage, E. (2018). Online versus paper-based screening for depression and anxiety in adults with cystic fibrosis in Ireland: A cross-sectional exploratory study. *BMJ Open*. https://doi.org/10.1136/bmjopen-2017-019305

Cruz-Jentoft, A. J., Baeyens, J. P., Bauer, J. M., Boirie, Y., Cederholm, T., Landi, F., Martin, F. C., Michel, J. P., Rolland, Y., Schneider, S. M., Topinková, E., Vandewoude, M., & Zamboni, M. (2010). Sarcopenia: European consensus on definition and diagnosis. *Age and Ageing*. https://doi.org/10.1093/ageing/afq034

Cruz-Jentoft, A. J., Bahat, G., Bauer, J., Boirie, Y., Bruyère, O., Cederholm, T., Cooper, C., Landi, F., Rolland, Y., Sayer, A. A., Schneider, S. M., Sieber, C. C., Topinkova, E., Vandewoude, M., Visser, M., Zamboni, M., Bautmans, I., Baeyens, J. P., Cesari, M., … Schols, J. (2019). Sarcopenia: Revised European consensus on definition and diagnosis. *Age and Ageing*, *48*(1), 16–31. https://doi.org/10.1093/ageing/afy169

Cruz-Jentoft, A. J., Landi, F., Schneider, S. M., Zúñiga, C., Arai, H., Boirie, Y., Chen, L. K., Fielding, R. A., Martin, F. C., Michel, J., Sieber, C., Stout, J. R., Studenski, S. A., Vellas, B., Woo, J., Zamboni, M., & Cederholm, T. (2014). Prevalence of and interventions for sarcopenia in ageing adults: A systematic review. Report of the International Sarcopenia Initiative (EWGSOP and IWGS). *Age and Ageing*. https://doi.org/10.1093/ageing/afu115

Cukor, D., Unruh, M., McCurry, S. M., & Mehrotra, R. (2021). The challenge of insomnia for patients on haemodialysis. In Nature Reviews Nephrology. https://doi.org/10.1038/s41581-021-00396-5

D'alessandro, C., Piccoli, G. B., Barsotti, M., Tassi, S., Giannese, D., Morganti, R., & Cupisti, A. (2018). Prevalence and correlates of sarcopenia among elderly CKD outpatients on tertiary care. *Nutrients*. https://doi.org/10.3390/nu10121951

D'Antono, B., & Bouchard, V. (2019). Impaired sleep quality is associated with concurrent elevations in inflammatory markers: Are post-menopausal women at greater risk?

Biology of Sex Differences. https://doi.org/10.1186/s13293-019-0250-x

Dattilo, M., Antunes, H. K. M., Medeiros, A., Mônico-Neto, M., de SáSouza, H., Lee, K. S., Tufik, S., & de Mello, M. T. (2012). Paradoxical sleep deprivation induces muscle atrophy. *Muscle and Nerve*. https://doi.org/10.1002/mus.22322

De Sá Souza, H., Antunes, H. K. M., Dáttilo, M., Lee, K. S., Mônico-Neto, M., De Campos Giampa, S. Q., Phillips, S. M., Tufik, S., & De Mello, M. T. (2016). Leucine supplementation is anti-atrophic during paradoxical sleep deprivation in rats. *Amino Acids*. https://doi.org/10.1007/s00726-015-2142-7

De Souza, V. A., Oliveira, D., Barbosa, S. R., Corrêa, J. O. D. A., Colugnati, F. A. B., Mansur, H. N., Fernandes, N. M. D. S., & Bastos, M. G. (2017). Sarcopenia in patients with chronic kidney disease not yet on dialysis: Analysis of the prevalence and associated factors. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0176230

Degens, H., Gayan-Ramirez, G., & Van Hees, H. W. H. (2015). Smoking-induced skeletal muscle dysfunction: From evidence to mechanisms. In *American Journal of Respiratory and Critical Care Medicine*. https://doi.org/10.1164/rccm.201410-1830PP

Demakakos, P., Cooper, R., Hamer, M., de Oliveira, C., Hardy, R., & Breeze, E. (2013). The Bidirectional Association between Depressive Symptoms and Gait Speed: Evidence from the English Longitudinal Study of Ageing (ELSA). *PLoS ONE*, *8*(7). https://doi.org/10.1371/journal.pone.0068632

Deutz, N. E. P., Bauer, J. M., Barazzoni, R., Biolo, G., Boirie, Y., Bosy-Westphal, A., Cederholm, T., Cruz-Jentoft, A., Krznariç, Z., Nair, K. S., Singer, P., Teta, D., Tipton, K., & Calder, P. C. (2014). Protein intake and exercise for optimal muscle function with aging: Recommendations from the ESPEN Expert Group. *Clinical Nutrition*.

https://doi.org/10.1016/j.clnu.2014.04.007

Dhalwani, N. N., Fahami, R., Sathanapally, H., Seidu, S., Davies, M. J., & Khunti, K. (2017). Association between polypharmacy and falls in older adults: A longitudinal study from England. In *BMJ Open*. https://doi.org/10.1136/bmjopen-2017-016358

Dhondup, T., & Qian, Q. (2017). Acid-Base and Electrolyte Disorders in Patients with and without Chronic Kidney Disease: An Update. *Kidney Diseases*. https://doi.org/10.1159/000479968

Domaski, M., & Ciechanowski, K. (2012). Sarcopenia: A major challenge in elderly patients with end-stage renal disease. In *Journal of Aging Research*. https://doi.org/10.1155/2012/754739

Drey, M., Ferrari, U., Schraml, M., Kemmler, W., Schoene, D., Franke, A., Freiberger, E., Kob, R., & Sieber, C. (2020). German Version of SARC-F: Translation, Adaption, and Validation. *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2019.12.011

Ekramzadeh, M., Mazloom, Z., Jafari, P., Ayatollahi, M., & Sagheb, M. M. (2014). Major barriers responsible for malnutrition in hemodialysis patients: Challenges to optimal nutrition. *Nephro-Urology Monthly*. https://doi.org/10.5812/numonthly.23158

Elia, M. (2000). Guidelines for detection and management of malnutrition. *Maidenhead: Malnutrition Advisory Group (MAG), Standing Committee of BAPEN*.

Eloueyk, A. K., Alameddine, R. Y., Osta, B. A., & Awad, D. M. (2019). Correlations between serum inflammatory markers and comorbidities in patients with end-stage renal disease. *Journal of Taibah University Medical Sciences*, *14*(6), 547–552. https://doi.org/10.1016/j.jtumed.2019.10.003

English, K. L., & Paddon-Jones, D. (2010). Protecting muscle mass and function in older adults during bed rest. In *Current Opinion in Clinical Nutrition and Metabolic Care*. https://doi.org/10.1097/MCO.0b013e328333aa66

Fahal, I. H. (2014). Uraemic sarcopenia: Aetiology and implications. *Nephrology Dialysis Transplantation*, *29*(9), 1655–1665. https://doi.org/10.1093/ndt/gft070

Falavigna, A., Righesso, O., Teles, A. R., Baseggio, N., Velho, M. C., Ruschel, L. G., Abruzzi, F., & Silva, P. G. da. (2012). Depression Subscale of the Hospital Anxiety and Depression Scale applied preoperatively in spinal surgery. *Arquivos de Neuro-Psiquiatria*. https://doi.org/10.1590/s0004-282x2012000500009

Farah, N. M. F., Yee, T. S., & Rasdi, H. F. M. (2019). Self-reported sleep quality using the malay version of the pittsburgh sleep quality index (PSQI-M) in Malaysian adults. *International Journal of Environmental Research and Public Health*. https://doi.org/10.3390/ijerph16234750

Fernandez-Mendoza, J., Baker, J. H., Vgontzas, A. N., Gaines, J., Liao, D., & Bixler, E. O. (2017). Insomnia symptoms with objective short sleep duration are associated with systemic inflammation in adolescents. *Brain, Behavior, and Immunity*. https://doi.org/10.1016/j.bbi.2016.12.026

Ferri, E., Marzetti, E., Calvani, R., Picca, A., Cesari, M., & Arosio, B. (2020). Role of age-related mitochondrial dysfunction in sarcopenia. *International Journal of Molecular Sciences*, *21*(15), 1–12. https://doi.org/10.3390/ijms21155236

Fex, A., Barbat-Artigas, S., Dupontgand, S., Filion, M. E., Karelis, A. D., & Aubertin-Leheudre, M. (2012). Relationship between long sleep duration and functional capacities in postmenopausal women. *Journal of Clinical Sleep Medicine*.

https://doi.org/10.5664/jcsm.1922

Foley, R. N., Wang, C., Ishani, A., Collins, A. J., & Murray, A. M. (2007). Kidney function and sarcopenia in the United States general population: NHANES III. *American Journal of Nephrology*. https://doi.org/10.1159/000101827

Friedman, A. N., & Fadem, S. Z. (2010). Reassessment of albumin as a nutritional marker in kidney disease. In *Journal of the American Society of Nephrology*. https://doi.org/10.1681/ASN.2009020213

Gade, J., Quick, A. A., Beck, A. M., Rønholt, F., & Vinther, A. (2020). SARC-F in hospitalized, geriatric medical patients – Feasibility, prevalence of risk of sarcopenia, and characteristics of the risk group, including one-year follow-up. *Clinical Nutrition ESPEN*. https://doi.org/10.1016/j.clnesp.2020.03.016

Garcia, R. S. A., Lucinda, L. M. F., Ramos, F. A., Bueno, G. de S., de Oliveira, G. M. R., Bonisson, L. S. A., Silva, M. A., Zolli, T. I., Pinheiro, B. V., Paula, R. B. de, Pazeli, J. M., & Reboredo, M. M. (2017). Factors Associated With Functional Capacity in Hemodialysis Patients. *Artificial Organs*. https://doi.org/10.1111/aor.12938

Giglio, J., Kamimura, M. A., Lamarca, F., Rodrigues, J., Santin, F., & Avesani, C. M. (2018). Association of Sarcopenia With Nutritional Parameters, Quality of Life, Hospitalization, and Mortality Rates of Elderly Patients on Hemodialysis. *Journal of Renal Nutrition*. https://doi.org/10.1053/j.jrn.2017.12.003

Gingrich, A., Volkert, D., Kiesswetter, E., Thomanek, M., Bach, S., Sieber, C. C., & Zopf, Y. (2019). Prevalence and overlap of sarcopenia, frailty, cachexia and malnutrition in older medical inpatients. *BMC Geriatrics*. https://doi.org/10.1186/s12877-019-1115-1

Gonzalez-Gonzalez, D. R., Lopez-Salazar, A. M., Gonzalez-Correa, C. H., & Curcio-Borrero,

C. L. (2019). Prevalence of sarcopenia among community-dwelling, young elderly people living in Manizales, Colombia. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1272/1/012005

Goodman, M. J., Ghate, S. R., Mavros, P., Sen, S., Marcus, R. L., Joy, E., & Brixner, D. I. (2013). Development of a practical screening tool to predict low muscle mass using NHANES 1999-2004. *Journal of Cachexia, Sarcopenia and Muscle*. https://doi.org/10.1007/s13539-013-0107-9

Goyal, E., Chaudhury, S., & Saldanha, D. (2018). Psychiatric comorbidity in patients undergoing hemodialysis. *Industrial Psychiatry Journal*. https://doi.org/10.4103/ipj.ipj_5_18

Guigoz, Y. (2006). The Mini Nutritional Assessment (MNA®) review of the literature - What does it tell us? In *Journal of Nutrition, Health and Aging*.

Hai, S., Cao, L., Wang, H., Zhou, J., Liu, P., Yang, Y., Hao, Q., & Dong, B. (2017). Association between sarcopenia and nutritional status and physical activity among community-dwelling Chinese adults aged 60 years and older. *Geriatrics and Gerontology International*. https://doi.org/10.1111/ggi.13001

Haizlip, K. M., Harrison, B. C., & Leinwand, L. A. (2015). Sex-based differences in skeletal muscle kinetics and fiber-type composition. In *Physiology*. https://doi.org/10.1152/physiol.00024.2014

Han, P., Zhao, J., Guo, Q., Wang, J., Zhang, W., Shen, S., Wang, X., Dong, R., Ma, Y., Kang, L., Fu, L., Jia, L., Han, X., He, Z., Bao, Y., Wang, L., & Niu, K. (2016). Incidence, risk factors, and the protective effect of high body mass index against sarcopenia in suburb-dwelling elderly Chinese populations. *Journal of Nutrition, Health and Aging*.

https://doi.org/10.1007/s12603-016-0704-3

Han, Peipei, Yu, H., Ma, Y., Kang, L., Fu, L., Jia, L., Chen, X., Yu, X., Hou, L., Wang, L., Zhang, W., Yin, H., Niu, K., & Guo, Q. (2017). The increased risk of sarcopenia in patients with cardiovascular risk factors in Suburb-Dwelling older Chinese using the AWGS definition. *Scientific Reports*. https://doi.org/10.1038/s41598-017-08488-8

Harding, K., & Feldman, M. (2008). Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem. *Journal of the American Academy of Child & Adolescent Psychiatry*. https://doi.org/10.1097/01.chi.0000270812.55636.3b

Hecking, M., Bieber, B. A., Ethier, J., Kautzky-Willer, A., Sunder-Plassmann, G., Säemann, M. D., Ramirez, S. P. B., Gillespie, B. W., Pisoni, R. L., Robinson, B. M., & Port, F. K. (2014). Sex-Specific Differences in Hemodialysis Prevalence and Practices and the Male-to-Female Mortality Rate: The Dialysis Outcomes and Practice Patterns Study (DOPPS). *PLoS Medicine*. https://doi.org/10.1371/journal.pmed.1001750

Heidari, B., Taheri, H., Hajian-Tilaki, K., Yolmeh, M., & Akbari, R. (2015). Low baseline serum albumin as a predictor of anemia in chronic hemodialysis patients. *Caspian Journal of Internal Medicine*.

Hendriks, F. K., Kooman, J. P., & van Loon, L. J. C. (2021). Dietary protein interventions to improve nutritional status in end-stage renal disease patients undergoing hemodialysis. *Current Opinion in Clinical Nutrition and Metabolic Care*. https://doi.org/10.1097/MCO.0000000000000703

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Katz, E. S., Kheirandish-Gozal, L., Neubauer, D. N., O'Donnell, A. E., Ohayon, M., Peever, J., Rawding, R., Sachdeva, R. C., Setters, B., Vitiello, M. V., Ware,

J. C., & Adams Hillard, P. J. (2015). National sleep foundation's sleep time duration recommendations: Methodology and results summary. *Sleep Health*. https://doi.org/10.1016/j.sleh.2014.12.010

Ho, L. L., Chan, Y. M., & Daud, Z. 'Azuan M. (2021). Dietary Factors and Sleep Quality Among Hemodialysis Patients in Malaysia. Journal of Renal Nutrition. https://doi.org/10.1053/j.jrn.2021.02.003

Holvoet, E., Wyngaert, K. Vanden, Van Craenenbroeck, A. H., Van Biesen, W., & Eloot, S. (2020). The screening score of Mini Nutritional Assessment (MNA) is a useful routine screening tool for malnutrition risk in patients on maintenance dialysis. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0229722

Hooi, L. S., Ong, L. M., Ahmad, G., Bavanandan, S., Ahmad, N. A., Naidu, B. M., Mohamud, W. N. W., & 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

Hooi, L. S., Mushahar, L., Ong, L. M., Visvanathan, R., & Wong, H. S. (2017). *Clinical Practice Guidelines Renal Replacement Therapy (Fourth Edition)*.

Hortegal, E., Alves, J., Santos, E., Nunes, L., Galvão, J., Nunes, R., Lula, D., Carvalho, S., França, A., Santos, E., & Santos, A. (2020). Sarcopenia and inflammation in patients undergoing hemodialysis. *Nutrición Hospitalaria*, *37*. https://doi.org/10.20960/nh.03068

Hu, X., Jiang, J., Wang, H., Zhang, L., Dong, B., & Yang, M. (2017). Association between sleep duration and sarcopenia among community-dwelling older adults. *Medicine (United States)*. https://doi.org/10.1097/MD.0000000000006268

Hughes, M. M., Connor, T. J., & Harkin, A. (2016). Stress-Related Immune Markers in

Depression: Implications for Treatment. In *International Journal of Neuropsychopharmacology*. https://doi.org/10.1093/ijnp/pyw001

Hulley, S. B., Cummings, S. R., Newman, T. B., Browner, W. S., & Grady, D. G. (2013). Designing cross-sectional and cohort studies. *Designing Clinical Research*, *85*.

Hunter, G. R., Singh, H., Carter, S. J., Bryan, D. R., & Fisher, G. (2019). Sarcopenia and Its Implications for Metabolic Health. In *Journal of Obesity*. https://doi.org/10.1155/2019/8031705

Ikizler, T. A., Burrowes, J. D., Byham-Gray, L. D., Campbell, K. L., Carrero, J. J., Chan, W., Fouque, D., Friedman, A. N., Ghaddar, S., Goldstein-Fuchs, D. J., Kaysen, G. A., Kopple, J. D., Teta, D., Yee-Moon Wang, A., & Cuppari, L. (2020). KDOQI Clinical Practice Guideline for Nutrition in CKD: 2020 Update. *American Journal of Kidney Diseases*. https://doi.org/10.1053/j.ajkd.2020.05.006

Ishii, S., Tanaka, T., Shibasaki, K., Ouchi, Y., Kikutani, T., Higashiguchi, T., Obuchi, S. P., Ishikawa-Takata, K., Hirano, H., Kawai, H., Tsuji, T., & Iijima, K. (2014). Development of a simple screening test for sarcopenia in older adults. *Geriatrics and Gerontology International*. https://doi.org/10.1111/ggi.12197

Jeng, C., Zhao, L.-J., Wu, K., Zhou, Y., Chen, T., & Deng, H.-W. (2018). Race and socioeconomic effect on sarcopenia and sarcopenic obesity in the Louisiana Osteoporosis Study (LOS). *JCSM Clinical Reports*. https://doi.org/10.17987/jcsm-cr.v3i2.27

Jialin, W., Yi, Z., & Weijie, Y. (2013). Relationship between body mass index and mortality in hemodialysis patients: A meta-analysis. *Nephron - Clinical Practice*. https://doi.org/10.1159/000345159

Jyotsna, B. (2019). A Descriptive Analysis of Prescribing Patterns of Drugs in Chronic Kidney Disease Patients on Maintenance Hemodialysis. *Journal of Medical Science And Clinical Research*. https://doi.org/10.18535/jmscr/v7i5.126

Kalantar-Zadeh, K., Ficociello, L. H., Bazzanella, J., Mullon, C., & Anger, M. S. (2021). Slipping through the pores: Hypoalbuminemia and albumin loss during hemodialysis. *International Journal of Nephrology and Renovascular Disease*. https://doi.org/10.2147/IJNRD.S291348

Kalantar-Zadeh, K., Gutekunst, L., Mehrotra, R., Kovesdy, C. P., Bross, R., Shinaberger, C. S., Noori, N., Hirschberg, R., Benner, D., Nissenson, A. R., & Kopple, J. D. (2010). Understanding sources of dietary phosphorus in the treatment of patients with chronic kidney disease. In *Clinical Journal of the American Society of Nephrology*. https://doi.org/10.2215/CJN.06080809

Kassebaum, N. J., Arora, M., Barber, R. M., Brown, J., Carter, A., Casey, D. C., Charlson, F. J., Coates, M. M., Coggeshall, M., Cornaby, L., Dandona, L., Dicker, D. J., Erskine, H. E., Ferrari, A. J., Fitzmaurice, C., Foreman, K., Forouzanfar, M. H., Fullman, N., Goldberg, E. M., … Zuhlke, L. J. (2016). Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet*, *388*(10053), 1603–1658. https://doi.org/10.1016/S0140-6736(16)31460-X

Kato, A. (2015). Arterial Stiffening and Clinical Outcomes in Dialysis Patients. *Pulse*. https://doi.org/10.1159/000381927

Khan, A., Khan, A. H., Adnan, A. S., Sulaiman, S. A. S., & Mushtaq, S. (2019). Prevalence

and predictors of depression among hemodialysis patients: A prospective follow-up study. *BMC Public Health*. https://doi.org/10.1186/s12889-019-6796-z

Khezrian, M., McNeil, C. J., Myint, P. K., & Murray, A. D. (2019). The association between polypharmacy and late life deficits in cognitive, physical and emotional capability: a cohort study. *International Journal of Clinical Pharmacy*. https://doi.org/10.1007/s11096-018-0761-2

Khor, B. H., Chinna, K., Abdul Gafor, A. H., Morad, Z., Ahmad, G., Bavanandam, S., Visvanathan, R., Yahya, R., Goh, B. L., Bee, B. C., & Karupaiah, T. (2018). The state of nutrition care in outpatient hemodialysis settings in Malaysia: A nationwide survey. *BMC Health Services Research*. https://doi.org/10.1186/s12913-018-3702-9

Kim, B. H., Kim, M. J., & Lee, Y. (2012). The effect of a nutritional education program on the nutritional status of elderly patients in a long-term care hospital in jeollanamdo province: Health behavior, dietary behavior, nutrition risk level and nutrient intake. *Nutrition Research and Practice*. https://doi.org/10.4162/nrp.2012.6.1.35

Kim, J. K., Choi, S. R., Choi, M. J., Kim, S. G., Lee, Y. K., Noh, J. W., Kim, H. J., & 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

Kim, J. K., Kim, S. G., Oh, J. E., Lee, Y. K., Noh, J. W., Kim, H. J., & Song, Y. R. (2019). Impact of sarcopenia on long-term mortality and cardiovascular events in patients undergoing hemodialysis. *Korean Journal of Internal Medicine*. https://doi.org/10.3904/kjim.2017.083

Kim, R. H., Kim, K. I., Kim, J. H., & Park, Y. S. (2018). Association between sleep duration

and body composition measures in Korean adults: The Korea national health and nutrition examination survey 2010. *Korean Journal of Family Medicine*. https://doi.org/10.4082/kjfm.17.0030

Kim, S., Kim, M., & Won, C. W. (2018). Validation of the Korean Version of the SARC-F Questionnaire to Assess Sarcopenia: Korean Frailty and Aging Cohort Study. *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2017.07.006

Kittiskulnam, P., Chertow, G. M., Carrero, J. J., Delgado, C., Kaysen, G. A., & Johansen, K. L. (2017). Sarcopenia and its individual criteria are associated, in part, with mortality among patients on hemodialysis. *Kidney International*. https://doi.org/10.1016/j.kint.2017.01.024

Kittiskulnam, P., & Johansen, K. L. (2019). The obesity paradox: A further consideration in dialysis patients. In *Seminars in Dialysis*. https://doi.org/10.1111/sdi.12834

König, M., Spira, D., Demuth, I., Steinhagen-Thiessen, E., & Norman, K. (2017). Polypharmacy as a Risk Factor for Clinically Relevant Sarcopenia: Results From the Berlin Aging Study II. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. https://doi.org/10.1093/gerona/glx074

Krzymińska-Siemaszko, R., Tobis, S., Lewandowicz, M., & Wieczorowska-Tobis, K. (2020). Comparison of four sarcopenia screening questionnaires in community-dwelling older adults from Poland using six sets of international diagnostic criteria of sarcopenia. PLoS ONE. https://doi.org/10.1371/journal.pone.0231847

Kushida, C. A. (2013). Encyclopedia of Sleep. In Encyclopedia of Sleep. https://doi.org/10.1016/c2011-1-69820-0

Lamon, S., Morabito, A., Arentson-Lantz, E., Knowles, O., Vincent, G. E., Condo, D., Alexander, S. E., Garnham, A., Paddon-Jones, D., & Aisbett, B. (2020). The effect of acute sleep deprivation on skeletal muscle protein synthesis and the hormonal environment. *BioRxiv*, 2020.03.09.984666. https://doi.org/10.1101/2020.03.09.984666

Landi, F., Camprubi-Robles, M., Bear, D. E., Cederholm, T., Malafarina, V., Welch, A. A., & Cruz-Jentoft, A. J. (2019). Muscle loss: The new malnutrition challenge in clinical practice. *Clinical Nutrition*. https://doi.org/10.1016/j.clnu.2018.11.021

Landi, Francesco, Calvani, R., Tosato, M., Martone, A. M., Fusco, D., Sisto, A., Ortolani, E., Savera, G., Salini, S., & Marzetti, E. (2017). Age-Related Variations of Muscle Mass, Strength, and Physical Performance in Community-Dwellers: Results From the Milan EXPO Survey. *Journal of the American Medical Directors Association*, *18*(1), 88.e17-88.e24. https://doi.org/10.1016/j.jamda.2016.10.007

Larsson, L., Degens, H., Li, M., Salviati, L., Lee, Y. Il, Thompson, W., Kirkland, J. L., & Sandri, M. (2019). Sarcopenia: Aging-related loss of muscle mass and function. *Physiological Reviews*. https://doi.org/10.1152/physrev.00061.2017

Law, T. D., Clark, L. A., & Clark, B. C. (2016). Resistance exercise to prevent and manage sarcopenia and dynapenia. In *Annual Review of Gerontology and Geriatrics*. https://doi.org/10.1891/0198-8794.36.205

Lee, E. J., Yang, S. K., & Lee, D. C. (2018). Smoking and its Relationship with Sarcopenia: Result from the 2008-2011 Korean National Health and Nutrition Examination Survey. *Korean Journal of Family Practice*, *8*(5), 752–758.

Lee, H. W., Yoon, H. S., Yang, J. J., Song, M., Lee, J. K., Lee, S. A., Choi, J. Y., & Kang, D. (2020). Association of sleep duration and quality with elevated hs-CRP among healthy

Korean adults. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0238053

Lee, I., Cho, J., Hong, H., Jin, Y., Kim, D., & Kang, H. (2018). Sarcopenia is associated with cognitive impairment and depression in elderly Korean women. *Iranian Journal of Public Health*.

Lee, W.-C., Lee, Y.-T., Li, L.-C., Ng, H.-Y., Kuo, W.-H., Lin, P.-T., Liao, Y.-C., Chiou, T., & Lee, C.-T. (2018). The Number of Comorbidities Predicts Renal Outcomes in Patients with Stage 3–5 Chronic Kidney Disease. *Journal of Clinical Medicine*. https://doi.org/10.3390/jcm7120493

Lee, Z. Y., Ong, S. P., Ng, C. C., Yap, C. S. L., Engkasan, J. P., Barakatun-Nisak, M. Y., Heyland, D. K., & Hasan, M. S. (2020). Association between ultrasound quadriceps muscle status with premorbid functional status and 60-day mortality in mechanically ventilated critically ill patient: A single-center prospective observational study. *Clinical Nutrition*. https://doi.org/10.1016/j.clnu.2020.08.022

Leong Joyce, W. S., Zukri, I. N. M., Ching, S. M., & Devaraj, N. K. (2020). Factors associated with falls among the elderly attending a government clinic in Kuala Lumpur. Malaysian Journal of Medicine and Health Sciences.

Leproult, R., & Van Cauter, E. (2011). Effect of 1 week of sleep restriction on testosterone levels in young healthy men. In *JAMA - Journal of the American Medical Association*. https://doi.org/10.1001/jama.2011.710

Lim, J. Y., Low, N. A., & Merchant, R. A. (2020). Prevalence of sarcopenia in pre-frail community dwelling older adult and utility of SARC-F, SARC-CalF and calf circumference in case finding. *Journal of Frailty, Sarcopenia and Falls*, *05*(03), 53–56. https://doi.org/10.22540/jfsf-05-053

Lim, T. O., Goh, A., Lim, Y. N., Zaher, Z. M. M., & Suleiman, A. B. (2010). How public and private reforms dramatically improved access to dialysis therapy in Malaysia. *Health Affairs*. https://doi.org/10.1377/hlthaff.2009.0135

Limpawattana, P., Kotruchin, P., & Pongchaiyakul, C. (2015). Sarcopenia in Asia. *Osteoporosis and Sarcopenia*, *1*(2), 92–97. https://doi.org/10.1016/j.afos.2015.10.001

Lin, Y.-L., Hou, J.-S., Lai, Y.-H., Wang, C.-H., Kuo, C.-H., Liou, H.-H., & Hsu, B.-G. (2020). Association of SARC-F Questionnaire and Mortality in Prevalent Hemodialysis Patients. *Diagnostics (Basel, Switzerland)*, *10*(11). https://doi.org/10.3390/diagnostics10110890

Lin, Y. L., Liou, H. H., Wang, C. H., Lai, Y. H., Kuo, C. H., Chen, S. Y., & Hsu, B. G. (2020). Impact of sarcopenia and its diagnostic criteria on hospitalization and mortality in chronic hemodialysis patients: A 3-year longitudinal study. *Journal of the Formosan Medical Association*, *119*(7), 1219–1229. https://doi.org/10.1016/j.jfma.2019.10.020

Ling, L. L., Chan, Y. M., & Mat Daud, Z. A. (2019). Serum potassium and handgrip strength as predictors of sleep quality among hemodialysis patients in Malaysia. *Asia Pacific Journal of Clinical Nutrition*. https://doi.org/10.6133/apjcn.201906_28(2).0023

Liu, X., Hao, Q., Yue, J., Hou, L., Xia, X., Zhao, W., Zhang, Y., Ge, M., Ge, N., & Dong, B. (2020). Sarcopenia, Obesity and Sarcopenia Obesity in Comparison: Prevalence, Metabolic Profile, and Key Differences: Results from WCHAT Study. *Journal of Nutrition, Health and Aging*. https://doi.org/10.1007/s12603-020-1332-5

Lo, K., Woo, B., Wong, M., & Tam, W. (2018). Subjective sleep quality, blood pressure, and hypertension: a meta-analysis. In *Journal of Clinical Hypertension*. https://doi.org/10.1111/jch.13220

Locquet, M., Beaudart, C., Delandsheere, L., Reginster, J. Y., & Bruyère, O. (2018). Subjective Sleep Quality among Sarcopenic and Non-Sarcopenic Older Adults: Results from the SarcoPhAge Cohort. *The Journal of Frailty & Aging*. https://doi.org/10.14283/jfa.2018.13

Locquet, Médéa, Beaudart, C., Reginster, J. Y., Petermans, J., & Bruyère, O. (2018). Comparison of the performance of five screening methods for sarcopenia. *Clinical Epidemiology*. https://doi.org/10.2147/CLEP.S148638

Lucassen, E. A., De Mutsert, R., Le Cessie, S., Appelman-Dijkstra, N. M., Rosendaal, F. R., Van Heemst, D., Den Heijer, M., Biermasz, N. R., Rabelink, T. J., Jukema, J. W., De Roos, A., Van Dijk, K. W., Hiemstra, P. S., Kloppenburg, M., De Koning, E. J. P., Reitsma, P. H., De Vries, A. P. J., Lamb, H. J., Jazet, I. M., … Cobbaert, C. M. (2017). Poor sleep quality and later sleep timing are risk factors for osteopenia and sarcopenia in middle-aged men and women: The NEO study. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0176685

Lutski M, Weinstein G, Tanne D, G. U. (2020). Overweight, Obesity, and Late-Life Sarcopenia Among Men With Cardiovascular Disease, Israel. *Preventing Chronic Disease, 17*.

Malaysia, D. of statistics, & Department of Statistics Malaysia. (2011). Population Distribution and Basic Demographic Characteristics. *Dept of Statistics, Malaysia*.

Malhotra, R., Deger, S. M., Salat, H., Bian, A., Stewart, T. G., Booker, C., Vincz, A., Pouliot, B., & Ikizler, T. A. (2017). Sarcopenic Obesity Definitions by Body Composition and Mortality in the Hemodialysis Patients. *Journal of Renal Nutrition.* https://doi.org/10.1053/j.jrn.2016.09.010

Malmstrom, T. K., & Morley, J. E. (2013). SARC-F: A simple questionnaire to rapidly diagnose sarcopenia. In *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2013.05.018

Mandelkorn, U., Genzer, S., Choshen-Hillel, S., Reiter, J., e Cruz, M. M., Hochner, H., Kheirandish-Gozal, L., Gozal, D., & Gileles-Hillel, A. (2021). Escalation of sleep disturbances amid the COVID-19 pandemic: A cross-sectional international study. Journal of Clinical Sleep Medicine. https://doi.org/10.5664/JCSM.8800

Marcus, R. L., Addison, O., Kidde, J. P., Dibble, L. E., & Lastayo, P. C. (2010). Skeletal muscle fat infiltration: Impact of age, inactivity, and exercise. *Journal of Nutrition, Health and Aging*. https://doi.org/10.1007/s12603-010-0081-2

Marincolo, J. C. S., Aprahamian, I., Corona, L. P., Neri, A. L., Yassuda, M. S., & Borim, F. S. A. (2021). Three definitions of probable sarcopenia and associations with falls and functional disability among community-dwelling older adults. Osteoporosis and Sarcopenia. https://doi.org/10.1016/j.afos.2021.05.001

Marini, A. C. B., Perez, D. R. S., Fleuri, J. A., & Pimentel, G. D. (2020). SARC-F Is Better Correlated with Muscle Function Indicators Than Muscle Mass in Older Hemodialysis Patients. *Journal of Nutrition, Health and Aging*. https://doi.org/10.1007/s12603-020-1426-0

Marini, A. C., Motobu, R. D., Freitas, A. T. V., Laviano, A., & Pimentel, G. D. (2018). Pre-sarcopenia in patients undergoing hemodialysis: Prevalence and association with biochemical parameters. *Clinical Nutrition ESPEN*. https://doi.org/10.1016/j.clnesp.2018.07.014

Masnoon, N., Shakib, S., Kalisch-Ellett, L., & Caughey, G. E. (2017). What is

polypharmacy? A systematic review of definitions. In *BMC Geriatrics*. https://doi.org/10.1186/s12877-017-0621-2

Massry, S. G., Coburn, J. W., Chertow, G. M., Hruska, K., Langman, C., Malluche, H., Martin, K., McCann, L. M., McCarthy, J. T., & Moe, S. (2003). K/DOQI clinical practice guidelines for bone metabolism and disease in chronic kidney disease. *American Journal of Kidney Diseases*, *42*(4 SUPPL. 3).

Maurya, N. K., Arya, P., & Sengar, N. S. (2019). DIETARY INTAKE AND NUTRITIONAL STATUS IN HEMODIALYSIS PATIENTS. International Research Journal Of Pharmacy. https://doi.org/10.7897/2230-8407.1004132

Medical Nutrition Therapy. (2005). *Medical Nutrition Therapy Guidelines for Chronic Kidney Disease*. Retrieved from http://dietitians.org.my/for-members/resources-for-practice/guidelines-for-dietetic-practice

Mc Causland, F. R., Brunelli, S. M., & Waikar, S. S. (2012). Association of smoking with cardiovascular and infection-related morbidity and mortality in chronic hemodialysis. *Clinical Journal of the American Society of Nephrology*. https://doi.org/10.2215/CJN.03880412

McKee, A., Morley, J. E., Matsumoto, A. M., & Vinik, A. (2017). Sarcopenia: an endocrine disorder? *Endocrine Practice*, *23*(9), 1143–1152.

Meader, Nick, Moe-Byrne, T., Llewellyn, A., & Mitchell, A. J. (2014). Screening for poststroke major depression: A meta-analysis of diagnostic validity studies. *Journal of Neurology, Neurosurgery and Psychiatry*. https://doi.org/10.1136/jnnp-2012-304194

Meader, Nicolas, Mitchell, A. J., Chew-Graham, C., Goldberg, D., Rizzo, M., Bird, V., Kessler, D., Packham, J., Haddad, M., & Pilling, S. (2011). Case identification of

depression in patients with chronic physical health problems: A diagnostic accuracy meta-analysis of 113 studies. *British Journal of General Practice*. https://doi.org/10.3399/bjgp11X613151

Meex, R. C. R., Blaak, E. E., & van Loon, L. J. C. (2019). Lipotoxicity plays a key role in the development of both insulin resistance and muscle atrophy in patients with type 2 diabetes. In *Obesity Reviews*. https://doi.org/10.1111/obr.12862

Meneses, E. H. (1994). Race and Ethnicity: An Anthropological Perspective. *Race, Sex & Class*, 137–146.

Mesinovic, J., Zengin, A., De Courten, B., Ebeling, P. R., & Scott, D. (2019). Sarcopenia and type 2 diabetes mellitus: A bidirectional relationship. In *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*. https://doi.org/10.2147/DMSO.S186600

Messier, V., Rabasa-Lhoret, R., Barbat-Artigas, S., Elisha, B., Karelis, A. D., & Aubertin-Leheudre, M. (2011). Menopause and sarcopenia: A potential role for sex hormones. In *Maturitas*. https://doi.org/10.1016/j.maturitas.2011.01.014

Mijnarends, D. M., Koster, A., Schols, J. M. G. A., Meijers, J. M. M., Halfens, R. J. G., Gudnason, V., Eiriksdottir, G., Siggeirsdottir, K., Sigurdsson, S., Jónsson, P. V., Meirelles, O., & Harris, T. (2016). Physical activity and incidence of sarcopenia: The population-based AGES-Reykjavik Study. *Age and Ageing*. https://doi.org/10.1093/ageing/afw090

Miller, D. K., Malmstrom, T. K., Andresen, E. M., Miller, J. P., Herning, M. M., Schootman, M., & Wolinsky, F. D. (2009). Development and validation of a short portable sarcopenia measure in the African American health project. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences*.

https://doi.org/10.1093/gerona/gln033

Moon, S. J., Kim, T. H., Yoon, S. Y., Chung, J. H., & Hwang, H. J. (2015). Relationship between stage of chronic kidney disease and sarcopenia in Korean aged 40 years and older using the Korea National Health and Nutrition Examination Surveys (KNHANES IV-2, 3, and V-1, 2), 2008-2011. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0130740

Moorthi, R. N., & Avin, K. G. (2017). Clinical relevance of sarcopenia in chronic kidney disease. In *Current Opinion in Nephrology and Hypertension*. https://doi.org/10.1097/MNH.0000000000000318

Moreira, V. G., Perez, M., & Lourenço, R. A. (2019). Prevalence of sarcopenia and its associated factors: The impact of muscle mass, gait speed, and handgrip strength reference values on reported frequencies. *Clinics*. https://doi.org/10.6061/clinics/2019/e477

Mori, K., Nishide, K., Okuno, S., Shoji, T., Emoto, M., Tsuda, A., Nakatani, S., Imanishi, Y., Ishimura, E., Yamakawa, T., Shoji, S., & Inaba, M. (2019a). Impact of diabetes on sarcopenia and mortality in patients undergoing hemodialysis. *BMC Nephrology*. https://doi.org/10.1186/s12882-019-1271-8

Mori, K., Nishide, K., Okuno, S., Shoji, T., Emoto, M., Tsuda, A., Nakatani, S., Imanishi, Y., Ishimura, E., Yamakawa, T., Shoji, S., & Inaba, M. (2019b). Impact of diabetes on sarcopenia and mortality in patients undergoing hemodialysis. *BMC Nephrology*, *20*(1), 1–7. https://doi.org/10.1186/s12882-019-1271-8

Morley, J. E., Baumgartner, R. N., Roubenoff, R., Mayer, J., & Nair, K. S. (2001). Sarcopenia. *Journal of Laboratory and Clinical Medicine*.

https://doi.org/10.1067/mlc.2001.113504

Morley, J. E., & Sanford, A. M. (2019). Screening for Sarcopenia. In *Journal of Nutrition, Health and Aging*. https://doi.org/10.1007/s12603-019-1259-x

Mukai, H., Villafuerte, H., Qureshi, A. R., Lindholm, B., & Stenvinkel, P. (2018). Serum albumin, inflammation, and nutrition in end-stage renal disease: C-reactive protein is needed for optimal assessment. In *Seminars in Dialysis*. https://doi.org/10.1111/sdi.12731

Musa, N. A., Moy, F. M., & Wong, L. P. (2018). Prevalence and factors associated with poor sleep quality among secondary school teachers in a developing country. *Industrial Health*. https://doi.org/10.2486/indhealth.2018-0052

Naderi, N., Kleine, C. E., Park, C., Hsiung, J. T., Soohoo, M., Tantisattamo, E., Streja, E., Kalantar-Zadeh, K., & Moradi, H. (2018). Obesity Paradox in Advanced Kidney Disease: From Bedside to the Bench. In *Progress in Cardiovascular Diseases*. https://doi.org/10.1016/j.pcad.2018.07.001

Najafi, A., Keihani, S., Bagheri, N., Jolfaei, A. G., & Meybodi, A. M. (2016). Association between anxiety and depression with dialysis adequacy in patients on maintenance hemodialysis. *Iranian Journal of Psychiatry and Behavioral Sciences*. https://doi.org/10.17795/ijpbs-4962

National Action Plan for Healthy Kidneys (ACT-KID) 2018-2025. Feisul I. M., Sunita. B. Eds.; Non-communicable Disease (NCD) Section; *Ministry of Health Malaysia, Putrajaya, Malaysia, 2018.*

National Renal Registry. (n.d.). 26th Report of the Malaysian Dialysis and Transplant Registry 2018. Kuala Lumpur. *National Renal Registry*. Retrieved from https://www.msn.org.my/nrr/mdtr2018.jsp

National Renal Registry. (2018). 24th Report of the Malaysian Dialysis and Transplant Registry 2016. *National Renal Registry*. Retrieved from https://www.msn.org.my/msn/Doc/PublicDoc_PB/Publication/mdtr2016/All%20Chapters.pdf

Navarro-González, J. F., Mora-Fernández, C., Muros, M., Herrera, H., & García, J. (2009). Mineral metabolism and inflammation in chronic kidney disease patients: A cross-sectional study. *Clinical Journal of the American Society of Nephrology*. https://doi.org/10.2215/CJN.02420409

Ng, E. S. Y., Wong, P. Y., Kamaruddin, A. T. H., Lim, C. T. S., & Chan, Y. M. (2020). Poor sleep quality, depression and social support are determinants of serum phosphate level among hemodialysis patients in Malaysia. *International Journal of Environmental Research and Public Health*. https://doi.org/10.3390/ijerph17145144

Ngoh, H. J., Chen, S. T., & Harith, S. (2011). Anthropometrie measurements among institutionalized elderly men in Northern Peninsular Malaysia. Journal of Men's Health. https://doi.org/10.1016/S1875-6867(11)60023-7

Nguyen, T. N., Nguyen, A. T., Khuong, L. Q., Nguyen, T. X., Nguyen, H. T. T., Nguyen, T. T. H., Hoang, M. Van, Pham, T., Nguyen, T. N., & Vu, H. T. T. (2020). Reliability and validity of SARC-F questionnaire to assess sarcopenia among vietnamese geriatric patients. *Clinical Interventions in Aging*. https://doi.org/10.2147/CIA.S254397

Noda, A., Miyata, S., Iwamoto, K., & Ozaki, N. (2017). 0847 EFFECTS OF SLEEP

DISORDER AND PHYSICAL ACTIVITY ON COGNITIVE FUNCTION IN OLDER ADULTS. *Sleep*. https://doi.org/10.1093/sleepj/zsx050.846

Nogueira, L., Trisko, B. M., Lima-Rosa, F. L., Jackson, J., Lund-Palau, H., Yamaguchi, M., & Breen, E. C. (2018). Cigarette smoke directly impairs skeletal muscle function through capillary regression and altered myofibre calcium kinetics in mice. *Journal of Physiology*. https://doi.org/10.1113/JP275888

Norshafarina, S. K., Ibrahim, M. S. N., Suzana, S., Hasnan, A. M., Zahara, M., & Zaitun, Y. (2013). Sarcopenia and its impact on health: do they have significant associations. *Sains Malaysiana*, *42*(9), 1345–1355.

Nurminen, J., Puustinen, J., Lähteenmäki, R., Vahlberg, T., Lyles, A., Partinen, M., Räihä, I., Neuvonen, P. J., & Kivelä, S. L. (2014). Handgrip strength and balance in older adults following withdrawal from long-term use of temazepam, zopiclone or zolpidem as hypnotics. *BMC Geriatrics*. https://doi.org/10.1186/1471-2318-14-121

Nuttall, F. Q. (2015). Body Mass Index: Obesity, BMI, and Health: A Critical Review. *Nutrition Today*, *50*(3), 117–128. https://doi.org/10.1097/NT.0000000000000092

Omari, A. M., Omari, L. S., Dagash, H. H., Sweileh, W. M., Natour, N., & Zyoud, S. H. (2019). Assessment of nutritional status in the maintenance of haemodialysis patients: A cross-sectional study from Palestine. *BMC Nephrology*. https://doi.org/10.1186/s12882-019-1288-z

Othayq, A., & Aqeeli, A. (2020). Prevalence of depression and associated factors among hemodialyzed patients in Jazan area, Saudi Arabia: a cross-sectional study. *Mental Illness*. https://doi.org/10.1108/MIJ-02-2020-0004

Pang, B. W. J., Wee, S. L., Lau, L. K., Jabbar, K. A., Seah, W. T., Ng, D. H. M., Ling Tan, Q.

L., Chen, K. K., Jagadish, M. U., & Ng, T. P. (2020). Prevalence and Associated Factors of Sarcopenia in Singaporean Adults—The Yishun Study. *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2020.05.029

Park, J., Jin, D. C., Molnar, M. Z., Dukkipati, R., Kim, Y. L., Jing, J., Levin, N. W., Nissenson, A. R., Lee, J. S., & Kalantar-Zadeh, K. (2013). Mortality predictability of body size and muscle mass surrogates in asian vs white and African American hemodialysis patients. *Mayo Clinic Proceedings*. https://doi.org/10.1016/j.mayocp.2013.01.025

Park, S. K., Jung, J. Y., Oh, C. M., McIntyre, R. S., & Lee, J. H. (2018). Association between sleep duration, quality and body mass index in the Korean population. *Journal of Clinical Sleep Medicine*. https://doi.org/10.5664/jcsm.7272

Patel, S. R., Zhu, X., Storfer-Isser, A., Mehra, R., Jenny, N. S., Tracy, R., & Redline, S. (2009). Sleep duration and biomarkers of inflammation. *Sleep*. https://doi.org/10.1093/sleep/32.2.200

Pellegrinelli, V., Rouault, C., Rodriguez-Cuenca, S., Albert, V., Edom-Vovard, F., Vidal-Puig, A., Clément, K., Butler-Browne, G. S., & Lacasa, D. (2015). Human adipocytes induce inflammation and atrophy in muscle cells during obesity. *Diabetes*. https://doi.org/10.2337/db14-0796

Perez-Gomez, M. V., Bartsch, L. A., Castillo-Rodriguez, E., Fernandez-Prado, R., Fernandez-Fernandez, B., Martin-Cleary, C., Gracia-Iguacel, C., & Ortiz, A. (2018). Clarifying the concept of chronic kidney disease for non-nephrologists. *Clinical Kidney Journal*, *12*(2), 258–261. https://doi.org/10.1093/ckj/sfz007

Pesta, D. H., Tsirigotis, D. N., Befroy, D. E., Caballero, D., Jurczak, M. J., Rahimi, Y., Cline,

G. W., Dufour, S., Birkenfeld, A. L., Rothman, D. L., Carpenter, T. O., Insogna, K., Petersen, K. F., Bergwitz, C., & Shulman, G. I. (2016). Hypophosphatemia promotes lower rates of muscle ATP synthesis. *FASEB Journal*. https://doi.org/10.1096/fj.201600473R

Pettitt, R., Kota, S. V, Hadfield, M., & II, O. M. S. (2017). Abnormal Loss of Weight. *Osteopathic Family Physician*, *9*(2).

Picariello, F., Moss-Morris, R., Macdougall, I. C., & Chilcot, J. (2018). 'It's when you're not doing too much you feel tired': A qualitative exploration of fatigue in end-stage kidney disease. British Journal of Health Psychology. https://doi.org/10.1111/bjhp.12289

Plantinga, L. C., Patzer, R. E., Franch, H. A., & Bowling, C. B. (2017). Serious Fall Injuries Before and After Initiation of Hemodialysis Among Older ESRD Patients in the United States: A Retrospective Cohort Study. American Journal of Kidney Diseases. https://doi.org/10.1053/j.ajkd.2016.11.021

Polonsky, T. S., Tian, L., Zhang, D., Bazzano, L. A., Criqui, M. H., Ferrucci, L., Guralnik, J. M., Kibbe, M. R., Leeuwenburgh, C., Sufit, R. L., & McDermott, M. M. (2019). Associations of weight change with changes in calf muscle characteristics and functional decline in peripheral artery disease. *Journal of the American Heart Association*. https://doi.org/10.1161/JAHA.118.010890

Ponti, F., Santoro, A., Mercatelli, D., Gasperini, C., Conte, M., Martucci, M., Sangiorgi, L., Franceschi, C., & Bazzocchi, A. (2020). Aging and Imaging Assessment of Body Composition: From Fat to Facts. In *Frontiers in Endocrinology*. https://doi.org/10.3389/fendo.2019.00861

Prior, S. J., Ryan, A. S., Blumenthal, J. B., Watson, J. M., Katzel, L. I., & Goldberg, A. P.

(2016). Sarcopenia is Associated With Lower Skeletal Muscle Capillarization and Exercise Capacity in Older Adults. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences*. https://doi.org/10.1093/gerona/glw017

Rahi, B., Daou, T., Gereige, N., Issa, Y., Moawad, Y., & Zgheib, K. (2020). Effects of Polypharmacy on Appetite and Malnutrition Risk Among Institutionalized Lebanese Older Adults - Preliminary Results. *Current Developments in Nutrition*. https://doi.org/10.1093/cdn/nzaa040_069

Ramot, Y., Nyska, A., & Spectre, G. (2013). Drug-Induced Thrombosis: An Update. *Drug Safety : An International Journal of Medical Toxicology and Drug Experience*, *36*. https://doi.org/10.1007/s40264-013-0054-6

Rantanen, T., Parkatti, T., & Heikkinen, E. (1992). Muscle strength according to level of physical exercise and educational background in middle-aged women in Finland. *European Journal of Applied Physiology and Occupational Physiology*. https://doi.org/10.1007/BF00602356

Rateb, A., Eastern, I., & Health, R. (2017). *Global Kidney Health Atlas (GKHA). August*.

Rehman, I. U., Lai, P. S. M., Lim, S. K., Lee, L. H., & Khan, T. M. (2019). Sleep disturbance among Malaysian patients with end-stage renal disease with pruritus. *BMC Nephrology*. https://doi.org/10.1186/s12882-019-1294-1

Ren, H., Gong, D., Jia, F., Xu, B., & Liu, Z. (2016a). Sarcopenia in patients undergoing maintenance hemodialysis: Incidence rate, risk factors and its effect on survival risk. *Renal Failure*, *38*(3), 364–371. https://doi.org/10.3109/0886022X.2015.1132173

Ren, H., Gong, D., Jia, F., Xu, B., & Liu, Z. (2016b). Sarcopenia in patients undergoing maintenance hemodialysis: Incidence rate, risk factors and its effect on survival risk.

Renal Failure. https://doi.org/10.3109/0886022X.2015.1132173

Reynolds, A. C., Dorrian, J., Liu, P. Y., van Dongen, H. P. A., Wittert, G. A., Harmer, L. J., & Banks, S. (2012). Impact of five nights of sleep restriction on glucose metabolism, leptin and testosterone in young adult men. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0041218

Rhee, C. M., Ahmadi, S. F., & Kalantar-Zadeh, K. (2016). The dual roles of obesity in chronic kidney disease: A review of the current literature. In Current Opinion in Nephrology and Hypertension. https://doi.org/10.1097/MNH.0000000000000212

Robinson, S. M., Reginster, J. Y., Rizzoli, R., Shaw, S. C., Kanis, J. A., Bautmans, I., Bischoff-Ferrari, H., Bruyère, O., Cesari, M., Dawson-Hughes, B., Fielding, R. A., Kaufman, J. M., Landi, F., Malafarina, V., Rolland, Y., van Loon, L. J., Vellas, B., Visser, M., Cooper, C., … Rueda, R. (2018). Does nutrition play a role in the prevention and management of sarcopenia? In *Clinical Nutrition*. https://doi.org/10.1016/j.clnu.2017.08.016

Rod, N. H., Vahtera, J., Westerlund, H., Kivimaki, M., Zins, M., Goldberg, M., & Lange, T. (2011). Sleep disturbances and cause-specific mortality: Results from the GAZEL cohort study. *American Journal of Epidemiology*. https://doi.org/10.1093/aje/kwq371

Rosenberg, I. H. (1989). Summary comments: epidemiological and methodological problems in determining nutritional status of older persons. *Am J Clin Nutr*. https://doi.org/10.1007/s13398-014-0173-7.2

Rosli, H., Shahar, S., Badrasawi, M., Singh, D. K. A., & Sakian, N. I. M. (2018). Identification of Older Adults with Sarcopenia: Comparison of Two Methods. *Jurnal Sains Kesihatan Malaysia (Malaysian Journal of Health Sciences)*, *15*(2).

Rubio-Arias, J. Á., Rodríguez-Fernández, R., Andreu, L., Martínez-Aranda, L. M., Martínez-Rodriguez, A., & Ramos-Campo, D. J. (2019). Effect of Sleep Quality on the Prevalence of Sarcopenia in Older Adults: A Systematic Review with Meta-Analysis. *Journal of Clinical Medicine*, *8*(12), 2156. https://doi.org/10.3390/jcm8122156

Rumyantsev, A., Jakovenko, A., & Iulia, L. (2019). Prevalence Of Sarcopenia In Hemodialysis Patients In The European Region Of The Russian Federation. *Nephrology Dialysis Transplantation*, *34*(Supplement_1). https://doi.org/10.1093/ndt/gfz106.FP704

Rusch, H. L., Guardado, P., Baxter, T., Mysliwiec, V., & Gill, J. M. (2015). Improved sleep quality is associated with reductions in depression and PTSD arousal symptoms and increases in IGF-1 concentrations. *Journal of Clinical Sleep Medicine*. https://doi.org/10.5664/jcsm.4770

Sabatino, A., Cuppari, L., Stenvinkel, P., Lindholm, B., & Avesani, C. M. (2020). Sarcopenia in chronic kidney disease: what have we learned so far? *Journal of Nephrology*, *0123456789*. https://doi.org/10.1007/s40620-020-00840-y

Saggini, R., Carmignano, S. M., Cosenza, L., Palermo, T., & Bellomo, R. G. (2017). Sarcopenia in Chronic Illness and Rehabilitative Approaches. In *Frailty and Sarcopenia - Onset, Development and Clinical Challenges*. https://doi.org/10.5772/intechopen.70223

Saglimbene, V. M., Wong, G., Ruospo, M., Palmer, S. C., Garcia-Larsen, V., Natale, P., Teixeira-Pinto, A., Campbell, K. L., Carrero, J. J., Stenvinkel, P., Gargano, L., Murgo, A. M., Johnson, D. W., Tonelli, M., Gelfman, R., Celia, E., Ecder, T., Bernat, A. G., Del Castillo, D., … Strippoli, G. F. M. (2019). Fruit and vegetable intake and mortality in adults undergoing maintenance hemodialysis. Clinical Journal of the American Society

of Nephrology. https://doi.org/10.2215/CJN.08580718

Sahril, N., Shahein, N. A., Yoep, N., Mahmud, N. A., Sooryanarayana, R., Maw Pin, T., Muhamad, N. A., & Ismail, H. (2020). Prevalence and factors associated with falls among older persons in Malaysia. Geriatrics and Gerontology International. https://doi.org/10.1111/ggi.13980

Saitoh, M., Ogawa, M., Kondo, H., Suga, K., Takahashi, T., Itoh, H., & Tabata, Y. (2019). Sarcopenic obesity and its association with frailty and protein-energy wasting in hemodialysis patients: Preliminary data from a single center in Japan. *Renal Replacement Therapy*. https://doi.org/10.1186/s41100-019-0240-9

Saminathan, T. A., Hooi, L. S., Mohd Yusoff, M. F., Ong, L. M., Bavanandan, S., Rodzlan Hasani, W. S., Tan, E. Z. Z., Wong, I., Rifin, H. M., Robert, T. G., Ismail, H., Wong, N. I., Ahmad, G., Ambak, R., Othman, F., Abd Hamid, H. A., & Aris, T. (2020). Prevalence of chronic kidney disease and its associated factors in Malaysia; findings from a nationwide population-based cross-sectional study. *BMC Nephrology*, *21*(1), 344. https://doi.org/10.1186/s12882-020-01966-8

Sanders, J. B., Bremmer, M. A., Deeg, D. J. H., & Beekman, A. T. F. (2012). Do depressive symptoms and gait speed impairment predict each other's incidence? A 16-year prospective study in the community. *Journal of the American Geriatrics Society*. https://doi.org/10.1111/j.1532-5415.2012.04114.x

Santilli, V., Bernetti, A., Mangone, M., & Paoloni, M. (2014). Clinical definition of sarcopenia. *Clinical Cases in Mineral and Bone Metabolism*, *11*(3), 177–180. https://doi.org/10.11138/ccmbm/2014.11.3.177

Santos, L., Cavalheiro Do Espírito Santo, R., Hax, V., Mendonça Da Silva Chakr, R., &

Xavier, R. (2020). Association of SARC-F performance with comorbidities, physical disability and lower albumin levels in systemic sclerosis patients. *Annals of the Rheumatic Diseases*, *79*(Suppl 1), 168 LP – 168. https://doi.org/10.1136/annrheumdis-2020-eular.3800

Sayer, A. A., Syddall, H., Martin, H., Patel, H., Baylis, D., & Cooper, C. (2008). The developmental origins of sarcopenia. *Journal of Nutrition, Health and Aging*. https://doi.org/10.1007/BF02982703

Sazlina, S.-G., Lee, P. Y., Chan, Y. M., A. Hamid, M. S., & Tan, N. C. (2020). The prevalence and factors associated with sarcopenia among community living elderly with type 2 diabetes mellitus in primary care clinics in Malaysia. *PLOS ONE*. https://doi.org/10.1371/journal.pone.0233299

Seo, J. Y., Kim, J. H., & Kong, Y. Y. (2019). Unraveling the paradoxical action of androgens on muscle stem cells. In *Molecules and Cells*. https://doi.org/10.14348/molcells.2019.0004

Sharma, D., Hawkins, M., & Abramowitz, M. K. (2014). Association of sarcopenia with egfr and misclassification of obesity in adults with ckd in the United States. *Clinical Journal of the American Society of Nephrology*. https://doi.org/10.2215/CJN.02140214

Shen, Y., Chen, J., Chen, X., Hou, L. S., Lin, X., & Yang, M. (2019). Prevalence and Associated Factors of Sarcopenia in Nursing Home Residents: A Systematic Review and Meta-analysis. In *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2018.09.012

Shimokata, H., & Ando, F. (2012). Sarcopenia and its risk factors in epidemiological study. *Nippon Ronen Igakkai Zasshi. Japanese Journal of Geriatrics*.

https://doi.org/10.3143/geriatrics.49.721

Smith, L., Firth, J., Grabovac, I., Koyanagi, A., Veronese, N., Stubbs, B., Soysal, P., Yang, L., & Jackson, S. E. (2019). The association of grip strength with depressive symptoms and cortisol in hair: A cross-sectional study of older adults. *Scandinavian Journal of Medicine and Science in Sports*. https://doi.org/10.1111/sms.13497

Snyder, C. K., Lapidus, J. A., Cawthon, P. M., Dam, T. T. L., Sakai, L. Y., & Marshall, L. M. (2012). Serum albumin in relation to change in muscle mass, muscle strength, and muscle power in older men. *Journal of the American Geriatrics Society*. https://doi.org/10.1111/j.1532-5415.2012.04115.x

Soares, J. D. P., Gomes, T. L. N., Siqueira, J. M., Oliveira, I. C. L., Mota, J. F., Laviano, A., & Pimentel, G. D. (2019). Muscle function loss is associated with anxiety in patients with gastrointestinal cancer. *Clinical Nutrition ESPEN*. https://doi.org/10.1016/j.clnesp.2018.11.003

Sonou, T., Ohya, M., Kawakami, K., Yashiro, M., Mima, T., Negi, S., & Shigematsu, T. (2020). High phosphate levels promote muscle atrophy via myostatin expression in differentiated L6 myotubes. *Research Square*. https://doi.org/10.21203/rs.3.rs-71503/v1

Soysal, P., Smith, L., Tan, S. G., Capar, E., Veronese, N., & Yang, L. (2021). Excessive daytime sleepiness is associated with an increased frequency of falls and sarcopenia. *Experimental Gerontology*. https://doi.org/10.1016/j.exger.2021.111364

St. Peter, W. L. (2015). Management of Polypharmacy in Dialysis Patients. *Seminars in Dialysis*. https://doi.org/10.1111/sdi.12377

Steffl, M., Bohannon, R., Petr, M., Kohlikova, E., & Holmerova, I. (2014). Relation Between Cigarette Smoking and Sarcopenia: Meta-Analysis. *Physiological Research / Academia*

Scientiarum Bohemoslovaca, *64*, 419–426. https://doi.org/10.33549/physiolres.932802

Stubbs, B., Vancampfort, D., Firth, J., Schuch, F. B., Hallgren, M., Smith, L., Gardner, B., Kahl, K. G., Veronese, N., Solmi, M., Carvalho, A. F., & Koyanagi, A. (2018). Relationship between sedentary behavior and depression: A mediation analysis of influential factors across the lifespan among 42,469 people in low- and middle-income countries. *Journal of Affective Disorders*. https://doi.org/10.1016/j.jad.2017.12.104

Su, Y., Hirayama, K., Han, T., Izutsu, M., & Yuki, M. (2019). Sarcopenia Prevalence and Risk Factors among Japanese Community Dwelling Older Adults Living in a Snow-Covered City According to EWGSOP2. *Journal of Clinical Medicine*. https://doi.org/10.3390/jcm8030291

Sugimoto, K., Tabara, Y., Ikegami, H., Takata, Y., Kamide, K., Ikezoe, T., Kiyoshige, E., Makutani, Y., Onuma, H., Gondo, Y., Ikebe, K., Ichihashi, N., Tsuboyama, T., Matsuda, F., Kohara, K., Kabayama, M., Fukuda, M., Katsuya, T., Osawa, H., … Rakugi, H. (2019). Hyperglycemia in non-obese patients with type 2 diabetes is associated with low muscle mass: The Multicenter Study for Clarifying Evidence for Sarcopenia in Patients with Diabetes Mellitus. *Journal of Diabetes Investigation*. https://doi.org/10.1111/jdi.13070

Suzana, S., & Siti Saifa, H. (2007). Validation of nutritional screening tools against anthropometric and functional assessments among elderly people in Selangor. Malaysian Journal of Nutrition.

Taburan Penduduk dan Ciri-ciri Asas Demografi. (2010). *Department of Statistics, Malaysia.* Retrieved from https://www.mycensus.gov.my/index.php/ms/produk-banci/penerbitan/banci-2010/664-taburan-penduduk-dan-ciri-ciri-asas-demografi-2010

Taibanguay, N., Chaiamnuay, S., Asavatanabodee, P., & Narongroeknawin, P. (2019). Effect of patient education on medication adherence of patients with rheumatoid arthritis: A randomized controlled trial. *Patient Preference and Adherence*. https://doi.org/10.2147/PPA.S192008

Tanaka, T., Akishita, M., Unyaporn, S., & Iijima, K. (2018). POLYPHARMACY AS A PREDICTOR OF SARCOPENIA, DISABILITY, AND MORTALITY AMONG COMMUNITY-DWELLING OLDER ADULTS. *Innovation in Aging*. https://doi.org/10.1093/geroni/igy031.3653

Tatt, C. H., Nur ', S., Adznam, A., Ibrahim, Z., & Norazman, C. W. (2019). Nutritional Status in Relation to Depressive Symptoms among Chinese Elderly in Malaysia. In Malaysian Journal of Medicine and Health Sciences.

Tsai, A. C., & Chang, M. Z. (2011). Long-form but not short-form Mini-Nutritional Assessment is appropriate for grading nutritional risk of patients on hemodialysis-A cross-sectional study. *International Journal of Nursing Studies*. https://doi.org/10.1016/j.ijnurstu.2011.05.004

Tuna, F., Üstündağ, A., Başak Can, H., & Tuna, H. (2019). Rapid Geriatric Assessment, Physical Activity, and Sleep Quality in Adults Aged more than 65 Years: A Preliminary Study. *Journal of Nutrition, Health and Aging*. https://doi.org/10.1007/s12603-019-1212-z

Tyrovolas, S., Koyanagi, A., Olaya, B., Ayuso-Mateos, J. L., Miret, M., Chatterji, S., Tobiasz-Adamczyk, B., Koskinen, S., Leonardi, M., & Haro, J. M. (2016). Factors associated with skeletal muscle mass, sarcopenia, and sarcopenic obesity in older adults: a multi-continent study. *Journal of Cachexia, Sarcopenia and Muscle*.

https://doi.org/10.1002/jcsm.12076

Ukegbu, P. O., Kruger, H. S., Meyer, J. D., Nienaber-Rousseau, C., Botha-Ravyse, C., Moss, S. J., & Kruger, M. I. (2018). The association between calf circumference and appendicular skeletal muscle mass index of black urban women in Tlokwe City. *Journal of Endocrinology, Metabolism and Diabetes of South Africa*. https://doi.org/10.1080/16089677.2018.1518825

Umeukeje, E. M., Mixon, A. S., & Cavanaugh, K. L. (2018). Phosphate-control adherence in hemodialysis patients: Current perspectives. In Patient Preference and Adherence. https://doi.org/10.2147/PPA.S145648

United Nations Department of Economic and Social Affairs Population Division. (2017). World Population Prospects: The 2017 Revision. *World Population Prospects*.

Valderas, J. M., Starfield, B., Sibbald, B., Salisbury, C., & Roland, M. (2009). Defining comorbidity: Implications for understanding health and health services. *Annals of Family Medicine*. https://doi.org/10.1370/afm.983

Vandewoude, M. F. J., Alish, C. J., Sauer, A. C., & Hegazi, R. A. (2012). Malnutrition-sarcopenia syndrome: Is this the future of nutrition screening and assessment for older adults? In *Journal of Aging Research*. https://doi.org/10.1155/2012/651570

Vasilopoulou, C., Bourtsi, E., Giaple, S., Koutelekos, I., Theofilou, P., & Polikandrioti, M. (2016). The Impact of Anxiety and Depression on the Quality of Life of Hemodialysis Patients. *Global Journal of Health Science*. https://doi.org/10.5539/gjhs.v8n1p45

Vaz, I. M. F., Freitas, A. T. V. de S., Peixoto, M. do R. G., Ferraz, S. F., & Campos, M. I. V. A. M. (2014). Food intake in patients on hemodialysis. Revista de Nutricao. https://doi.org/10.1590/1415-52732014000600002

Velázquez-Alva, M. C., Irigoyen-Camacho, M. E., Zepeda-Zepeda, M. A., Lazarevich, I., Arrieta-Cruz, I., & D'Hyver, C. (2019). Sarcopenia, nutritional status and type 2 diabetes mellitus: A cross-sectional study in a group of Mexican women residing in a nursing home. *Nutrition and Dietetics*. https://doi.org/10.1111/1747-0080.12551

Vikberg, S., Sörlén, N., Brandén, L., Johansson, J., Nordström, A., Hult, A., & Nordström, P. (2019). Effects of Resistance Training on Functional Strength and Muscle Mass in 70-Year-Old Individuals With Pre-sarcopenia: A Randomized Controlled Trial. *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2018.09.011

Visser, W. J., Egmond, A. M. E. de M., Timman, R., Severs, D., & Hoorn, E. J. (2020). Risk Factors for Muscle Loss in Hemodialysis Patients with High Comorbidity. *Nutrients*, *12*(9), 2494. https://doi.org/10.3390/nu12092494

Volpato, S., Bianchi, L., Cherubini, A., Landi, F., Maggio, M., Savino, E., Bandinelli, S., Ceda, G. P., Guralnik, J. M., Zuliani, G., & Ferrucci, L. (2014). Prevalence and clinical correlates of sarcopenia in community-dwelling older people: Application of the EWGSOP definition and diagnostic algorithm. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences*. https://doi.org/10.1093/gerona/glt149

Volpi, E., Nazemi, R., & Fujita, S. (2004). Muscle tissue changes with aging. In *Current Opinion in Clinical Nutrition and Metabolic Care*. https://doi.org/10.1097/01.mco.0000134362.76653.b2

Wang, H., Naghavi, M., Allen, C., Barber, R. M., Carter, A., Casey, D. C., Charlson, F. J., Chen, A. Z., Coates, M. M., Coggeshall, M., Dandona, L., Dicker, D. J., Erskine, H. E., Haagsma, J. A., Fitzmaurice, C., Foreman, K., Forouzanfar, M. H., Fraser, M. S.,

Fullman, N., … Zuhlke, L. J. (2016). Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet*, *388*(10053), 1459–1544. https://doi.org/10.1016/S0140-6736(16)31012-1

Wang, T., Feng, X., Zhou, J., Gong, H., Xia, S., Wei, Q., Hu, X., Tao, R., Li, L., Qian, F., & Yu, L. (2016). Type 2 diabetes mellitus is associated with increased risks of sarcopenia and pre-sarcopenia in Chinese elderly. *Scientific Reports*. https://doi.org/10.1038/srep38937

Wilkinson, D. J., Piasecki, M., & Atherton, P. J. (2018). The age-related loss of skeletal muscle mass and function: Measurement and physiology of muscle fibre atrophy and muscle fibre loss in humans. In *Ageing Research Reviews*. https://doi.org/10.1016/j.arr.2018.07.005

Wilkinson, T., Miksza, J., Baker, L., Lightfoot, C., Watson, E., Yates, T., & Smith, A. (2020). Sarcopenia, Chronic Kidney Disease and Risk of Mortality: Findings From 426,839 Individuals in the UK Biobank. *Nephrology Dialysis Transplantation*, *35*(Supplement_3). https://doi.org/10.1093/ndt/gfaa140.MO023

Will, Y., Shields, J. E., & Wallace, K. B. (2019). Drug-induced mitochondrial toxicity in the geriatric population: Challenges and future directions. In *Biology*. https://doi.org/10.3390/biology8020032

Wilson, D., Jackson, T., Sapey, E., & Lord, J. M. (2017). Frailty and sarcopenia: The potential role of an aged immune system. In *Ageing Research Reviews*. https://doi.org/10.1016/j.arr.2017.01.006

Wong, S. W., Chan, Y. M., & Lim, T. S. (2011). Correlates of physical activity level among

hemodialysis patients in Selangor, Malaysia. *Malaysian Journal of Nutrition*.

Woo, J., Leung, J., & Morley, J. E. (2014). Validating the SARC-F: A Suitable Community Screening Tool for Sarcopenia? *Journal of the American Medical Directors Association*, *15*(9), 630–634. https://doi.org/10.1016/j.jamda.2014.04.021

Wu, Y. H., Hwang, A. C., Liu, L. K., Peng, L. N., & Chen, L. K. (2016). Sex differences of sarcopenia in Asian populations: The implications in diagnosis and management. *Journal of Clinical Gerontology and Geriatrics*, *7*(2), 37–43. https://doi.org/10.1016/j.jcgg.2016.04.001

Yamada, S., Tokumoto, M., Tatsumoto, N., Taniguchi, M., Noguchi, H., Nakano, T., Masutani, K., Ooboshi, H., Tsuruya, K., & Kitazono, T. (2014). Phosphate overload directly induces systemic inflammation and malnutrition as well as vascular calcification in uremia. *American Journal of Physiology - Renal Physiology*. https://doi.org/10.1152/ajprenal.00633.2013

Yamamoto, S., Matsuzawa, R., Harada, M., Watanabe, T., Shimoda, T., Suzuki, Y., Kamiya, K., Osada, S., Yoshida, A., & Matsunaga, A. (2019). SARC-F Questionnaire: Rapid and Easy Tool for Identifying Physical Limitations in Hemodialysis Patients. *JCSM Clinical Reports*. https://doi.org/10.17987/jcsm-cr.v4i1.74

Yang, C. W., Li, C. I., Li, T. C., Liu, C. S., Lin, C. H., Lin, W. Y., & Lin, C. C. (2019). Combined Effects of Having Sleep Problems and Taking Sleeping Pills on the Skeletal Muscle Mass and Performance of Community-Dwelling Elders. *Scientific Reports*. https://doi.org/10.1038/s41598-019-50295-w

Yap, S. F., Boo, N. Y., Pramod, D. S., Thaw, Z., Liew, S. F., Woo, L. F., Choo, P. Y., & Hatta, N. M. (2020). Risk Factors Associated with Sarcopenia Among Independently

Mobile, Institutionalised Older People in the Klang Valley of Malaysia: A Cross-Sectional Study. *The Malaysian Journal of Medical Sciences: MJMS*, *27*(2), 120.

Yazar, T., & Olgun Yazar, H. (2019). Prevalance of sarcopenia according to decade. *Clinical Nutrition ESPEN*. https://doi.org/10.1016/j.clnesp.2018.11.005

Yong, H. W., Hashim, Z., & Jamil @ Osman, Z. (2016). Reliability and validatidity of Hospital Anxiety and Depression Scale (HADS) on breast cancer survivors: Malaysia case study. *Asia Pacific Environmental and Occupational Health Journal*.

Yoon, K. H., Lee, J. H., Kim, J. W., Cho, J. H., Choi, Y. H., Ko, S. H., Zimmet, P., & Son, H. Y. (2006). Epidemic obesity and type 2 diabetes in Asia. *In Lancet.* https://doi.org/10.1016/S0140-6736(06)69703-1

Yoowannakul, S., Tangvoraphonkchai, K., Vongsanim, S., Mohamed, A., & Davenport, A. (2018). Differences in the prevalence of sarcopenia in haemodialysis patients: the effects of gender and ethnicity. *Journal of Human Nutrition and Dietetics*. https://doi.org/10.1111/jhn.12555

Yu, R., Wong, M., Leung, J., Lee, J., Auyeung, T. W., & Woo, J. (2014). Incidence, reversibility, risk factors and the protective effect of high body mass index against sarcopenia in community-dwelling older Chinese adults. *Geriatrics and Gerontology International*. https://doi.org/10.1111/ggi.12220

Yu, S., Appleton, S., Chapman, I., Adams, R., Wittert, G., Visvanathan, T., & Visvanathan, R. (2015). An Anthropometric Prediction Equation for Appendicular Skeletal Muscle Mass in Combination With a Measure of Muscle Function to Screen for Sarcopenia in Primary and Aged Care. *Journal of the American Medical Directors Association*. https://doi.org/10.1016/j.jamda.2014.06.018

Yu, S. C. Y., Khow, K. S. F., Jadczak, A. D., & Visvanathan, R. (2016). Clinical Screening Tools for Sarcopenia and Its Management. *Current Gerontology and Geriatrics Research, 2016*. https://doi.org/10.1155/2016/5978523

Yusop, N. B. M., Mun, C. Y., Shariff, Z. M., & Huat, C. B. (2013). Factors associated with quality of life among hemodialysis patients in Malaysia. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0084152

Zaky, D. S. E., & Abdallah, A. M. (2019). *Prevalence of Sarcopenia among Hemodialysis Patients in a University Hospital , Cairo , Egypt*. *8*(2), 46–51. https://doi.org/10.5923/j.ijpt.20190802.03

Zasadzka, E., Pieczyńska, A., Trzmiel, T., & Pawlaczyk, M. (2020). Polish translation and validation of the SARC-F tool for the assessment of sarcopenia. *Clinical Interventions in Aging*. https://doi.org/10.2147/CIA.S245074

Zha, Y., & Qian, Q. (2017). Protein nutrition and malnutrition in CKD and ESRD. In *Nutrients*. https://doi.org/10.3390/nu9030208

Zhao, Z., Ji, C., Liu, Y., Gao, S., & Xia, Y. (2020). Higher handgrip strength predicts a lower risk of depressive symptoms in rural Chinese populations. *Journal of Affective Disorders*. https://doi.org/10.1016/j.jad.2020.03.028

Zhu, B. Q., Li, X. M., Wang, D., & Yu, X. F. (2014). Sleep quality and its impact on glycaemic control in patients with type 2 diabetes mellitus. *International Journal of Nursing Sciences*. https://doi.org/10.1016/j.ijnss.2014.05.020

ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA

Research title	:	**Risk of Sarcopenia and its Associated Factors Among Hemodialysis Patients in Selected Dialysis Centres.**
Study Site	:	**Hemodialysis centers in Kinta District, Perak**
JKEUPM Ref No.	:	**JKEUPM-2021-017**
Researcher	:	**Low Siao Jou**
Supervisor	:	**Assoc. Prof. Dr. Chan Yoke Mun**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 8/1/2021
2. Respondent Information Sheet & Consent (English), Version 2 dated 16/2/2021
3. Respondent Information Sheet & Consent (Malay), Version 2 dated 16/2/2021
4. Respondent Information Sheet & Consent (Other), Version 2 dated 16/2/2021
5. Proposal (English), Version 2 dated 16/2/2021
6. Questionnaire/Interview (English), Version 1 dated 8/1/2021
7. Questionnaire/Interview (Malay), Version 1 dated 8/1/2021
8. Questionnaire/Interview (Other), Version 1 dated 8/1/2021
9. Curriculum Vitae of:
    a. Dr. Assoc. Prof. Dr. Chan Yoke Mun

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance to the ICH-GCP Guidelines.
Decision by JKEUPM:

[x] Approved

[x] **Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research**

[ ] Disapproved

Please note that the approval is **VALID UNTIL 12 MARCH 2022**

Researchers should comply with the following:

I. Complete a Study Final Report upon study completion (Form 3.2).

II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.

III. Applicable for Clinical Trial Studies and Clinical interventional Studies only: Progress Report has to be submitted to JKEUPM at every 6 months from the date of approval (Form 3.1). Report occurrences of all Serious Adverse Events (SAEs), Suspected Unexpected Serious Adverse Reaction (SUSARs) and Protocol Deviation/ Violation at all JKEUPM approved sites to JKEUPM. SAEs are to be reported within 15 calendar days from awareness of event by investigator. Initial report of SUSARs are to be reported as soon as possible but not later than

sk: Prof Dr Chan Yoke Mun
Penyelia Projek Akhir Tahun

Dr Syafiqah Rahamat
Penyelaras kursus

APPENDIX C RESPONDENT'S INFORMATION SHEET AND CONSENT FORM (3 LANGUAGES)

JAWATANKUASA ETIKA UNIVERSITI UNTUK PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR, MALAYSIA

FORM 2.4: RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE :
Risk of sarcopenia and its associated factors among hemodialysis patients in selected dialysis centres

2. INTRODUCTION:

Hemodialysis is require for patients who have kidney failure disease. Nevertheless, hemodialysis treatment may lead to certain complications such as sarcopenia. Sarcopenia is a condition commonly happen in older person whereby patients are losing their body muscle and getting weaker. Current studies show incidence of sarcopenia is high among hemodialysis patients, at a magnitude higher than older persons. This is caused by the kidney disease and the dialysis procedure itself which promote the breakdown of protein of the body and other factors such as increasing in age, body weight, educational level, smoking, presence of other diseases, serum phosphorus and malnutrition.

Sarcopenia can elevate risk for falls, reduced functional capacity, and increased cardiovascular risk in hemdialysis patients. Despite its importance and growing clinical recognition, the issue of sarcopenia has not been fully addressed in the CKD literature. Most of the sarcopenia studies globally or locally, were focused on the older adults, with little information available for dialysis patients. Hence, this study aims to identify the risk of sarcopenia and its associated factors among haemodialysis patients in selected dialysis centers in Malaysia.

3. WHAT WILL YOU HAVE TO DO?

You will be provided with quick response (QR) codes to access the online version of questionnaire (in Google form). No invasive measurement is included and it will not cause any discomfort. After reading the information sheet and informed consent, you need to answer the only question provided on the first page of Google form : "Do you agree to participate in this study?". If the answer Yes was chosen, this means that you agree and have voluntarily participated in this study.

The questionnaire will take approximately 25-30 minutes to complete. You are only required to answer the following sections: **Section A** (socio-demographic factors), **Section E** (nutritional status), **Section F** (sleep quality), **Section G** (depression) and **Section H** (risk of sarcopenia). For **Section E**, you are required to measure your calf-circumference and mid-arm circumference. You can refer to the attached video to get an idea on how to use a non-elastic tape (tailor tape)/ string for measurements. The questionnaire will not ask for information on **Sections B, C, D** (polypharmacy, comorbidities, dry weight, height, BMI, serum albumin, and serum phosphorus). Your consent is required to obtain these information from your medical records.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

Your participation is **NOT SUITABLE** if you are:

a) Non-Malaysian
b) Having unstable condition, being hospitalized in past three months
c) Diagnosed with Hepatitis B or C
d) Diagnosed with specific health issues (e.g., dementia, inflammatory illness, lung or heart failure or liver diseases)

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

You will be able to know your risk of sarcopenia, nutritional status, sleep quality, and depression. These information will help you to improve your health status.

You will not be paid by participating in this study but a small door gift will be given as a token of appreciation.

(b) TO THE INVESTIGATOR?

Information obtained will be used by researchers to find out the association between several factors with the risk of sarcopenia among haemodialysis patients. These findings will serve as baseline data for future sarcopenia research, and allow healthcare professionals to plan for intervention programs to improve the quality of life (QoL) and functional status of the hemodialsysis patients.

6. WHAT ARE THE POSSIBLE RISKS?

As this study applies non-invasive techniques, you are not expose to any physical risk.

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

The information collected is used for academic purposes only and will be kept strictly confidential. Once the data retrieved from the survey software provider (Google Forms), it will be stored in a password protected Google Drive.

8. WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

Ethics Committee for Research Involving Human Subject UPM (JKEUPM) Review Panel has approved the study, and may be reached through the following contact for information regarding rights of study participants, including grievances and complaints.

Ethics Committee for Research Involving Human Subject UPM (JKEUPM)
Research Management Centre
Office of The Deputy Vice Chancellor (Research & Innovation)
University Putra Malaysia
43400 UPM Serdang, Selangor

If you have any inquiry about the study, you may contact Ms Low Siao Jou at 019-5610491 (email: 198446@student.upm.edu.my) or to the research's supervisor: Professor Dr. Chan Yoke Mun at 03-89472433 (email: cym@upm.edu.my).

*Please initial here if you have read and understood the contents of this page*_____

9. CONSENT

I ..... Identity Card No. .....

address.....

.....hereby voluntarily agree to take part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature .....
(Respondent)

Date :.....

Signature .....
(Witness)

Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date .....

Signature .....
(Researcher)

JAWATANKUASA ETIKA UNIVERSITI UNTUK PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR, MALAYSIA

BORANG 2.4: PENERANGAN DAN PERSETUJUAN RESPONDEN

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1.TAJUK KAJIAN

Risiko sarkopenia dan faktor-faktor yang berkaitan dalam kalangan pesakit hemodialisis di pusat dialisis terpilih

2. PENGENALAN

Hemodialysis merupakan rawatan yang diperlukan untuk pesakit yang mengalami penyakit kegagalan fungsi buah pinggan. Namum demikian, rawatan hemodialisis boleh menyebabkan komplikasi tertentu seperti sarkopenia. Sarkopenia adalah suatu keadaan yang selalu berlaku dalam kalangan warga emas di mana pesakit mengalami kehilangan otot badan dan semakin lesu. Namum demikian, kajian terkini menunjukkan kejadian sarkopenia adalah tinggi dalam kalangan pesakit hemodialisis, jauh lebih tinggi berbanding kejadian dalam kalangan warga emas. Hal ini disebabkan oleh pelbagai faktor termasuk penyakit kegagalan fungsi buah pinggan dan rawatan dialisis sendiri yang menyebabkan pemecahan protein badan serta faktor-faktor lain seperti usia yang semakin meningkat, berat badan, tahap pendidikan, merokok, penyakit lain, tahap fosforus darah dan kekurangan zat makanan.

Sarkopenia boleh meningkatkan risiko kematian dan morbiditi pesakit hemodialisis, dan juga menyebabkan peningkatan risiko jatuh, penurunan keupayaan berfungsi, dan peningkatan risiko kardiovaskular. Malangnya, masalah sarkopenia tidak diberi perhatian sepenuhnya dalam literatur penyakit buah pinggang kronik (CKD). Kebanyakan kajian sarkopenia dijalankan dalam kalangan warga emas, dengan maklumat yang amat kekurangan untuk pesakit hemodialysis, sama ada di peringkat antarabangsa mahupun di Malaysia. Oleh itu, kajian ini bertujuan untuk mengenal pasti risiko sarkopenia dan faktor-faktor yang berkaitan dalam kalangan pesakit hemodialisis di pusat dialisis terpilih di Malaysia.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Anda akan diberikan kod respons pantas (QR) untuk menjawab versi soal selidik dalam talian (Google Form). Kajian ini tidak akan menimbulkan rasa tidak selesa kerana tiada pengukuran invasif yang terlibat. Setelah membaca lembaran maklumat tersebut, anda diminta untuk menjawab soalan yang disediakan di halaman pertama borang Google Form: "Adakah anda bersetuju untuk mengambil bahagian dalam kajian ini?" Sekiranya anda memilih Ya, ini bermaksud anda bersetuju dan mengambil bahagian dalam kajian ini secara sukarela.
Soal selidik ini akan mengambil masa selama 25-30 minit untuk disiapkan. Dalam soal selidik ini, anda diminta untuk melengkapkan bahagian-bahagian tersebut: **Bahagian A** (sosio-demografi), **Bahagian E** (status pemakanan), **Bahagian F** (kualiti tidur), **Bahagian G** (kemurungan), dan **Bahagian H** (risiko sarkopenia). Untuk **Bahagian E**, anda diminta untuk mengukur lilitan betis dan lilitan lengan atas anda. Sila merujuk kepada video yang dilampirkan untuk mendapatkan idea mengenai cara menggunakan pita tidak elastik (pita jahit) / utas untuk pengukuran. Soal selidik tersebut tidak akan meminta maklumat mengenai **bahagian B, C, dan D** (pengambilan ubat, masalah penyakit lain, berat badan kering, tinggi, BMI, albumin serum dan fosfor serum). Persetujuan anda diminta bagi memperoleh data dari rekod perubatan ada.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?
Anda **TIDAK SESUAI** untuk mengambil bahagian dalam kajian ini sekiranya anda :

a) Bukan warganegara Malaysia
b) Mengalami keadaan yang tidak stabil atau dimasukkan ke hospital dalam tiga bulan terakhir
c) Diagnosis dengan Hepatitis B atau C
d) Diagnosis dengan masalah kesihatan tertentu (seperti demensia, penyakit keradangan, paru-paru atau jantung atau penyakit hati)

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a)KEPADA ANDA SEBAGAI PESERTA?

Anda boleh mengetahui lebih lanjut mengenai risiko sarkopenia, status pemakanan, kualiti tidur, dan kemurungan anda. Maklumat ini dapat membantu anda untuk meningkatkan taraf kesihatan. Anda tidak akan dibayar untuk menyertai kajian ini, tetapi hadiah kecil akan diberikan sebagai tanda penghargaan.

b) KEPADA PENYELIDIK?

Maklumat tersebut akan digunakan oleh penyelidik untuk menentukan hubungan antara faktor-faktor dan risiko sarkopenia pada pesakit hemodialisis. Penemuan ini dapat berfungsi sebagai data asas untuk penyelidikan sarcopenia di masa depan, dan membolehkan profesional kesihatan merancang program intervensi untuk meningkatkan kualiti hidup (QoL) dan status fungsi pesakit hemodialisis.

6. ADAKAH IA BERISIKO?

Oleh kerana kajian ini melibatkan teknik yang tidak invasif, anda tidak akan terdedah kepada risiko fizikal.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Maklumat yang dikumpulkan adalah digunakan untuk tujuan akademik sahaja dan akan dirahsiakan. Setelah data diambil daripada perisian Google Forms, data tersebut akan disimpan dalam Google Drive yang dilindungi kata laluan.

8. SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA MEMPUNYAI SOALAN TAMBAHAN SEMASA MENGIKUTI PENYELIDIKAN INI?

Panel Penilai Jawatankuasa Etika UPM (Jawatan Etika untuk Penyelidikan Melibatkan Manusia) telah meluluskan kajian ini, dan dapat dihubungi menerusi alamat berikut untuk mendapatkan maklumat mengenai hak peserta kajian atau membuat aduan.

Jawatan Etika untuk Penyelidikan Melibatkan Manusia
Pusat Pengurusan Penyelidikan
Pejabat Timbalan Cancelor (Penyelidikan & Inovasi)
University Putra Malaysia
43400 UPM Serdang, Selangor

Sekiranya anda mempunyai pertanyaan mengenai kajian ini, anda boleh menghubungi Cik Low Siao Jou di atas talian 019-5610491 (e-mel: 198446@student.upm.edu.my) atau penyelia penyelidikan: Profesor Dr. Chan Yoke Mun di atas talian 03-97692433 (e-mel: cym@upm.edu.my).

Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan halaman ini _____

9. PERSETUJUAN

Saya…… No Kad Pengenalan. …… beralamat…… ……..dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam penyelidikan yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi metodologi, risiko dan komplikasi (seperti tertulis pada Helaian Penerangan Responden). Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang melibatkan saya.

I setuju/tidak bersetuju untuk imei/gambar/rakaman video/ rakaman suara digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan …… (*Responden*)

Tarikh :……..

Tandatangan …… (*Saksi*)

Nama :……..

No. K/P: ……..

Saya mengesahkan bahawa saya telah menerangkan kepada responden ini sifat dan tujuan penyelidikan yang tersebut di atas.

Tarikh ……..……

Tandatangan …….. (*Penyelidik*)

JAWATANKUASA ETIKA UNIVERSITI UNTUK
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UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

表格 2.4：受访者资料与知情同意书

请仔细阅读以下信息。如有任何疑問，欢迎联络我们咨询。

1. **研究标题：**
   血液透析中心患者的肌肉减少症风险（*risk of sarcopenia*）以及其相关因素

2. **简介：**
   患有肾衰竭疾病的患者需要进行血液透析治疗(简称血透)。但是，这治疗有可能诱发并加重肌肉减少症等其他状况。肌肉减少症是老年人中常见的一种病症，患者将会失去身体部分的肌肉并变得虚弱。当前的研究表明血液透析患者的肌肉减少症的发病率更为普遍，且高于老年人。首要原因很可能是由疾病本身以及血透治疗所引起的蛋白水解(proteolysis)导致， 并且也受到个人因素（例如：年龄，体重指数(BMI)，教育程度，吸烟，慢性病，血清磷和营养不良等）的影响。

   肌肉减少症可使病人的身体功能下降以及提高他们跌倒与血管疾病的风险。尽管当代社会对肌肉减少症的认知日益提高，此问题并未在 CKD 文献中得到充分的解释。全球或本地肌肉减少症的研究大多针对老年群体，而有关血透患者的信息是相当的少。因此本研究旨在探讨马来西亚血液透析中心患者的肌肉减少症风险以及其相关因素。

3. **如果参加本研究您需要做什么？**
   请您扫描二维码*(QR codes)*以进入答题页面*(Google Form)*。为了您的安全着想，此问卷将采用非侵入性测量方式进行。本知情同意书将提供给您一些信息以帮助您决定是否参与此研究。如果您对本协议的任何条款表示异议，您可以选择不进入问卷进行回答。反之，如果您自愿参与本研究，则请您在以下问题：“请问您同意参加此项研究吗？”勾选“是”。

   填写问卷大约需要 25-30 分钟。您只需要回答以下部分：**A 部分**（背景资料）,**E 部分**（营养状况），**F 部分**（睡眠质量），**G 部分**（抑郁症）以及 **H 部分**（肌肉减少症的风险）。在 **E 部分**中，您需要测量自己的小腿围和臂围。您可以参考问卷中随附的视频，以了解如何使用非弹性胶带（裁缝带）/绳子进行测量。此问卷将不会要求您提供有关 **B，C 和 D 部分**的信息（药物治疗，合并症，体重，身高，BMI，血清白蛋白和血清磷。这些信息将会在获取您的同意后从您的病历中获取。

4. **哪些人不宜参加本研究？**
   a）非马来西亚人
   b）病情不稳定/曾在过去三个月内住院
   c）诊断为 B 型或 C 型肝炎
   d）诊断出以下健康问题（例如痴呆，炎症，肺或心力衰竭或肝病）

5. 参与本研究所带来的益处：

a) **对您：**
此研究将加深您对自身的肌肉减少症风险，营养状况，睡眠质量，以及抑郁水平的认知。这些信息将帮助您更好地了解并且改善您的健康状况。虽然参与本研究将无提供任何经济补偿， 但您将会获得我们所赠送的小礼品以表谢意。

b) **对研究人员：**
此研究结果将有利于我们更深入地了解血透患者中肌肉减少症的风险，并阐明其与其他相关因素之间的关系。这些发现将为未来的肌肉减少症研究提供一些指导方针，并进一步完善现有的治疗方案，以改善血透患者的生活质量（QoL）及身体功能。

6. 参与本研究所带来的风险：
由于本研究采用非侵入性测量方式所进行，因此您将不会遭受任何风险以及不利影响。

7. 您个人信息的保密：
此研究仅出于学术目地對您进行個人資料收集。您的信息将完整并安全地保存在云存储服务 – *Google Drive* 上， 并且本研究结果的公开报告将不会披露您的个人身份。我们将在允许的范围内，尽一切努力保护您个人资料的隐私。

8. 如有问题或困难， 该与谁联系？
本研究已向博特拉大学研究伦理委员会（JKEUPM）进行报告，并经过委员会的全面审查后获得了批准。在回答问卷过程中，如有关伦理和权益的问题宜可联系：

Ethics Committee for Research Involving Human Subject UPM (JKEUPM)
Research Management Centre
Office of The Deputy Vice Chancellor (Research & Innovation)
University Putra Malaysia
43400 UPM Serdang, Selangor

如有其他疑问，请联络 Ms Low Siao Jou 電話：0195610491（198446@student.upm.edu.my）或研究主管：Chan Yoke Mun 教授，电话：03-89472433（cym@upm.edu.my）

如果您已经阅读并理解了此页面的内容，请在此处进行签名_____

9. 知情同意书

我_____身份证号码_____

地址_____

在此自愿同意参与上述研究*（临床/药物试验/录像/专门小组/访谈/问卷）。

我已经阅读了有关上述研究的介绍，包括其权利以及可能的受益和风险。我了解我有权在没有任何理由的情况下随时退出上述研究。我也了解这项研究是机密的，并且所有有关我的身份的信息将得以安全保密。

我*（希望/不希望）知道与我参与研究的相关结果。

我*（同意/不同意）与我有关的图像/照片/录像/声音记录，被任何形式的出版物或演示文稿所使用（如果适当）

***請删去不適用者**

受访者签名：_____ 见证人签名:_____

日期：_____ 日期:_____

IC:_____

我已经确认向受访者解释了上述研究的性质和目的。

日期：_____ 研究者签名：_____

APPENDIX D QUESTIONNAIRE (3 LANGUAGES)

FACULTY OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF DIETETICS

Questionnaire (English)

Research Title:

Risk of Sarcopenia and Its Associated Factors among Hemodialysis Patients in Selected Dialysis Centres

Researcher's Name: Low Siao Jou

Matric Number : 198446

Supervisor's Name: Professor Dr. Chan Yoke Mun

Confidential and for research purpose only

Name: _____

SECTION A

Instruction: This questionnaire is for academic purpose only. All the information will be kept private and confidential. Thank you for your cooperation in answering this questionnaire.

1. Age: _____ years old

2. Sex:
   - ☐ Male
   - ☐ Female

3. Ethnicity
   - ☐ Malay
   - ☐ Chinese
   - ☐ Indian
   - ☐ Others, please specify: _____

4. Educational Level:
   - ☐ No formal education
   - ☐ Primary Education
   - ☐ Secondary Education
   - ☐ Tertiary (Diploma/ Degree/ Master/ PhD)
   - ☐ others, please specify_____

5. Smoking status:
   - ☐ Non-smoker
   - ☐ Past smoker
   - ☐ Current smoker

6. Smoking level **(answer if you are past smoker or current smoker):**
   - Total number of years of smoking :- _____
   - Number of cigarettes per day: _____

SECTION B

Instruction: Please read each of the following statements and tick the statement that applied to you the most. There are no right or wrong answers.

A. Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties? ☐ severe decrease in food intake ☐ moderate decrease in food intake ☐ no decrease in food intake
B. Do you experience any weight loss during the past 3 months? ☐ weight loss greater than 3kg ☐ does not know ☐ weight loss between 1 and 3kg ☐ no weight loss
C. Mobility ☐ bed or chair bound ☐ able to get out of bed or chair but does not go out ☐ goes out
D. Has suffered psychological stress or acute disease in the past 3 months? ☐ yes ☐no

E. Neuropsychological problems

☐ severe dementia or depression
☐ mild dementia
☐ no psychological problems

G. Lives independently (not in nursing home or hospital)
☐ yes ☐ *no*

H. Takes more than 3 prescription drugs per day
☐ yes ☐no

I. Pressure sores or skin ulcers
☐ yes ☐no

J. How many full meals does the patient eat daily?

☐ 1 meal
☐ 2 meals
☐ 3 meals

K. Selected consumption markers for protein intake
•At least one serving of **dairy products** (milk, cheese, yoghurt) per day
☐ yes ☐no

•Two or more servings of **legumes or eggs** per week
☐ yes ☐no

•**Meat, fish or poultry** every day
☐ yes ☐no

L. Consumes two or more servings of **fruit or vegetables** per day
☐ no ☐yes

M. How much **fluid** (water, juice, coffee, tea, milk...) is consumed per day
☐ less than 3 cups
☐ 3 to 5 cups
☐ more than 5 cups

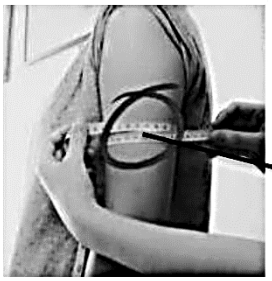
N. Mode of feeding
☐ unable to eat without assistance
☐ self-fed with some difficulty
☐ self-fed without any problem

O. Self-view of nutritional status
☐ views self as being malnourished
☐ is uncertain of nutritional state
☐ views self as having no nutritional problem

P. In comparison with other people of the same age, how does the patient consider his / her health status?
☐ not as good
☐ does not know
☐ as good
☐ better

Q. Mid-arm circumference in cm

☐ less than 21
☐ 21 to 22
☐ greater than 22



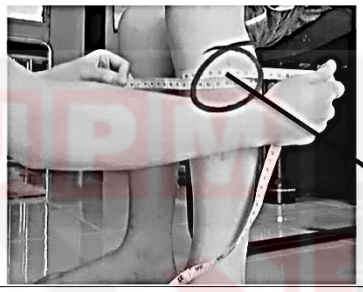
How to measure using sewing tape

1. Subject is asked to stand with his hands hanging on the sides
2. Determine the center point on the right arm
3. Place the tape on the center point
4. Measurement values can be taken

For more information, please scan

R. Calf circumference in cm

☐ less than 31
☐ 31 or greater



How to measure using sewing tape

1. Subjects are required to sit with leg bend at a 90 -degree angle.
2. Place the tape on the subject's right calf
3. Move the tape up & down until you find the largest circumference.
4. Measurement values can be taken

For more information, please scan

SECTION C

Instructions: The following questions relate to your usual sleep habits during the past month only (past 30 days). Please answer all questions.

1. During the past month, what time have you usually **sleep at night**

   - BED TIME (non HD treatment day)_____
   - BED TIME (HD treatment day) _____

2. During the past month, **how long** (in minutes) has it usually taken you to **fall asleep each night**?
   NUMBER OF MINUTES_____

3. During the past month, what time have you usually **got up in the morning**?
   - GETTING UP TIME (non-HD treatment day)_____
   - GETTING UP TIME (HD treatment day)_____

4. During the past month, how many **hours of actual sleep** have you got at night?

   HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions tick the one best response. Please answer <u>all</u> questions.

5. During the past month, how often have you had trouble sleeping because you ….

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
A. Could not get to sleep within 30 minutes	☐	☐	☐	☐
B. Woke up in the middle of the night or early morning	☐	☐	☐	☐

C. Had to get up to use the toilet	☐	☐	☐	☐
D. Could not breathe easily	☐	☐	☐	☐
E. Coughed or snored loudly	☐	☐	☐	☐
F. Felt too cold	☐	☐	☐	☐
G. Felt too hot	☐	☐	☐	☐
H. Had bad dreams	☐	☐	☐	☐
I. Had pain	☐	☐	☐	☐

J. Others, please describe ☐Yes:_____ ☐No

6. During the past month, how often have you taken **medicine to help you sleep** (prescribed or "over the counter")	☐	☐	☐	☐
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or taking part in social activities?	☐	☐	☐	☐
8. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	No problem at all ☐	Only a very slight problem ☐	Quite a problem ☐	A very big problem ☐
9. During the past month, how would you rate your sleep quality in general?	Very good ☐	Fairly good ☐	Fairly bad ☐	Very bad ☐

10. Do you have any food practices to help you sleep better?
☐No ☐Yes: _____

SECTION D

Instruction: Tick the box beside the statement that is closest to how you have been feeling in the past week. There is no right or wrong.

1. I still enjoy the things I used to enjoy
☐Definitely as much
☐Not quite so much
☐Only a little
☐Hardly at all

2. I can laugh and see the funny side of things
☐As much as I always could
☐Not quite so much now
☐Definitely not so much now
☐Not at all

3. I feel cheerful ☐Not at all ☐Not often ☐Sometimes ☐Most of the time
4. I feel as if I am slowed down ☐Nearly all the time ☐Very often ☐Sometimes ☐Not at all
5. I have lost interest in my appearance ☐Definitely ☐I don't take as much care as I should ☐I may not take quite as much care ☐No loss of interest — still as usual
6. I look forward with enjoyment to things ☐As much as I ever did ☐Rather less than I used to ☐Definitely less than I used to ☐Hardly at all
7. I can enjoy a good book or radio or TV program ☐Often ☐Sometimes ☐Not often ☐Very seldom

SECTION E

Instruction: For each of the remaining questions **tick the one best response**. Please answer all questions

How much difficulty do you have in lifting and carrying 4.5 kg (e.g large packs of detergent powder)	☐None ☐Some ☐A lot or unable
How much difficulty do you have walking across a room	☐None ☐Some ☐A lot, use aids (walking stick), or unable
How much difficulty do you have transferring from a chair or bed?	☐None ☐Some ☐A lot or unable without help
How much difficulty do you have climbing a flight of 10 stairs?	☐None ☐Some ☐A lot or unable
How much times have you fallen in the past year?	☐None ☐Some ☐A lot or unable

FACULTY OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF DIETETICS

Questionnaire (Bahasa Malayu)

Research Title:

Risk of Sarcopenia and Its Associated Factors among Hemodialysis Patients in Selected Dialysis Centres

Risiko sarcopenia dan faktor-faktor yang berkaitan antara pesakit hemodialisis di pusat dialisis terpilih

Researcher's Name: **Low Siao Jou**

Matric Number : **198446**

Supervisor's Name: **Professor Dr. Chan Yoke Mun**

Confidential and for research purpose only

Sulit dan untuk kegunaan kajian sahaja

Nama: _____

Bahagian A

Arahan: Borang ini adalah untuk kegunaan akademik sahaja. Semua maklumat dalam kajian ini akan disimpan secara sulit. Terima kasih atas menjawab borang ini.

1. Umur : _____ tahun

2. Jantina:

   ☐Lelaki
   ☐ Perempuan

3. Bangsa:

   ☐ Melayu
   ☐ Cina
   ☐ India
   ☐ Lain-lain, sila nyatakan: _____

4. Latar belakang pendidikan:

   ☐ Tiada Pendidikan Formal
   ☐ Sekolah Rendah
   ☐ Sekolah Menengah
   ☐ Pendidikan IPTA, Diploma ke atas
   ☐ Lain-lain, sila nyatakan _____

5. status merokok :

   ☐ tidak merokok
   ☐ bekas perokok
   ☐ perokok aktif

6. Tahap merokok ***jika anda pernah merokok atau ialah perokok semasa**
   - Jumlah tahun merokok :_____
   - Bilangan rokok setiap hari : _____

BAHAGIAN B

A. Adakah pengambilan makanan menurun sejak 3 bulan yang lalu disebabkan oleh hilang selera makan, masalah pencernaan, masalah mengunyah atau menelan? ☐ penurunan pengambilan makanan secara teruk ☐ penurunan pengambilan makanan secara sederhana ☐ tiada penurunan pengambilan makanan
B. Adakah anda mengalami penurunan berat badan selama 3 bulan yang lalu? ☐ lebih daripada 3kg ☐ tidak tahu ☐ antara 1 hingga 3kg ☐ tiada penurunan berat badan
C. Mobiliti ☐ imobilisasi ☐ dapat bangun dari katil atau kerusi tetapi tidak mampu keluar ☐ mampu keluar
D. Pernah mengalami tekanan psikologi atau penyakit akut dalam 3 bulan terakhir? ☐ ya ☐tidak

E. Masalah neuropsikologi
☐ demensia atau kemurungan yang teruk
☐ demensia ringan
☐ tiada masalah psikologi

G. Hidup secara mandiri (bukan di rumah jagaan atau hospital
☐ ya ☐ tidak

H. Mengambil lebih daripada 3 ubat preskripsi setiap hari
☐ ya ☐tidak

I. Luka atau ulser kulit
☐ ya ☐tidak

J. Berapa banyak makanan penuh yang pesakit makan setiap hari?
☐ 1 hidangan
☐ 2 hidangan
☐ 3 hidangan

K. Penanda penggunaan terpilih untuk pengambilan protein
• Sekurang-kurangnya satu hidangan **produk tenusu** (susu, keju, yoghurt) setiap hari
☐ ya ☐tidak

• Dua atau lebih hidangan **kekacang atau telur** setiap minggu
☐ ya ☐tidak

• **Daging, ikan atau ayam** setiap hari
☐ ya ☐tidak

L.Mengambil dua atau lebih hidangan **buah atau sayur** setiap hari?
☐ tidak ☐ya

M. Berapa banyak **cecair** (air, jus, kopi, teh, susu ...) yang diminum setiap hari?
☐ kurang daripada 3 cawan
☐ 3 hingga 5 cawan
☐ lebih daripada 5 cawan

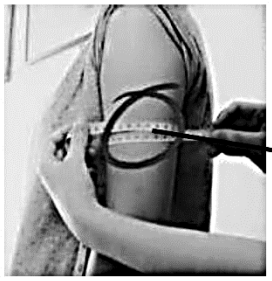
N. Cara makan
☐ tidak dapat makan tanpa bantuan
☐ makan sendiri dengan sedikit kesukaran
☐ makan sendiri tanpa masalah

O. Pandangan diri mengenai status pemakanan
☐ memandang diri sebagai kekurangan zat makanan
☐ tidak pasti keadaan pemakanan
☐ memandang diri sebagai tidak mempunyai masalah pemakanan

P. Bagaimana anda mempertimbangkan status kesihatannya berbanding dengan orang yang pada usia yang sama?
☐ tidak sehebat
☐ tidak tahu
☐ sama baik
☐ lebih baik

Q. Lingkaran lengan tengah dalam cm

☐ kurang daripada 21
☐ 21 hingga 22
☐ lebih daripada 22



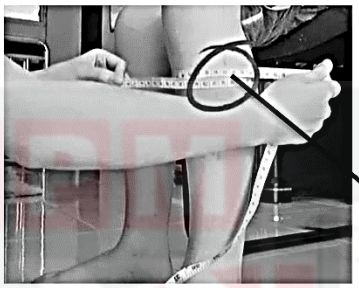
Cara mengukur menggunakan pita jahit

1. Subjek dikehendaki berdiri dengan lengan tergantung pada sisi
2. Tentukan titik tengah pada lengan kanan
3. Letakkan pita pada titik tengah
4. Nilai pengukuran boleh diambilkan.

Untuk maklumat yang lebih lanjut, sila imbas

R. Lingkar betis dalam cm

☐ kurang daripada 31
☐ 31 atau lebih



Cara mengukur menggunakan pita jahit

1. Subjek dikehendaki duduk dengan kaki pada sudut 90 darjah.
2. Letakkan pita pada betis kanan subjek.
3. Gerakkan pita ke atas & ke bawah sehingga jumpa lilitan terbesar.
4. Nilai pengukuran boleh diambilkan.

Untuk maklumat yang lebih lanjut, sila imbas

BAHAGIAN C

Arahan: Soalan-soalan berikut adalah berkaitan dengan tabiat tidur anda yang biasa dalam tempoh bulan yang lalu (30 hari yang lalu) sahaja. Sila jawab semua soalan.

1. Dalam tempoh bulan yang lalu, pada pukul berapakah biasanya anda masuk **tidur pada waktu malam**?
   - WAKTU MASUK TIDUR (hari bukan rawatan HD) _____
   - WAKTU MASUK TIDUR (hari rawatan HD)_____

2. Dalam tempoh bulan yang lalu, **berapa lamakah** (dalam minit) biasanya anda **ambil untuk tidur** pada setiap malam?
   JUMLAH MINIT _____

3. Dalam tempoh bulan yang lalu, pada pukul berapakah biasanya anda **bangun dari katil pada waktu pagi**?
   - WAKTU BANGUN DARI KATIL (hari bukan rawatan HD) _____
   - WAKTU BANGUN DARI KATIL (hari rawatan HD)_____

4. Dalam tempoh bulan yang lalu, berapa **jamkah sebenarnya anda tidur** pada waktu malam?
   JUMLAH JAM TIDUR UNTUK SATU MALAM _____

Bagi setiap soalan-soalan di bawah tandakan jawapan yang paling sesuai. Sila jawab semua soalan.

5. Dalam tempoh bulan yang lalu, berapa kerapkah anda telah mengalami masalah tidur kerana anda ……

	Tidak dalam tempoh bulan yang lalu	Kurang daripada sekali seminggu	Satu atau dua kali seminggu	Tiga kali atau lebih seminggu
A. Tidak boleh tidur dalam tempoh 30 minit	☐	☐	☐	☐

B. Bangun pada waktu tengah malam atau awal pagi	☐	☐	☐	☐
C. Perlu bangun tidur untuk menggunakan tandas	☐	☐	☐	☐
D. Tidak boleh bernafas dengan selesa	☐	☐	☐	☐
E. Batuk atau berdengkur dengan kuat	☐	☐	☐	☐
F. Rasa begitu sejuk	☐	☐	☐	☐
G.Rasa begitu panas	☐	☐	☐	☐
H. Mengalami mimpi yang buruk	☐	☐	☐	☐
I. Mengalami kesakitan	☐	☐	☐	☐

J. Lain-lain, sila terangkankan ☐Ya:_____ ☐Tidak

6. Dalam tempoh bulan yang lalu, berapa kerapkah anda telah mengambil **ubat untuk membantu anda untuk tidur** (ubat yang dinasihati oleh doktor anda atau ubat yang dibeli sendiri tanpa preskripsi)?	☐	☐	☐	☐
7. Dalam tempoh bulan yang lalu, berapa kerapkah anda mengalami masalah untuk berjaga (staying awake) semasa memandu kenderaan, makan, atau melibatkan diri dengan aktiviti sosial?	☐	☐	☐	☐
8. Dalam tempoh bulan yang lalu, berapa banyakkah masalah anda untuk memastikan anda cukup semangat untuk menyelesaikan kerja?	Tiada masalah langsung ☐	Hanya sedikit masalah ☐	Agak banyak masalah ☐	Satu masalah yang besar ☐
9. Dalam tempoh bulan yang lalu, bagaimanakah anda nilai kualiti tidur anda secara keseluruhan?	Sangat baik ☐	Agak baik ☐	Agak buruk ☐	Sangat buruk ☐

10. Adakah anda mempunyai apa-apa amalan pemakanan untuk membantu anda tidur dengan lebih baik?

☐Tidak ☐ Ya:_____

BAHAGIAN D

Arahan: Tandakan kotak di sebelah pernyataan yang paling sesuai dengan perasaan anda dalam seminggu yang lalu. Tiada jawapan yang betul atau salah.

1. Saya masih seronok melakukan perkara yang menyeronokkan.
☐Seperti dahula atau biasa (tiada perubahan)
☐Tidak seseronok seperti dahulu
☐Seronok sedikit sahaja
☐Tidak lagi atau hamper tiada lagi keseronokan

2. Saya boleh ketawa dan dapat meyukai/ nampak perkara-perkara yang melucukan. ☐Sememangnya seperti dahulu ☐Tidak seperti dahulu ☐Sememangnya tidak seperti dahulu ☐Tidak ada langsung
3. Saya berasa ceria. ☐Tidak ada langsung ☐Tidak selalu ☐Kadang-kadang ☐Sepanjang masa
4. Saya berasa kurang/ tidak secergas dahulu ☐Hampir sepanjang masa ☐Kerapkali ☐Kadang-kadang ☐Tidak ada langsung
5. Saya sudah hilang minat terhadap keterampilan (appearance) diri sendiri. ☐Sememangnya ☐Kurang minat dari biasa yang seharusnya ☐Kadang-kdang kurang minat dari biasa ☐Tidak hilang minat-masih seperti biasa
6. Saya sentiasa mengharapkan keceriaan/kegembiraan apabila melakukan sesuatu perkara ☐Sama seperti dulu ☐Tidak seperti dulu ☐Sememangnya amat kurang daripada dahulu ☐Tidak hamper berasa ceria langsung
7. Saya dapat merasai nikmat/ keseronokan apabila melakukan sesuatu seperti membaca buku yang menarik/ mendengar radio/ menonton rancangan televisyen yang menarik ☐Kerapkali ☐Kadang-kadang ☐Tidak selalu ☐Jarang sekali

BAHAGIAN E

Arahan: Bagi setiap soalan-soalan di bawah tandakan jawapan yang paling sesuai. Sila jawab semua soalan.

Berapa banyak kesukaran yang anda hadapi dalam mengangkat dan membawa 4.5 kg (contohnya, sebungkus besar serbuk pencuci)	☐tiada ☐sedikit kesukaran ☐banyak kesukaran
Berapa banyak kesukaran yang anda jalan ke bilik?	☐tiada ☐sedikit kesukaran ☐gunakan alat bantu, banyak kesukaran

Berapa banyak kesukaran yang anda ada untuk pindah dari kerusi atau tempat tidur?	☐tiada ☐sedikit kesukaran ☐banyak kesukaran jika tanpa pertolongan
Berapa banyak kesukaran yang anda miliki untuk menaiki 10 tangga?	☐tiada ☐sedikit kesukaran ☐banyak kesukaran
Berapa kali anda jatuh pada tahun lalu?	☐tiada ☐beberapa kali ☐banyak kali

FACULTY OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF DIETETICS

问卷

Research Title:

血液透析中心患者的肌肉减少症风险（**risk of sarcopenia**）

以及其相关因素

Researcher's Name: **Low Siao Jou 罗晓柔**

Matric Number : **198446**

Supervisor's Name: **Professor Dr. Chan Yoke Mun**

Confidential and for research purpose only

Sulit dan untuk kegunaan kajian sahaja

姓名：_____

A 部分

说明：本问卷仅出于学术研究所必要，并且您的个人信息将被视为严格保密。感谢您的支持与合作。

1. 年龄 ： _____

2. 性别：
   - ☐ 男
   - ☐ 女

3. 种族：
   - ☐ 马来人
   - ☐ 华人
   - ☐ 印度人
   - ☐ 其他，请列出：_____

4. 教育程度：
   - ☐ 非正规教育
   - ☐ 小学
   - ☐ 中学
   - ☐ 大专（文凭/学位/硕士/博士学位）
   - ☐ 其他，请列出：_____

5. 吸烟状况
   - ☐ 非吸烟者
   - ☐ 前吸烟者
   - ☐ 当前吸烟者

6. 吸烟水平(如果您是前吸烟者/当前吸烟者)
   - 吸烟年数:_____
   - 每天吸烟支数：_____

B 部分

说明：请阅读以下每条陈述，并且勾选最适合您的陈述。答案没有对错之分。

A. 过去三个月内有没有因为食欲不振（没胃口），消化问题、咀嚼或吞咽困难而减少食量? ☐食量严重减少 ☐食量中度减少 ☐食量没有改变
B. 在过去的 3 个月内，您是否体重减轻了? ☐体重下降大於 3 公斤 ☐不知道 ☐体重下降 1 - 3 公斤 ☐体重沒有下降
C. 活动能力 ☐需长期臥床或坐轮椅 ☐可以下床或离开轮椅，但不能外出 ☐可以外出

D.过去三个月内有沒有受到心理創伤或患上急性疾病?
☐ 有
☐ 沒有

E. 精神心理問題
☐严重痴呆或压抑
☐轻度痴呆
☐沒有精神心理问题

G. 是否独立生活 ?(非居住疗养院或医院)
☐ 是
☐ 否

H. 每天服用三种以上的药物?
☐ 是
☐ 否

I. 是否有褥疮或皮肤溃烂?
☐ 是
☐ 否

J. 每天吃多少次主餐?
☐ 1 餐
☐ 2 餐
☐ 3 餐

K. 蛋白质摄取量
• 每天進食至少一份乳制品 (牛奶、芝士或乳酪)
☐ 是
☐ 否

• 每天進食肉类、魚类或家禽(鸡)类
☐ 是
☐ 否

• 每周食兩份以上干豆类或蛋类
☐ 是
☐ 否

L. 每天有進食兩份或以上水果或蔬菜?
☐ 否
☐ 是

M. 每天喝多少流质 (水、果汁、咖啡、茶、牛奶….)?
☐少於 3 杯
☐3 至 5 杯
☐多於 5 杯

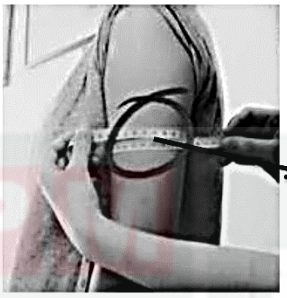
N. 進食模式
☐需帮助才能進食
☐能自己進食但稍有困難
☐能自己進食

O. 自我評估营养狀
☐自觉营养不良
☐不清楚自我的营养狀況

☐自觉没有营养問題

P. 与同年龄人士相比，您如何评价自己的健康状况？
☐比别人差
☐不知道
☐和别人一样
☐比别人更好

Q. 上手臂中点臂围
☐ 少过 21cm
☐ 21 和 22cm 之间
☐ 22cm 或以上



如何使用裁缝带/ 卷尺进行测量
1. 受试者须站立，并且手臂垂在侧面
2. 确认右上臂的中点位置
3. 将裁缝带放在中心点上
4. 您现在可测量并且读取测量结果

有关更多信息，请扫描

R. 小腿圍
☐ 少过 31cm
☐ 31cm 或以上

如何使用裁缝带/ 卷尺进行测量
1. 受试者坐下时双脚需弯曲 90 度
2. 将裁缝带放在受试者的右小腿上
3. 上下移动裁缝带，直到找到最大的小腿围
4. 您现在可测量并且读取测量结果

有关更多信息，请扫描

C 部分

指示:下面一些问题是关于您最近 1 个月的睡眠状态，请选择或填写与您近 1 个月实际情况的最符合答案。请回答全部问题。

1. 在过去一个月内，你晚上通常什么时候睡觉？
   - **睡觉时间(非洗肾日)**_____
   - **睡觉时间(洗肾日)**_____
2. 近 1 个月，从上床到入睡通常需要（_____）分钟。
3. 在过去一个月内，你早上通常什么时候起床？
   - **起床时间(非洗肾日)**_____
   - **起床时间(洗肾日)**_____
4. 近 1 个月，每夜通常实际睡眠（_____）小时（。

下列的问题，请选择并勾选最符合您实际情况的答案。

5. 在过去的一个月里，您有多少次入睡困难…

	过去一个月内没有	1 次／周	1 ～ 2 次／周	⩾ 3 次／周
A. 入睡困难(30 分钟内不能入睡	☐	☐	☐	☐
B. 夜间易醒或早醒	☐	☐	☐	☐
C. 夜间起床上厕所	☐	☐	☐	☐
D. 无法顺畅呼吸	☐	☐	☐	☐
E. 大声咳嗽或打鼾声	☐	☐	☐	☐
F. 感觉太冷	☐	☐	☐	☐
G. 感觉太热	☐	☐	☐	☐
H. 做恶梦	☐	☐	☐	☐
I. 疼痛不适	☐	☐	☐	☐
J. 如有其它，请说明：	☐有：_____		☐没有	
6. 在过去一个月内，你有多少次需要服用药物来帮助睡眠？	☐	☐	☐	☐
7. 在过去一个月内，在开车、吃饭、参加社交活动时，你有多少次觉得很难保持清醒？	☐	☐	☐	☐

	一点也不困难	只有一点点困难	有一些困难	很困难
8. 在过去一个月内，您有多难要保持足够的毅力去完成某些事情？	☐	☐	☐	☐

	很好	较好	差	较差
9. 近 1 个月您认为己的睡眠质量	☐	☐	☐	☐

10. 你是否有特定饮食习惯，以帮助你更容易入睡？

☐有：_____ ☐没有

D 部分

指示：下列的问题，请选择并勾选最符合您过去 7 天情况的答案。答案没有对错之分。

1. 我对以往感兴趣的事情还是有兴趣。 ☐肯定一样	5. 我对自己的外表（打扮自己）失去兴趣。

☐不像以前那样多 ☐只有一点 ☐基本上没有了	☐肯定 ☐经常 ☐并不经常 ☐根本没有
2. 我能够哈哈大笑，并看到事物有趣的一面。 ☐我经常这样 ☐我现在已经不大这样了 ☐现在肯定是不太多了 ☐根本没有	6. 我怀着愉快的心情憧憬/期待未来。 ☐差不多是这样 ☐并不完全是这样 ☐很少这样 ☐几乎从来不
3. 我感到愉快。 ☐根本没 ☐并不经常这样 ☐有时 ☐大多数时间	7. 我能欣赏一本好书或一项好的广播或电视节目。 ☐常常 ☐有时 ☐并非经常 ☐很少
4. 我感到人好像变迟钝了。 ☐几乎所有时间 ☐很经常 ☐有时 ☐根本没有	

E 部分

问题	答案
您是否在搬运 4.5 公斤的重物时面对困难？（例如 4.5kg 大包洗衣粉）	☐无 ☐有时 ☐经常
您是否在步行回房间时面对困难？	☐无 ☐有时 ☐经常，需要帮助/拐杖
当您从椅子转移到床上时，是否有面对困难？	☐无 ☐有时 ☐经常（如果没人帮助）
您是否在爬 10 阶/层楼梯时面对困难？	☐无 ☐有时=1 ☐经常=2
过去一年中您跌倒了多少次？	☐无 ☐有时 ☐经常

APPENDIX E TURNITIN ORIGINALITY REPORT