UNIVERSITI PUTRA MALAYSIA

HAND GRIP STRENGTH AND ITS ASSOCIATED FACTORS AMONG HOSPITALIZED ELDERLY IN KLANG VALLEY HOSPITALS

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BY

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LIST OF ABBREVIATIONS

AWGS	Asian Working Group of Sarcopenia
BMI	Body Mass Index
BMR	Basal Metabolic Rate
BIA	Bioelectrical Impedance Analysis
CVD	Cardiovascular Diseases
ESPEN	European Society for Clinical Nutrition and Metabolism
GOHAI	Global Oral Health Assessment Index Score
KH	Knee Height
KORA	Cooperative Health Research in Region of Augsburg
MNA	Mini Nutrition Assessment
MNA-SF	Mini Nutrition Assessment - Short Form
MUAC	Mid Upper Arm Circumference
NHMS	National Health Morbidity Survey
ONS	Oral Nutrition Support
SPSS	Statistical Package for Social Science
SGA	Subjective Global Assessment
WHO	World Health Organization
AWGS	Asian Working Group of Sarcopenia

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Abstract

HAND GRIP STRENGTH AND ITS ASSOCIATED FACTORS AMONG HOSPITALIZED ELDERLY IN KLANG VALLEY HOSPITALS

Khairunisar-E-Rashim Binti Mohammed Yusufirashim

Hand grip strength is a crucial biomarker of ageing. Poor grip strength among hospitalized elderly increases risk of nutritional and functionality complications leading to higher risk of hospital readmissions and hospital in-mortality. This cross-sectional study aimed to study hand grip strength among hospitalized elderly in Klang Valley hospitals measured using Jamar Plus+ Digital Handgrip Dynamometer and compared it with the cut-off by Asian Working Group of Sarcopenia (2014) alongside its associated factors. Face-to-face interview and physical assessment were conducted to fill in the self-administered questionnaire for each subject, two days 24-hour dietary recall, Global Oral Health Assessment Index Score and Mini Nutrition Assessment- Short Form. A total of 57 subjects were recruited where 58% were female and 42% were male with mean age of 72.27 $\pm$ 7.31 years. Based on the hand grip strength comparison, 95% of them had low hand grip strength with a mean of 8.28 $\pm$ 6.92 kg/force. Next, only 40.4 % of the elderly were on polypharmacy where the highest prevalence was hypertension (75.4%) followed by Diabetes Mellitus (54.4%). Majority of them also had elevated BMI (54.4%) and body fat percentage (61.8%), low serum albumin level (65.4%), low hemoglobin level (69.6%), low perception towards oral health (100%), inadequate energy intake (90.9%), inadequate protein intake (87.3%) and were at risk of malnutrition (57.9%). Besides, this study found age, educational level, perception towards oral health and energy intake to be significantly associated with hand grip strength ($p<0.05$). Thus, more research together with intervention and prevention strategies should be done to improve hand grip strength among hospitalized elderly in effort to reduce hospital readmission and in-mortality rate.

Abstrak

KEKUATAN GENGGAMAN TANGAN DAN FAKTOR-FAKTOR YANG MEMPENGARUHINYA DALAM KALANGAN PESAKIT WARGA TUA DI HOSPITAL SEKITAR LEMBAH KLANG

Khairunisar-E-Rashim Binti Mohammed Yusufirashim

Kekuatan genggaman tangan yang lemah menyebabkan kadar kemasukkan semula ke hospital dan kematian di hospital tinggi dalam kalangan pesakit tua. Kajian ini dilakukan atas tujuan mengkaji kekuatan genggaman tangan dalam kalangan pesakit warga tua di hospital sekitar Lembah Klang menggunakan *Jamar Plus+ Digital Handgrip Dynamometer* serta faktor-faktor yang mempengaruhinya. Borang soal selidik bagi setiap subjek termasuk rekod makanan bagi 24 jam yang lepas untuk dua hari, Skor Penilaian Kesihatan Gigi (GOHAI) serta Penilaian Ringkas Pemakanan Mini (MNA-SF) dipenuhi melalui temuduga dan penilaian fizikal. Seramai 57 subjek telah terlibat di mana 58% adalah wanita dan 42% lelaki berumur 72.27 $\pm$ 7.31 tahun. Berdasarkan kekuatan genggaman tangan, 95% daripada mereka didapati mempunyai genggaman tangan yang lemah dengan purata 8.28 $\pm$ 6.92 kg/daya. Selain itu, 40.4% daripada mereka mengambil lebih daripada empat ubatan di mana penyakit darah tinggi adalah tertinggi di kalangan mereka (75.4%) diikuti penyakit diabetes (54.4%). Kebanyakan mereka memiliki Indeks Jisim Tubuh (IJT) (54.4%) dan peratusan lemak badan tidak normal (61.8%), bacaan serum albumin rendah (65.4%), hemoglobin rendah (69.6%), persepsi rendah terhadap kesihatan mulut (100%), pengambilan kalori dan protein tidak mencukupi (90.9% dan 87.3%) serta mempunyai risiko malnutrisi (57.9%). Dalam kajian ini, umur, tahap pendidikan, pengambilan tenaga dari makanan dan persepsi terhadap kesihatan mulut didapati berkait dengan kekuatan genggaman tangan. Oleh itu, lebih banyak kajian harus dijalankan bagi meningkatkan kekuatan genggaman tangan dalam kalangan pesakit warga tua.

CHAPTER 1

INTRODUCTION

1.1 Background

Today, people are expecting to live longer. The proportion of elderly in every country is increasing globally as the population ageing phenomena continues to occur. While most of the developed countries defined elderly as individual 65 years old and above depending on the age the population in those countries retire, elderly were defined as 60 years and older in Malaysia referring to the agreed 'cut-off' by the United Nations (World Population Ageing, 2019).

Statistically, across the globe, the world is expecting to have a double fold in its' elderly populations from 12% in 2015 to 22% in 2050 (World Health Organization, 2018). United Nations (2019) concluded in World Population Prospects that by the year 2050, there would be an elderly in every six persons which is doubled from the current rate of an elderly in every 11 persons. Currently, Malaysia is moving towards an 'aged' nation as according to the Department of Statistics of Malaysia, for 2020, approximately 11% of Malaysian population are elderly which counts more than 3.5 million of total Malaysian population. Among this growing elderly population, according to the Institute for Health System Research & Institute for Health Policy in 2013, the rate of hospital admission among elderly was almost 16% making hospitalization common among Malaysian elderly (Yunus et al., 2017).

As every individual aged, their body function either biologically or physically undergo changes that usually leads to a health decline. Furthermore, common health related concerns of elderly are often related to their muscle strength, functional status and their quality of life. Hand grip strength which is also known as arm strength is an indicator of all these components

among elderly where it is widely accepted as a 'vital sign' of elderly's health and a crucial aging biomarker (McGrath et al., 2020). This is especially significant as the neural and muscular decline among elderly affects their hand grip strength. Although hand grip strength alone does not totally predict functional status or muscle strength of elderly as it needs to be aided with other diagnosis such as Instrument of Daily Living Activity and lower limb strength measure, it is a good indicator of these components and in alerting further assessments to be carried out. It functions in a way that the maximum force applied by a person through a grip on the assessment tool to resist the stationery grip resistance gives the measurement of isometric muscle contraction which is indicated by the hand grip strength (Ong et al., 2017). Meanwhile, hand grip strength is also used to predict the clinical outcomes especially among hospitalized elderly with extreme weakness and functional limitation. Thus, hand grip strength which is convenient for hospitalized elderly are often used to indicate physical well-being and in overall, the quality of life among hospitalized elderly (Musalek & Kirchengast, 2017).

Besides, hand grip strength being an indicator of the hospitalized elderly's overall strength and well-being, it was affected by many internal and environmental based factors including anthropometry, physical, medical and some sociodemographic factors where some of these factors were changeable while some were permanent in the elderly's life (Manoharan et al., 2015). Thus, studying these factors and how they influence the hand grip strength among elderly patients was important to address the elderly's life quality and wellness.

1.2 Problem statement

Hand grip strength is used as a significant indicator of health among elderly. The Federal National Health Institutes had found that among the United States elderly, 5 % were having a weak grip strength while it was prevalence as 19 % among the older old. In this context, it can be concluded that the grip strength among elderly tend to reduce with an increasing age.

Whereas, the reduction in hand grip strength which occurs with increasing age is also often affected by other health factors such as nutritional status (Riviati et al., 2017).

Besides, malnutrition is also a common and concerning problem among the elderly. Malnutrition which occurred due to multiple factors was significant among elderly with a reduced grip strength. Meanwhile, malnutrition was common among Malaysian hospitalized elderly as according to a review study by Fazimah et al. (2013), they had found that in Malaysia, the prevalence of malnutrition among hospitalized elderly reached 55% where Lin et al. (2016) had found 35 % of elderly patients being malnourished in their study. Meanwhile, malnutrition issues among hospitalized elderly who were impaired with the functional status had been proven to affect the hand grip strength too (Riviati et al., 2017). Thus, a reduced grip strength is often indicated by the high prevalence of malnutrition among Malaysian hospitalized elderly.

Furthermore, another nutritional status related problem which is common among Malaysian elderly and is indicated by a reduced grip strength is the impaired weight status which is either being underweight or overweight and obese (Unal et al., 2018). Among Malaysian elderly, in 2018, it was found that 5% of our elderly population were underweight while 55 % were either overweight or obese (National Institutes of Health, 2018). While being underweight often results in fatigue and frailty which impaired the hand grip strength, being overweight or obese also reduced grip strength as it increases the incidence of sarcopenic obesity which resulted from a higher body fat but reduced muscle strength among elderly (Bassi et al., 2016).

Thus, the main issue and concern that develops from a reduced grip strength among hospitalized elderly is the high risk of hospital readmission. As hand grip strength is related to nutritional status, reduced grip strength among hospitalized elderly which impairs nutritional status will lead to prolonged hospital stay among the elderly. Hence, for elderly who have

longer hospital stay, will also have a higher risk of hospital readmission (Chites et al., 2020). Besides, as hand grip strength is also one of the diagnostic criteria of poor or good functional status, poor hand grip strength might also be a sign of poor functional status during discharge where these elderlies will then have a difficulty in carrying out their daily activities at home such as eating home cooked meal or moving around. Thus, this barrier will cause their full recovery to be interrupted causing higher risk of hospital readmission (Allard et al., 2016). Due to the higher risk of hospital readmission, there will also be an increase in hospital in-mortality rate and higher facility cost to bear for our healthcare facilities (Upadhyay et al., 2019).

Research have been carried out to study the associated factors affecting hand grip strength among elderly worldwide in different settings (Alqahtani et al., 2019 & Kim et al., 2019). Some factors generally were identified in sociodemographic context including in a study done in Malaysia (Moy et al., 2011). However, there are still very limited research done among the hospitalized elderly to study the sociodemographic factors affecting hand grip strength. Besides, medical background in terms of the diseases and medication drugs were also found to be affecting the hand grip strength (Volaklis et al., 2018). Yet, most of the studies were done abroad and there is still a gap in this field in Malaysian research. Meanwhile, although anthropometry changes are obvious among elderly in both the measurements and body composition, the studies on the association of this aspect with hand grip strength among the hospitalized elderly populations in Malaysia are still very limited as per knowledge (Lam et al., 2016). Besides, the factors such as biochemical markers, dietary intake, oral health perception and malnutrition risk were limitedly studied among hospitalized elderly in Malaysia in terms of their association with hand grip strength. Therefore, this study was aimed to address the research gap and identify the factors associated with hand grip strength among hospitalized elderly in Malaysia, precisely, in Klang Valley hospitals.

1.3 Research Questions

i. What is the mean of hand grip strength among hospitalized elderly in Klang Valley hospitals?

ii. What are the factors associated with hand grip strength among hospitalized elderly in Klang Valley hospitals?

1.4 Significance of the Study

The aim of this study was to address the research gap in terms of the most important indicator of elderly's health status which is the hand grip strength and its associated factors. Thus, the results of this study could be used by researchers in future as a baseline to conduct studies, especially intervention studies among elderly in clinical settings regarding hand grip strength and the issues that result from the outcomes of it. Besides, this study would be useful for policy makers to find ways to improve the nutritional status of our nations' senior citizens, which will then help the elderly to improve their overall health and quality of life. To address health issues regarding the risk of hospital readmission among elderly, the health professionals including medical doctors, dietitians, nurses and nutritionists could plan prevention and intervention strategies and improve their care by referring to this study findings on hand grip strength which is strongly related to risk of hospital readmission and overall health and wellbeing of the elderly.

Moreover, the results from this study also will be useful in responding to the increasing concern of 'ageing nation' by addressing and improving elderly care in terms of their functionality and health important indicator, the hand grip strength, which could be contributed by health professionals involved and their caregivers. Overall, this study would be helpful in

the future to increase the duration of independency along with age for our elderly, promising a healthy ageing nation.

1.5 Research Objectives

1.5.1 General objective

To determine the associations between sociodemographic factors, medical background, anthropometry data, biochemical markers, perception towards oral health, dietary assessments and malnutrition risk with the hand grip strength among hospitalized elderly in Klang Valley hospitals.

1.5.2 Specific objectives

i. To assess the sociodemographic factors, medical background, anthropometry data, biochemical markers level, perception towards oral health, dietary assessments and malnutrition risk among hospitalized elderly in Klang Valley hospitals.
ii. To determine the hand grip strength among hospitalized elderly in Klang Valley hospitals.
iii. To determine the associations between sociodemographic factors, medical background, anthropometry data, biochemical markers level, perception towards oral health, dietary assessments and malnutrition risk with hand grip strength of hospitalized elderly in Klang Valley hospitals.

1.6 Null Hypotheses

There are no significant associations between sociodemographic factors, medical background, anthropometry data, biochemical markers, perception towards oral health, dietary assessments and malnutrition risk with hand grip strength among hospitalized elderly in Klang Valley hospitals.

1.7 Conceptual Framework

Conceptual framework below shows that the independent variables were sociodemographic factors, medical background, anthropometry data, biochemical markers, perception towards oral health, dietary assessment and malnutrition risk. Dependent variable is hand grip strength among hospitalized elderly in Klang Valley hospitals.

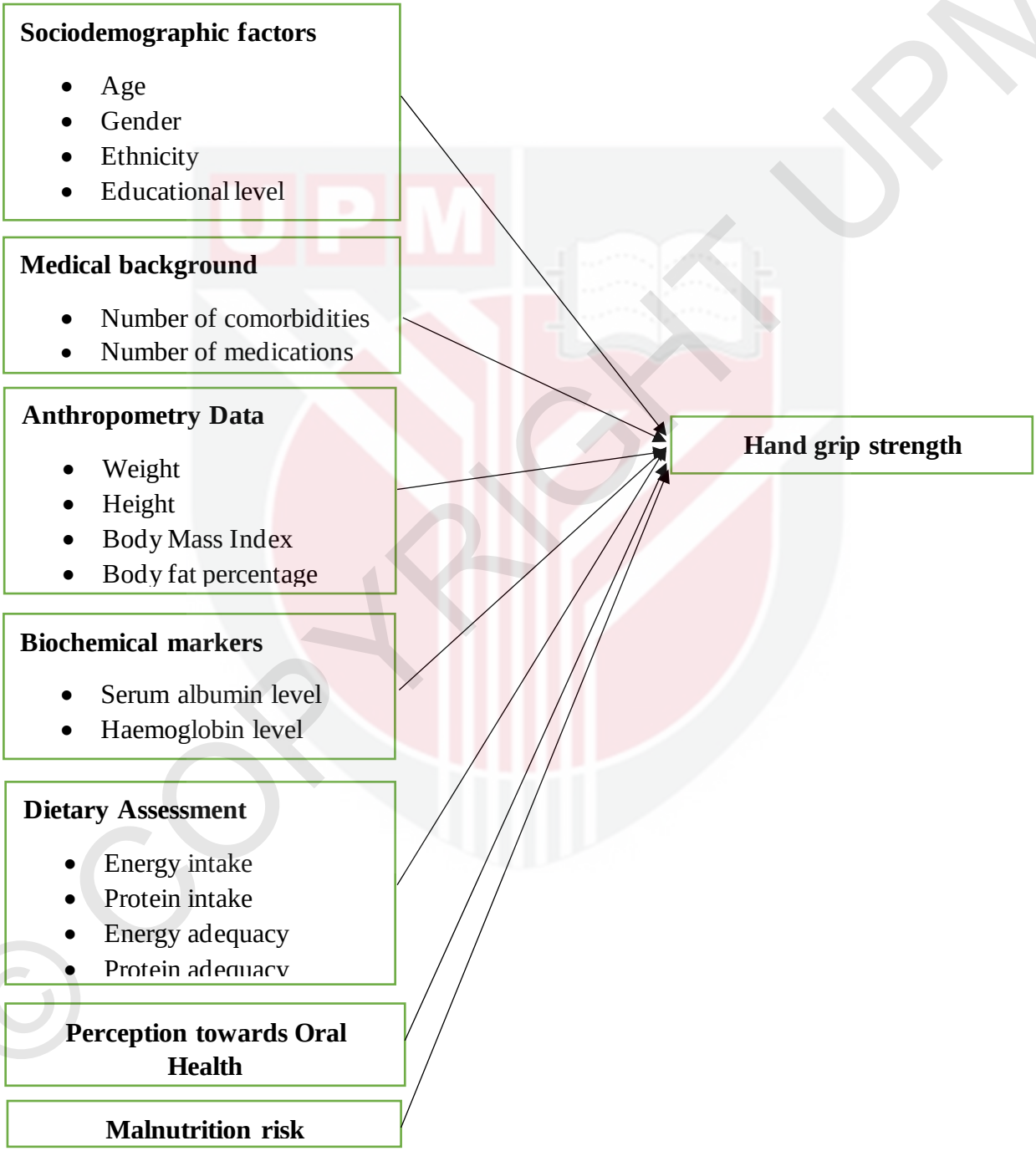

Figure 1.0: Conceptual framework

CHAPTER 2

LITERATURE REVIEW

2.1 Hand Grip Strength

Hand grip strength is an assessment to measure arm strength among elderly. It is also an important indicator of overall muscle function and functionality among the older adults which could predict their muscle strength (Sousa-Santos & Amaral, 2017). According to Bohannon (2019), hand grip strength which changes by the multiple factors influences among the older adults is also a biomarker to indicate the elderly overall health that includes their strength, performance and functionality. Therefore, it is important to measure hand grip strength by using the most validated tool and comparing it with a validated cut-off.

Hand grip strength can be measured by a dynamometer tool. Thus, there are few tools that were commonly used to measure hand grip strength among different population where the most validated tool was the Jamar Dynamometer (Neumann et al., 2017). The different tools had their own reliability standard and target population. One such tool used in clinical setting was the sphygmomanometer which measured the grip strength among bedside patients by measuring the pressure applied by the hand (Denby et al., 2013). However, this tool is less convenient to be carried around to assess among large number of patients; therefore, rarely used in research or scientific studies. Meanwhile, the use of Jamar Dynamometer had also found a better influence of the hand's force compared to Martin-Vigorimeter tool (Neumann et al., 2017). Thus, Jamar Dynamometer was found to be the most reliable tool to measure hand grip strength among elderly whereas the latest technology of digital Jamar Dynamometer was also more convenient as it was easier to read and could show force between 0 to 90 kg accurately. Based on Trampisch et al. (2012), the result of Jamar Plus+ Digital Hand

Dynamometer was most accurate when the position of the handles was standardized according to subjects. Thus, by taking the appropriate measures and steps, the Jamar Plus+ Digital Hand Dynamometer could help a study to achieve accurate and reliable result.

Foundation of National Institutes of Health conducted a study in United States to come out with 26.0 kg for older men and 16.0 kg for older women as the below normal cut-off of hand grip strength where almost 5% of elderly had weak strength while among the older old it was prevalence as 19 % (Looker et al., 2015). Meanwhile, there were different cut-offs suggested for hand grip strength among the older adults for different populations too. European Working Group of Sarcopenia (EWGS) suggested <30 kg for men and <20 kg for women as the hand grip strength cut-off among their population (Lee & Gong, 2020). Meanwhile, among Asian countries, the most validated and comparable cut off point for hand grip strength was as proposed by the Asian Working Group of Sarcopenia (AWGS) as the Asians had different lifestyle compared to Europeans and their hand grip strength was found lower than the EWGS cut off where AWGS proposed <26 kg for men and <18 kg for women as the hand grip strength cut off (Lee & Gong, 2020). Therefore, most of the studies on hand grip strength among elderly compared their results with the AWGS cut off and found different outcomes through the comparison such as the study by Akbar & Setiati (2018) in Indonesia.

Meanwhile, Riviati et al. (2017) had concluded in their study that most of the geriatric patients had weak grip strength especially among malnourished patients. Similarly, Bentli et al. (2019) had also found more than half of the elderly in their study to have a weak grip strength. As the findings of the previous studies in relation to hand grip strength among elderly had been analyzed, many factors had been identified to significantly affect the hand grip strength which was listed in Table 2.1.

2.2 Factors Associated with Hand Grip Strength among Elderly

2.2.1 Sociodemographic factors

Based on previous studies done across the world, a significant association had been found in few sociodemographic characteristics with hand grip strength among elderly including of age, gender, ethnicity and educational level as listed in Table 2.1. According to Pinheiro et al. (2013), who did research on elderly in Northeast Brazil to determine the relation of motor performance with gender and age, had found that lower hand grip strength was associated with older age for both men and women. They also found that the grip weakness prevalence was found highest at different ages between men and women, making the gender associated with hand grip strength too alongside age (Pinheiro et al., 2013). Similarly, another study done in Brazil had also concluded that hand grip strength was inversely correlated with age where the grip strength was higher among men than women (Amaral et al., 2019). This study by Amaral et al. (2019) had also found that men faced greater decline in grip strength than women after the age of 60 where both gender underwent steady loss of strength with increasing age due to muscle function decline. Thus, both the studies in Brazil had supported the association of hand grip strength with gender and age.

There were some studies carried out in Asian countries too to study the correlation of hand grip strength with sociodemographic factors. In a study carried out in Singapore among 2043 elderly aged 60 years and older to establish normative value of hand grip strength, had found that hand grip strength decreased with older age despite different ethnicities and gender (Ong et al., 2017). Meanwhile, a study carried out in Malaysia which included healthy elderly from both rural and urban living areas, had found that men were found to have higher hand grip strength than women (Lam et al., 2016). This study among 362 elderly from Klang Valley and

Bahau, Negeri Sembilan had also concluded that there was a significant difference between age groups where the youngest age group had the highest grip value.

Thus, as most of the studies carried out among healthy elderly in community settings supported the association between hand grip strength with age and gender, they are most likely to be associated. Another significant sociodemographic characteristic studied was ethnicity where it was found that the Asian had lower hand grip strength than western established standard (Lam et al., 2016). This study in Malaysia by Lam et al. (2016) had also found that ethnicities resulted in differences of hand grip strength too where the Chinese had higher grip strength than the Indian subjects. Similarly, the study among Singaporeans had also found higher grip strength among Chinese compared to Malay and Indian (Ong et al., 2017). Therefore, ethnicity was also found associated with hand grip strength as there was a difference of hand grip strength among different ethnic group.

Next, the association of hand grip strength with educational level had been found in a study done in Korea which was aimed to study the risk factors affecting hand grip strength (Kim et al., 2019). This study had concluded that lower educational level among both men and women was associated with weaker grip strength. Similarly, in Indonesia, a study which was done among 7097 elderly of 50 years and older had found that educational level was associated with hand grip strength only in men where the hand grip strength was found higher than women (Pengpid & Peltzer, 2018). On the other hand, higher educational level being positively associated with higher hand grip strength had also been found from the study by Alqahtani et al. (2019) in Saudi Arabia among elderly. Therefore, educational level was also found associated with hand grip strength along with age, gender and ethnicity, where the significance was found more apparent in men than women in terms of educational level.

2.2.2 Medical background

Elderly are prone to get more diseases in their older age and they often take medications to control those diseases. Therefore, association between the number of diseases and the number of medication drugs consumed by the elderly had been studied and found to be associated with hand grip strength among elderly in some studies. Through a study done in Malaysia by Maung & Phyu (2018), a prevalence of 65.9% had been found among elderly aged 60 years and above who had more than one comorbidity. Therefore, as multi morbidity was considered as a common issue among the elderly, studies have been carried out to find the association between number of diseases and hand grip strength.

As in Table 2.1, few studies had been done across the world on the relationship of hand grip strength with number of diseases and medications among adults and elderly. A study among 477 older adults aged 60 years and above in Southern Brazil had found an association between number of diseases with hand grip strength as there was an inverse relationship between both of them among men (Pessini et al., 2016). Meanwhile, another study carried out on 1079 elderlies in Germany aged 65 years and above had also found a number of diseases to be correlated with hand grip strength (Volaklis et al., 2016). However, contrary to the study by Pessini et al. (2016), this study concluded an independent association only among women but not in men. Besides, the study by Pessini et al. (2016) had also found that certain diseases such as diabetes and hypertension had significantly associated with hand grip strength whereas, some other diseases weren't associated which indicated that the type of comorbidities among elderly might also affect their hand grip strength. Therefore, these studies had found the association between type and number of diseases and presence of multi-morbidities with hand grip strength in men and women.

While co-morbidities are common among elderly, medication drugs consumption is another common thing. It was found through a study in United States that more than 40% of men and more than 50% of women in their study among 2230 men and 2336 women aged 30 years and older were already taking at least one prescribed medication (Love et al., 2020). Meanwhile, another study done in Malaysia itself among Malaysian elderly had found nearly 50% of the elderly aged 60 years and above were taking 5 or more medication drugs (Lim et., 2006). Therefore, some studies had been done to study the association between the number of medication drugs and hand grip strength as the drugs was known to affect the strength among elderlies too (Campins et al., 2017).

However, through a study carried out among 711 elderly patients aged above 65 in German, no association had been found between the number of medications with hand grip strength among elderly (Volaklis et al., 2018). Meanwhile, another study was done by Sganga et al. (2014) among hospitalized elderly too where there were 51.3% patients on more than one medications who had found a significant association between the number of medications with hand grip strength as they were inversely related. Similarly, the study in United Stated on polypharmacy had also found a significant association between the number of medications and hand grip strength in both men and women (Love et al., 2020). Therefore, the number of medications and hand grip strength were most likely to be associated although denied in some studies as in Table 2.1.

2.2.3 Anthropometry data

In terms of anthropometry data association with hand grip strength among elderly patients, an association had been found in previous studies on height, body weight, body mass index (BMI) and body fat percentage. Height and weight changes are common among elderly and

they are found to be associated with hand grip strength through few studies carried out across the world (Mendes et al., 2017; Ong et al., 2017 & Santos Neves et al., 2017).

In a cross sectional study carried out by Mendes et al. (2017) among 1500 elderly in Portugal, a strong association was found of hand grip strength with the elderly height where their association was the strongest compared to other factors that were studied. Similarly, another community based study had also found that body height can be used as a component to estimate the value of hand grip strength among both young and older adults where this study had been done among subjects aged 18 to 71 years old in Brazil by Santos Neves et al. (2017).

Besides western countries, few studies were also carried out in Asian countries to study the association between height and hand grip strength as listed in Table 2.1. In South Korea, a research was carried out by Kim et al. (2018) among more than 7969 participants aged above 10 years old where all the factors studied were stratified by age to study their associations. Through their study, among elderly aged above 65 years old, an association had been found between height and hand grip strength where height affected hand grip strength in almost all age groups.

Similarly, another study by Ong et al. (2017) among elderly in Singapore had also concluded that height affected hand grip strength among both men and women aged above 60 years old. On the other hand, in Malaysia, a similar result was found by Kamarul et al. (2006) where through their study, association between height and hand grip strength was also found to be significant. However, this study carried out in Malaysia was done among young adults and using different tool than recent studies on hand grip strength.

Meanwhile weight was also found to be associated with hand grip strength in previous studies including in studies that studied on height as both of these components are crucial as

anthropometric measurements. In the study by Kim et al. (2018) besides height, weight was also found to be associated with hand grip strength among elderly. Similarly, the association of weight and hand grip strength was also found in the study by Ong et al. (2017). However, in this study done in Singapore, the association was only significant among elderly women.

Besides, another study carried out by Pan et al. (2020) had also found the association of weight with hand grip strength where this study was carried out among 2470 elderly living in a community aimed to find the factors affecting hand grip strength among elderly in Yilan City, Taiwan. On the other hand, the study by Alqahtani et al. (2019) had also found an association between elderly's weight with their hand grip strength where it is found that higher weight resulted in higher value of grip strength.

Meanwhile, weight status, which is usually measured by body mass index (BMI) was also found to be associated with hand grip strength among elderly as the prevalence is significant among elderly. Based on National Institutes of Health (2018), it is stated that only 40% of elderlies in Malaysia have a normal weight status while smaller proportion of about 5 % are underweight and the rest in overweight and obese category. Therefore, as the BMI in elderly was significant, the association with hand grip strength was studied in past research.

A study in Australia among 1314 men and 1315 women aged 20 years and older by Unal et al. (2018) aimed to study hand grip strength among the Australian community population found that BMI was associated with hand grip strength. Meanwhile, another study in Brazil by Amaral et al. (2019) had also found a positive correlation between BMI and hand grip strength among the older adults regardless of gender.

However, another study carried out in Saudi Arabia had found that BMI was only significant among men but not among women among elderly in a community setting (Alqahtani

et al., 2019). Meanwhile, as there were limited studies in Asian countries on the association between BMI and hand grip strength, the study by Kim et al. (2019) in South Korea had found an association between BMI and hand grip strength where almost similar to the study by Alqahtani et al. (2019), the significant correlation was found higher among men than women. Thus BMI and hand grip strength was found to be associated in past studies although some denied the association in regards to gender differences.

Finally, referring to Table 2.1, another anthropometry assessment which was found to be associated with hand grip strength is body fat percentage. As human aged, changes in body composition occur where both fat and muscles are two related components of the body composition (Miyatake et al., 2012). Therefore, some studies had studied the association between body fat percentage with hand grip strength.

A study on 40 subjects in India aged 18 to 14 years which was aimed to find correlation between strength and body fat had found a significant association between body fat percentage with hand grip strength of both hands (Bindiya et al., 2017). Similarly, another study by Lad et al. (2013) also in India had been done among adolescence. However, in contrast to study by Bindiya et al. (2017), this study had found that body fat percentage was not significantly associated with hand grip strength among the male normal and overweight subjects where on the other hand, was significantly associated among normal and overweight female subjects.

Meanwhile, some studies also had been done among elderlies. A study was carried out by Kim et al. (2017) in North Carolina to study the association between body composition and functionality among elderly aged 60 years and older where through this study, it was found that lower grip strength was found to be related with the body fat percentage. Furthermore, Charlton et al. (2015) in their study among 117 elderly aged 55 years and above had found that only the

right hand grip strength was associated with the body fat percentage. Thus, body fat percentage had been found associated with hand grip strength in some previous studies.

2.2.4 Biochemical markers

Biochemical markers tend to change with aging including haemoglobin and serum albumin where few studies had found the association of these two biochemical markers with hand grip strength (Yamada et al., 2015). Haemoglobin level is significant to be noted among elderly especially in those with medical problems as low haemoglobin level which is lower than 13g/dL in men and 12g/dL in women as defined by World Health Organization could leads to anaemia among the older adults where according to the study by Yusof et al. (2018), among 3794 Malaysian elderlies , more than 35% of the elderly were anaemic.

Furthermore, through a study conducted among 4499 older adults in rural South Africa by Payne et al. (2018) aimed to find the association between haemoglobin level with physical and mental performance, haemoglobin level was found to be significantly associated in women but not in men. Next, a study in Australia which was mainly among the Australian older men aged 70 years and older had found low haemoglobin level to be associated with a poor grip strength among the men (Hirani et al., 2016).

Similarly, another study was carried out in Japan among men aged 60 to 69 years old by Shimizu et al. (2018) which was aimed to study the relationship of haemoglobin with hand grip strength in relation to the hepatocyte growth factor (HGF). This study had found that hand grip strength was affected by haemoglobin only among men with higher HGF (Shimizu et al., 2018). In contrast, another study was done by Yamada et al. (2015) among 202 Japanese elderly women in community setting which had found an association of hand grip strength with both haemoglobin and serum albumin level..

Meanwhile, serum albumin level is usually related to hand grip strength too among elderly as the hypoalbuminemeia or inflammation marked by this serum albumin level could diminishes the strength among elderly (Pham et al., 2007). Therefore, due to the inflammation caused by the albumin level, serum albumin was found to be associated with hand grip strength (Kitamura et al., 2012).

Besides, a study carried out in Tenerife among 310 hospitalized elderly by Martín-Ponce et al. (2014) had also found the association between the serum albumin level with hand grip strength where this study was carried out among elderly aged 60 years and above. However, according to a cohort study by Reijnierse et al. (2015) among 271 older participants aged 69 to 81 years from the MYOAGE study in Europe, no association had been found between serum albumin level with hand grip strength. Thus, although some studies had denied the association between haemoglobin level and serum albumin level with hand grip strength, there are also studies that found the association between these biochemical markers with hand grip strength as summarised in Table 2.1.

2.2.5 Perception towards oral health

Oral health had been proven to affect the food intake of elderly which eventually causes impairment in functionality of the elderlies including the grip strength due to reduced strength (Rosli et al., 2019). In a review by Ahmad et al. (2018) based on the prevalence from previous studies, almost all the elderly have impairment of oral health although the prevalence of peridontal disease and edentoulousness is reducing by years among the older adults. Whereas, to assess the oral health among elderly, Global Oral Health Assessment Index form was often used including in a study among Malaysian elderly by Rosli et al. (2019) as it was validated with a 0.79 Cronbach alpha's value to report the oral health as a self-reported perception by the elderly (Othman et al., 2006).

Through a systematic review by Tôrres et al. (2015) who reviewed previous studies regarding the association of oral health with frailty components among elderly had proven that hand grip strength was one of the components found to be associated with oral health in previous studies. This included the study carried out by Shin (2019) among 7741 adults in Korea who had found that each teeth has a potential to increase the grip strength for 0.12 kg in men and 0.07 kg in women which proved that number of teeth which is important part of good oral health and oral health perception was associated with hand grip strength.

Meanwhile, the study by Kim et al. (2019) had only found a significant association of hand grip strength with oral health among men but not among women. Another study was carried out by Moriya et al. (2012) among 354 adults aged 65 years and above in Japan. They found that there was a significant association between GOHAI score with hand grip strength in a positive relationship which indicated that a high score of oral perception by the elderly would results in a higher hand grip strength among them (Moriya et al., 2012). Thus, referring to Table 2.1, these past studies shown that oral health, especially oral health perception by elderly was associated with hand grip strength among the elderly.

2.2.6 Dietary Assessments

In terms of dietary intake, energy and protein adequacy are often associated with hand grip strength among hospitalized elderly patients. Among hospitalized elderly, energy and protein inadequacy had been a common problem where in a study by Kong et al. (2019) among 2759 patients from 21 public hospitals in Malaysia, they found that most of the elderly consumed inadequate energy and protein intake. Meanwhile, according to ESPEN guidelines, an elderly is recommended to take 30kcal/kg total energy and 1.2g/kg body weight of protein daily (Volkert et al., 2019).

Furthermore, through study carried out by Kim et al. (2019) among the elderly had found that both protein and energy intake had an effect on hand grip strength. Similarly, another study was done by Tak et al. (2018) among 1533 Korean elderly to study the influence of diet quality on hand grip strength where they had found that both energy and protein intake had an association with hand grip strength which however, was influenced by the micronutrients too as a reduced protein synthesis due to insufficient nutritional intake might lead to muscle atrophy which ended up with muscle dysfunction.

Meanwhile, another study was carried out in Korea too which involved only Korean elderly women by Jang & Ryu (2020) which was aimed to study the factors of low hand grip strength among the women. Thus, they found that both energy intake and the consumption of animal based protein could cause a better result in hand grip strength. Also, Mishra et al. (2018) had also discussed in their study among 4123 elderly in Taiwan that consumption of 25g protein in more than one eating occasion in a day leads to adequacy among the elderly which eventually was associated with a better hand grip strength. Therefore, both energy and protein intake were found to be associated with hand grip strength among elderly in previous studies and was listed in Table 2.1.

2.2.7 Malnutrition risk

Malnutrition risk is also associated with hand grip strength among the elderly patients which had been proven in previous studies as in Table 2.1. One such study was conducted by Bentli et al. (2019) where they studied the factors affecting malnutrition risk among elderly in Turkey. The study of 65 subjects from a nursing home in the city of Malatya concluded that hand grip strength was correlated with Mini Nutritional Assessment (MNA) score which is a nutritional screening tool validated with 0.62 Cronbach alpha's value (Harith & Tan, 2020). Besides, as more than half of the subjects were either malnourished or at risk of malnutrition,

an almost similar proportion resulted in the number of subjects having weak grip strength. This community-based study concluded that as majority of the elderly were more than 85 years old, the increasing level of dependency is a prerequisite of higher malnutrition risk associated with lower grip strength (Bentli et al., 2019).

Meanwhile, in Asian region, a study by Riviati et al. (2017) in Jakarta, Indonesia among patients receiving medical care at Geriatric Outpatient Clinic in two health care centres had found that malnourishment affects muscle strength or precisely hand grip strength among elderly. The result was more obvious if the subject was above 75 years old. Next, a further study on the correlation between hand grip strength and nutritional status in similar setting among patients with similar criteria as Riviati et al. (2017) was done by Akbar & Setiati in 2018, the following year . Their study had concluded that hand grip strength was strongly correlated with nutritional status. However, if the gender was separated, the correlation was found not significant. The discrepancy between the findings of these two analyses despite using same method and subjects might be due to the difference in sample size as separating male and female subjects will lead to small number of subjects. For the same reason, stronger association was found in research by Riviati et al. (2017) as the sample size of 352 was larger.

On the other hand, Zhang et al. (2017) had also found in their study that muscle strength can be used as a predictor of nutritional status among elderly. This clinical based study was done among 1343 patients receiving internal medical care in Chinese PLA general hospital in Beijing. Higher grip strength was found among patients with lower risk of malnourishment (Zhang et al., 2017). Although this study had used a different method to assess nutritional status which is Nutrition Risk Screening and Subjective Global Assessment, a similar result with most of the other studies was found. Thus, all the findings signified the relationship between nutritional status and hand grip strength among hospitalized elderly.

2.3 Other factors

Referring to Table 2.1, there were some other factors as well that were associated with hand grip strength among elderly or that might cause a difference in the values. One such factor is the hand dominance where according to the study carried out by Charlton et al. (2015) the right hand gave a different result than the left hand in terms of its association with the studied factors. Besides, lifestyle factors that weren't discussed in this study could be associated with hand grip strength too such as smoking habit among the elderly which was found to be associated with hand grip strength by Kim et al. (2019). Meanwhile physical activity could be related to hand grip strength as well by increasing the resistance of muscles involved in a grip especially resistance exercise (Pan et al., 2020). Thus, there might be other factors that could affect the result of the studies on associated factors of hand grip strength among hospitalized elderly that might not be focused in this study.

Table 2.1: Prevalence and factors associated with hand grip strength

Title/ Author/ Year	Location (Setting)	Population	Tool	Proportion of Hand Grip Strength	Factor	
					Significant	Non-significant
Motor performance of the elderly in northeast Brazil: Differences with age and sex (Pinheiro et al., 2013)	Northeast Brazil (Community)	316 elderly (≥ 60 years)	Hydraulic Dynamometer	Disabled: 1.9 % Poor: 26.2 % Medium: 49.5 % Good: 22.3 %	• *Gender* • *Age*	-
Factors associated with low handgrip strength in older people: data of the Study of Chronic Diseases (Edoc-I) (Amaral et al., 2019)	Brazil (Community)	1609 adults (≥ 18 years)	SAEHAN Hydraulic dynamometer	-	• *Height* • *Weight* • Arm and hip circumference • *BMI*	• Waist circumference
Hand-grip strength among older adults in Singapore: a comparison with international norms and associative factors (Ong et al., 2017b)	Singapore (Community)	2043 elderly (≥ 60 years)	Jamar Plus + Digital Hand Dynamometer	-	• *Age* • *Gender* • *Ethnicity* • *Height* • *Weight (W)* • Waist Circumference (W)	• Marital status • *Educational level*

Normative data for hand grip strength and key pinch strength, stratified by age and gender for a multiethnic Asian population (Lam et al., 2016)	Malaysia (Community)	362 elderly (≥ 60 years)	Jamar hydraulic dynamometer	-	• *Age*	-
Risk factors associated with low handgrip strength in the older Korean population (Kim et al., 2019)	Korea (Community)	3643 elderly (≥ 65 years)	Digital grip strength dynamometer	Low hand grip strength: Men – 32 % Women – 33.2 %	• *Age* • Smoking status • *Educational level* • *BMI* • *Protein intake* • *Energy intake* • *Oral health (M)*	• *Oral health (W)* • *Comorbidities*
Hand grip strength and its sociodemographic and health correlates among older adult men and women (50 years and older) in Indonesia (Pengpid & Peltzer, 2018)	Indonesia (Community)	7097 elderly (≥ 50 years)	Baseline Smedley Spring type dynamometer	-	• *Height* • *Weight status* • *Age* • *Educational level (M)* • Income level (M)	• *Educational level (W)* • Income level (W) • *Number of diseases (W)*

					• *Number of diseases (M)*	
Reference values and associated factors of hand grip strength in elderly Saudi population: a cross-sectional study (Alqahtani et al., 2019)	Saudi Arabia (Community)	1048 elderly (≥ 65 years)	Jamar Plus + Digital Hand Dynamometer	-	• *Age* • *Education* • *Height* • *Weight* • Arm length • Arm circumference • *BMI (M)*	• *Education* • *BMI (W)* • Arm length (W)
Chronic diseases, multimorbidity, and handgrip strength among older adults from Southern Brazil (Pessini et al., 2016)	Brazil (Community)	477 elderly (≥ 60 years)	TK 1201 Mechanical dynamometer	-	• *Education level* • Living status • Smoking • *Hypertension* • *Diabetes* • *Number of diseases* • Depression	• Dependency • *Other diseases*

Handgrip strength is inversely and independently associated with multimorbidity among older women: Results from the KORA-Age study K.A. (Volaklis et al., 2016)	Germany (Community)	1079 elderly (≥ 65 years)	Jamar Handgrip dynamometer	-	• *Number of diseases*	-
Physical performance measures and polypharmacy among hospitalized older adults: Results from the crime study (Sganga et al., 2014)	CRIME study (Hospital)	1123 elderly (≥ 65 years)	North Coast Medical hand dynamometer	-	• *Number of medications*	-
Physical activity, muscular strength, and polypharmacy among older multimorbid persons: Results from the KORA- Age study (Volaklis et al., 2018)	Europe (Community)	711 elderly patients (≥ 65 years)	Jamar Handgrip dynamometer	-	• Physical Activity level	• *Number of medications*
Association Between Reduced Handgrip Strength and Commonly Prescribed Medications (Love et al., 2020)	America (Community)	4566 adults (≥ 30 years)	Digital grip strength dynamometer	-	• *Age* • *Gender* • *Number of medications*	-

Handgrip strength values of Portuguese older adults: a population based study (Mendes et al., 2017)	Portugal (Community)	1500 elderly (≥ 65 years)	Jamar Plus® + Digital Hand Dynamometer	-	• *Age* • Mental status • *Height* • *Weight* • *Malnutrition risk* • Physical activity	• *Number of diseases* • *BMI* • Waist circumference • Calf circumference
Hand grip strength in healthy young and older Brazilian adults: development of a linear prediction model using simple anthropometric variables (Santos Neves et al., 2017)	Brazil (Community)	203 adults (≥ 18 years)	Hydraulic dynamometer	-	• *Body height* • *Body mass* • *Gender*	• *Age* • Physical activity
Reference values for hand grip strength in the South Korean population (Kim et al., 2018)	Korea (Community)	7976 (≥ 10 years)	Digital grip strength dynamometer	Decline at rate of 2.6–3.2% 65 years onwards	➢ 65 years: • *Height* • *Weight* • *BMI*	-
Hand grip strength in the adult Malaysian population (Kamarul et al., 2006)	Malaysia (Clinic)	412 young adults (≥ 18 years)	LIDO kinetic work set	-	• Hand dominance • *Gender*	• *BMI* • *Race* • Income level

					• Occupation • *Height* • *Weight*	
Normative Data And Associated Factors Of Hand Grip Strength Among Elderly Individuals: The Yilan Study, Taiwan (Pan et al., 2020)	Taiwan (Community)	2470 elderly (≥ 65 years)	Hydraulic dynamometer	-	• *Height* • *Weight* • Exercise habit	• Living status
Hand Grip Strength: age and gender stratified normative data in a population-based study (Unal et al., 2018)	Australia (Community)	2629 adults (≥ 20 years)	Jamar Hand Dynamometer	-	• *BMI*	-
Comparison of fat percentage with muscle strength/endurance and blood pressure response in young adults (Bindiya et al., 2017)	India (Community)	40 adults (≥ 18 years)	Dynamometer	-	• *Body fat percentage*	-
A study on the correlation between the body mass index (BMI), the body fat percentage, the handgrip Strength and the handgrip endurance in	India (Community)	180 adolescences (18-21 years)	INCO hand grip dynamometer	-	• *BMI (W)* • *Fat percentage (underweight male)*	• *BMI (M)* • *Fat percentage (male)*

underweight, normal weight and overweight adolescents (Lad et al., 2013)					• *Fat percentage (female)*	• *Fat percentage (underweight female)*
Body composition and physical function in older adults with various comorbidities (Kim et al., 2017)	North Carolina (Community)	1821 elderly (≥ 60 years)	Jamar grip strength dynamometer	-	• *Fat percentage*	-
Lean body mass associated with upper body strength in healthy older adults While Higher Body Fat Limits Lower Extremity Performance and Endurance (Charlton et al., 2015)	Australia (Community)	117 elderly (≥ 55 years)	Jamar Plus® + Digital Hand Dynamometer	-	• *Age* • *Weight* • *Fat percentage* • *Energy intake* • Fat intake • CHO intake	• *BMI* • *Malnutrition risk* • *Protein intake*
Cross-sectional relationship between haemoglobin concentration and measures of physical and cognitive function in an older rural South African population (Payne et al., 2018)	South Africa (Community)	4499 adults (≥ 40 years)		-	• *Haemoglobin (W)* • Stroke • *Age*	• *Haemoglobin (M)* • *Type of diseases*
Low hemoglobin concentrations are associated with sarcopenia, physical	Australia (Community)	1511 elderly men	Jamar dynamometer	-	• *Haemoglobin*	-

performance, and disability in older australian men in cross-sectional and longitudinal analysis: The Concord Health and Ageing in Men Project (Hirani et al., 2016)		(≥ 60 years)				
Association of hemoglobin concentration with handgrip strength in relation to hepatocyte growth factor levels among elderly Japanese men aged 60–69 years: a cross-sectional study (Shimizu et al., 2018)	Japan (Clinic)	255 elderly (60-69 years)	Smedley handgrip dynamometer	-	• *Haemoglobin (Low HGF)*	• *Haemoglobin (High HGF)*
Low haemoglobin levels contribute to low grip strength independent of low-grade inflammation in Japanese elderly women (Yamada et al., 2015)	Japan (Community)	202 elderly women	The Takei 5401 hand held dynamometer	-	• *Age* • *Height* • *Weight* • *Fat percentage* • *Albumin* • *Haemoglobin*	• *BMI* • Total cholesterol
Determination of whether the association between serum albumin	Japan (Community)	254 elderly	The Takei 5401 handheld dynamometer	-	• *Serum albumin (baseline only)*	• *Albumin*

and activities of daily living in frail elderly people is causal (Kitamura et al., 2012)						
Prognostic value of physical function tests: hand grip strength and six-minute walking test in elderly hospitalized patients (Martín-Ponce et al., 2014)	Spain (Hospital)	310 elderly patients (≥ 60 years)	Collin's dynamometer	-	• *Serum albumin level*	-
Serum albumin and muscle measures in a cohort of healthy young and old participants (Reijnierse et al., 2015)	Europe (Community)	172 young and 271 elderly	Jamar Handgrip Dynamometer	-	-	• *Serum albumin level*
Association of handgrip strength with dietary intake in the Korean population: Findings based on the seventh Korea National Health and Nutrition Examination Survey (KNHANES VII-1), 2016 (Tak et al., 2018)	Korea (Community)	1533 elderly (≥ 60 years)	The Takei digital handheld dynamometer	-	• *Total Energy intake* • *Protein/weight* • PUFA • Fibre • Micronutrients	-

Association of low hand grip strength with protein intake in Korean female elderly: based on the seventh Korea National Health and Nutrition Examination Survey (KNHANES VII), 2016-2018 (Jang & Ryu, 2020)-	Korea (Community)	2083 elderly women (≥ 60 years)	TAKEI hand grip dynamometer	Low Hand Grip Strength: 35 % (< 18 kg) Normal: 65 %	• *Energy intake* • *Protein Intake* • Fat intake • Carbohydrate intake • Total food	• Cereal intake • Egg and egg products intake • Legume intake • Dairy products
Association between dietary protein intake and grip strength among adults aged 51 years and over: What We Eat in America, National Health and Nutrition Examination Survey 2011-2014 (Mishra et al., 2018)	Taiwan (Community)	4123 elderly (≥ 55 years)	Hand grip dynamometer	-	• *Dietary protein intake*	-
Handgrip strength and the number of teeth among Korean population (Shin, 2019)	Korea (Community)	7741 adults	Digital hand grip dynamometer	-	• *Number of teeth*	-
Relationships between Geriatric Oral Health Assessment Index scores and	Japan (Community)	354 elderly (≥ 65 years)	TANITA hand grip dynamometer	-	• *Age* • *Gender* • *Number of teeth*	• Employment status

general physical status in community-dwelling older adults (Shingo Moriya et al., 2012)					• *GOHAI score*	• *Educational background* • Social interaction • *Number of diseases*
Nutritional status of elderly people living in nursing home and some related factors (Bentli et al., 2019)	Turkey (Nursing home)	65 elderly	Jamar Hydraulic Hand Dynamometer	Low Hand grip strength: 52.3 %	• *Malnutrition risk (MNA)* • Depression • ADL score	-
Factors Related with Handgrip Strength in Elderly Patients (Riviati et al., 2017)	Indonesia (Hospital)	352 elderly (≥ 60 years)	Dynamometer	Low HGS among Malnourished: 56.2 % Normal HGS among malnourished: 43.8 %	• *Age* • *Malnutrition risk (MNA)*	• Waist circumference • *Type of diseases*

Correlation between hand grip strength and nutritional status in elderly patients (Akbar and Setiati, 2018)	Indonesia (Hospital)	98 geriatric patients (≥ 60 years)	Dynamometer	-	• *Malnutrition risk (MNA)*	-
Handgrip strength as a predictor of nutritional status in Chinese elderly inpatients at hospital admission (Zhang et al., 2017)	China (Hospital)	1343 geriatric patients (≥ 65 years)	Jamar Dynamometer	-	• *Malnutrition risk (SGA)*	-

**Factors studied in this study*

*M = Men, W= Women

CHAPTER 3

METHODOLOGY

3.1 Study Design

This was a cross sectional study to study the association between sociodemographic factors, medical background, anthropometry data, biochemical markers level, perceptions towards oral health, dietary assessments and malnutrition risk with the hand grip strength of hospitalized elderly in Klang Valley hospitals.

3.2 Study Location

The study was conducted in three public hospitals around the Klang Valley area which falls under the City of Kuala Lumpur and Selangor. The hospitals included Hospital Sungai Buloh, Hospital Kuala Lumpur and Hospital Tengku Ampuan Rahimah. The hospitals were chosen due to the availability of geriatric wards in those hospitals easing the study purpose to recruit elderly patients from geriatric ward to participate in this study.

Hospital Sungai Buloh was located 25 kilometres away from the main city of Kuala Lumpur where this hospital received patients for secondary and tertiary care. The geriatric ward also admitted elderly patients for rehabilitation purpose where the average number of beds occupied in the ward was around 12 beds. Also, based on the official website of Hospital Sungai Buloh, the hospital was in overall occupied with 620 beds mainly aimed to reduce the flux of patients in Hospital Kuala Lumpur.

Next, Hospital Kuala Lumpur (HKL) which is in Kuala Lumpur City was occupied with a total of 2300 beds where according to the HKL official website, there were 53 departments with

83 wards in total including geriatric ward in the hospital. Whereby, HKL often admitted patients for a tertiary referral.

Lastly, Hospital Tengku Ampuan Rahimah (HTAR) was located in the south side of Klang in Jalan Langat. This hospital which was built in 1985 received 260 admissions daily where the geriatric ward included five cubicles that could place 15 geriatric patients (HTAR official website). HTAR used a manual bedside patient record for their medical records.

3.3 Study Subjects

The study respondents included patients from geriatric ward. The subjects who must be Malaysian citizens were selected according to several inclusion criteria. Firstly, the subjects were aged 60 years and above to meet the study objective, besides were able to either communicate in English or Malay as an ease for communication. Finally, the subjects also were on oral diet which included with or without oral nutrition supplement in their hospital diet besides being admitted for more than 48 hours and received the hospital diet since past 2 or more days.

There were also few criteria to exclude the subjects from the study. Firstly, subjects who were full enteral or parenteral fed patients were excluded. Besides, patients who were critically ill or mentally disturbed were excluded too. Finally, to ensure the subjects were able to participate fully in the study, patients with less than 48 hours of hospital stay were excluded. The subjects chosen to join the study were given a consent form upon participation.

3.4 Sampling Design

This study used a non-probability sampling design which included both purposive and convenience sampling. Klang Valley hospitals with geriatric ward were purposively selected for the study location to meet the aim of the study subjects. Therefore, only three public hospitals in Klang Valley with geriatric ward were selected purposively for this study. Meanwhile, the subjects were selected as per convenience sampling method to ease the study and reach the desired sample size. Subjects who were available during the research period were selected during each alternated visit to the hospitals until the desired sample size was reached.

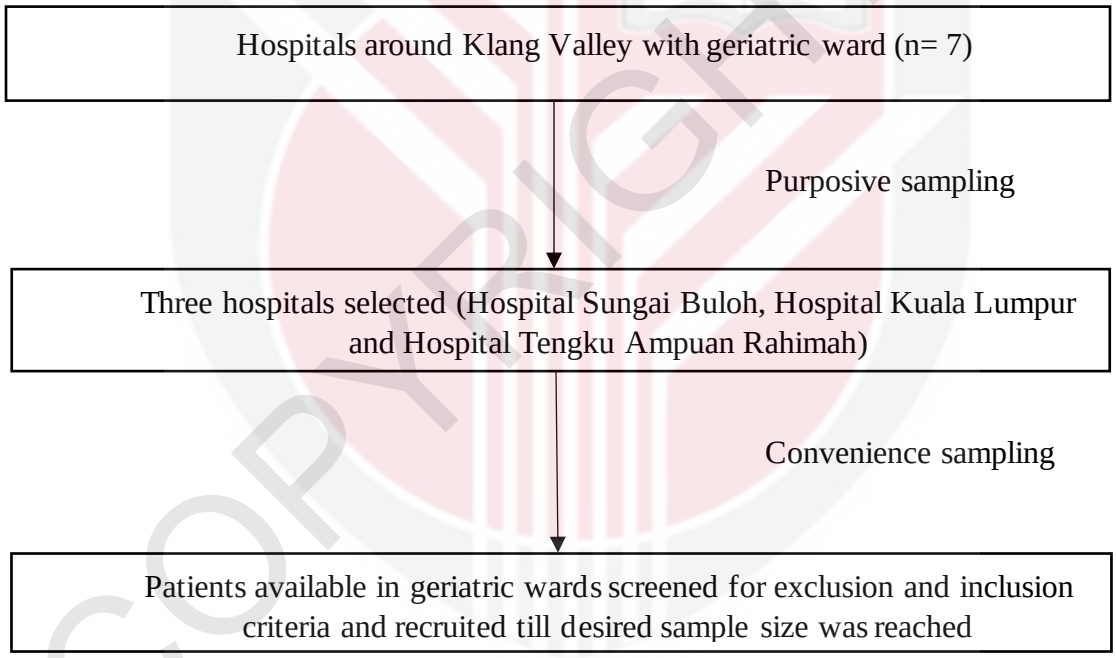

Figure 3.1: Flow chart of sampling method

3.5 Sample Size Determination

$$n = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2}{r^2/(1-r^2)} + 5$$

Where,

n = Sample size

$Z_{1-\alpha/2}$ = Z score for significance level at 5 % = 1.96

$Z_{1-\beta}$ = Z score for power set at 80% = 0.842

r = Correlation coefficient

Table 3.1: Sample size calculation

Correlation studies	Factor	Correlation coefficient, r	Sample size
Reference values and associated factors of hand grip strength in elderly Saudi Population; a cross sectional study (Alqahtani et al., 2019)	**Sociodemographic Factor** Educational level	-0.420	Using above formula, n = 42
Reference values and associated factors of hand grip strength in elderly Saudi population: A cross-sectional study (Alqahtani et al., 2019)	**Anthropometry Data** Height	0.637	Using above formula, n = 17
Association of handgrip strength with dietary intake in the Korean population: Findings based on the seventh Korea national health and nutrition examination survey (Tak et al., 2018)	**Biochemical Markers** Haemoglobin level	0.520	Using above formula, n = 28
Association of handgrip strength with dietary intake in the Korean population: Findings based on the seventh Korea national health and nutrition examination survey (Tak et al., 2018)	**Dietary Intake** Total Energy Intake	0.411	Using above formula, n = 44

The use of hand grip strength as a predictor of nutrition status in hospital patients (Flood et al., 2013)	**Malnutrition risk**	0.767	Using above formula, n = 11

After comparing the sample size values obtained, the highest value from the study by Tak et. (2018) who aimed to study the association between hand grip strength and dietary intake among elderly was used. After accounting for 20% non response, the sample size of 53 was obtained for minimum subjects.

3.6 Measures

Research instrument that was used in the study was a questionnaire which included self-administered questions, validated forms and measurements recorded. The questionnaire was filled in by researcher to ensure all the information were accurate and there was no mistake in the data obtained. The time estimated for a subject to complete the questionnaire was around 45 minutes.

3.6.1 Sociodemographic factors

The sociodemographic factors information was obtained through medical record. Besides, a face-to-face interview was done with the subjects if there was a lack of information in the patient record. The sociodemographic factors that were included were age, gender, ethnicity and educational level. The information obtained were then filled in the self-administered questionnaire as in Appendix VI (Part A).

3.6.2 Medical background

Medical background information was obtained through the medical records and their bed head ticket. To complete the information, an interviewing method was carried out too. The information

in this context included the type and number of co-existing diseases the subjects had and their number of medication drugs which they consumed. After obtaining the data, they were categorized as on polypharmacy which was categorized for those who were on four or more medication drugs (Volaklis et al., 2018). The data obtained was then filled in the self-administered questionnaire as shown in Appendix VI (Part B).

3.6.3 Anthropometry data

The anthropometry assessments included the subject's current weight, height, body mass index (BMI) and their body fat percentage.

i. Weight

The body weight of the subjects was measured using the Digital Weighing Scale OMRON HBF-357. The scale was placed on a flat surface while ensuring the scale was at zero before doing the weighing procedures. After making sure the subject was wearing light clothes and not carrying anything heavy, the subject needed to stand straight on the scale at the centre without assistance and distribute weight equally on both feet. The measurement was then taken at the nearest 0.1 kg.

However, for patients who were bed ridden or could not stand without assistance, their weight was estimated using the mid upper arm circumference and knee height measurement. To measure the mid upper arm circumference, the subject either standing or lying was needed to roll up their sleeves and bend their right arm at 90 degree or if the right hand was injured or in pain, the left arm was used to take measurement. The midpoint between shoulder bone (acromion) and olecranon was marked with a pen. Next, subject was needed to straight their arm loosely by making the palm face their thigh. The measuring tape was then looped and tightened around the midpoint without compressing the tissues to measure the mid upper arm circumference. For the knee height,

patient in a lying position, held both knee and ankle at 90-degree angle. After ensuring the measuring tape was at zero, the tape was placed at the heel of the right leg or left if the right was not appropriate for the measurement. The tape was extended to the anterior position of the thigh. By ensuring the tape was correctly positioned, the length was taken at nearest 0.1 cm.

Once both measurements were taken, the weight was measured by using Ross et al. (2002) equations as below:

Men: Weight = [(1.10 x KH) + (3.07 x MUAC)] – 75.81

Women: For women; Weight = [(1.01 x KH) + (2.81 x MUAC)] – 66.04

ii. Height

To measure height, TANITA height rod was used. The subjects stood straight barefooted without assistance. After ensuring the subjects had their heels together and against the wall of the stadiometer with relaxed position and head in Frankfurt position, subjects were asked to take a deep breathe with the headboard lowered to the highest position of the head. While recording the height at nearest 0.1 cm, the eyes level was ensured to be at same level with the headboard. Meanwhile, if the subject was unable to stand straight for the height measurement, an estimation of height was done by using the formula by Chumlea et al. (1985) where it is considered as the most accurate height estimation formula (Berger et al., 2008). The formula to estimate the height using knee height is as below:

Men: Height = 64.19 – (0.04 × age) + [2.02 × KH (cm)]

Women: Height = 84.8 – (0.24 × age) + [1.83 × KH (cm)]

iii. Body Mass Index

Body mass index (BMI) was calculated using the formula of 'Weight (kg)/ Height (m2)' in kg/m^2. The BMI was classified according to the WHO (2016) BMI cut-off as below:

Table 3.2: WHO BMI classifications

Category	Cut-Off Value
Underweight	<18.5 kg/m^2
Normal	18.5 to 24.9 kg/m^2
Overweight	25.0 to 29.9 kg/m^2
Obesity Class I	30.0-34.9 kg/m^2
Obesity Class II	35.0-39.9 kg/m^2
Obesity Class III	$\geq$40.0 kg/m^2

Source: World Health Organization (2016)

iv. Body fat percentage

Body fat percentage was measured using the Bioelectrical Impendence Analysis OMRON HBF-302 tool which was a simple and accurate tool to measure body fat in clinical studies according to National Institutes of Health. Subjects held the tool with both hands with both arms straighten forward. The data such as the height, weight, age and gender was inserted into the BIA before letting the subject held it. The fingers were ensured to be on the electrode while the middle finger was wrapped around the handle groove. While palms will be on the tool, the thumbs should be resting on top of the device handle. Subjects remained static and calm with arms at 90 degree angle to the body during measurement. Results in percentage was compared to following recommendation for elderly:

Table 3.3: Body fat percentage classification

Gender	Low (%)	Normal (%)	High (%)	Very high (%)
Male	<13.0	13.0 – 24.9	25.0 – 29.9	≥ 30.0
Female	<24.0	24.0 – 35.9	36.0 – 41.9	≥ 42.0

Source: Gallagher et al. (2000)

The information obtained through physical assessments were then recorded in the self-administered questionnaire as in Appendix VI (Part C).

3.6.4 Biochemical markers

The biochemical data was recorded through the medical record or their bed head ticket. The biochemical data included the serum albumin level and haemoglobin level where an elevated value marked an inflammation or muscle dysfunction among elderly which affected the hand grip strength (Kitamura et al., 2012). After obtaining the value, the data was classified as normal and abnormal after being compared with their normal range as below:

Table 3.4: Normal range for serum albumin and haemoglobin level

Biochemical markers	Normal range
Serum albumin	35 – 50 g/L
Haemoglobin	Male: 14 – 18 g/dL Female: 12 – 16 g/dL

Source: TMCE (2017)

The information obtained through physical assessments were then recorded in the self-administered questionnaire as in Appendix VI (Part D).

3.6.5 Perception towards oral health

The perception towards oral health was assessed using the Geriatric Oral Health Assessment Index (GOHAI) form which was developed by Atchinson and Dolan in 1990 with 0.79 Cronbach alpha's value (Nasir et al., 2004). This tool has been used as a validated tool in a study in Malaysia (Rosli et al., 2019). The GOHAI had 12 questions and three sections of assessments; which included four items of oral physical function, five items of psychological function dimensions and three items of questions on pain or discomfort (Azogui-Lévy et al., 2018). The score was ranged and labelled 1 for Always, 2 for Often, 3 for Sometimes, 4 for Seldom and 5 for Never. This scoring was obtained based on a face-to-face interview with the subjects by asking the questions on the GOHAI score form one by one. As a result, the score for the perceptions towards their oral health was totalled to note the 'Total Oral Health Perception Score' where 12 was the lowest score a subject could obtain while 60 was the highest. The score classification was as below:

Table 3.5: Score for perceptions towards oral health

Category	Score
Low perception towards oral health	12-56
High perception towards oral health	≥57

Source: Kshetrimayum et al. (2013)

Questions in GOHAI form was as shown in Appendix VI (Part F).

3.6.6 Dietary assessments

i. Dietary Requirement

The dietary requirement of the subjects were calculated using the formula which were derived from the ESPEN guidelines on clinical nutrition and hydration of geriatric patients by Volkert et

al. (2019) where information needed such as actual weight of the subjects were obtained through anthropometry assessment and included in the formula as below:

Energy requirement: 30 kcal/kg body weight x Actual Weight (kg)

Protein requirement: 1.2g/ kg body weight x Actual Weight (kg)

ii. Dietary Intake

The dietary intake of the subjects was taken by 24-hour dietary recall of the patients for two days as it was a flexible method to accurately record their dietary intake as reported in the study by Tak et al. (2018). The dietary intake was obtained of patients who had taken at least two days hospital meals. The type of diet received, method of preparation, amount consumed alongside any outside food consumed by patient and oral nutrition supplements was also noted to further aid in the result discussion. The total energy intake and protein intake was calculated by using the Nutritionist Pro Software and averaged for the two days intake where the second day was asked on the following day. Underreporting (lesser than 0.69 Energy Intake: Basal Metabolic Rate ratio) was measured by comparing Energy for dietary intake with BMR (Pfrimer et al., 2015).

Basal Metabolic Rate: 10 x Actual Weight (kg) + 6.25 x Height (cm) – 5 x Age (Years) + X

Men, X = 5 ; Women, X = -161

Underreporting: Energy Intake/Basal Metabolic Rate

iii. Dietary Adequacy

To calculate the dietary adequacy, the averaged energy and protein intake of the subjects were compared against the 100 % of requirement as the requirement recommended by ESPEN where subjects who had 100% or more dietary adequacy were categorized as having adequate dietary

intake either of Energy or Protein intake. The formula used to calculate the adequacy were as below:

$$\text{Energy adequacy} = \frac{Energy\ Intake}{Energy\ Requirement} \times 100$$

$$\text{Protein adequacy} = \frac{Protein\ Intake}{Protein\ Requirement} \times 100$$

Alongside, the reason of the altered intake of the subjects according to the dietary recall was also asked as a remark. The information obtained through dietary recall were then recorded as in Appendix VI (Part G).

3.6.7 Malnutrition risk

Malnutrition risk of the subjects was measured by using the Mini Nutritional Assessment-Short Form (MNA-SF) tool which was developed in 2001. MNA-SF is a validated tool to measure malnutrition risk among geriatric patients where in the latest revision, it incorporated either BMI or calf circumference as the sixth aspect (Dent et al., 2014). The aspects asked in MNA-SF included nutrition, weight loss, mobility, psychological distress or acute illness in the past three months, dementia or depression and anthropometry aspects. Besides, the reliability of MNA-SF as a validated tool among geriatric patients was supported by more than 400 studies worldwide as it had sensitivity of 93.2% to detect malnutrition (Suzana & Siti Saifa, 2007). There were seven questions in MNA-SF where the lowest total score was zero while the highest was 14. The total score was categorised in three categories as such:

i. Normal nutritional status – 12-14 points

ii. At risk of malnourishment – 8-11 points

iii. Malnourished – 0-7 points

Questions in MNA-SF form was as shown in Appendix VI (Part H).

3.6.8 Hand Grip Strength

Hand grip strength was measured by using Jamar Plus+ Digital Handgrip Dynamometer. The measurement was taken at the nearest 0.1 kg as the hand grip strength value. Before measuring hand grip strength, the subjects were asked to position their elbow at 90 degree. The handle of the dynamometer was ensured that it was according to the subject's comfort. The best position was when the subject could give out maximum force on the grip handle (Trampisch et al., 2012). Both hands measurement were taken twice which started with the right hand and alternating with the left hand.

The grip force was applied for around 3 to 5 seconds by the subjects. Next, the average of both the measurements from both hands were counted. The maximum hand grip strength (Max HGS) was taken based on the highest value between both hands or if the patient was able to grip only by a hand, then the measurement from the single hand was taken as the Max HGS (Amaral et al., 2019). Also, the tool was sanitized before and after taking the measurements. The validated cut-off point by the Asian Working Group of Sarcopenia (AWGS) was used to determine the hand grip strength cut off. The cut-off point recommended was as below:

Table 3.6: Hand grip strength cut-off values

	Cut-off points	
	Lower	**Normal**
Male	<26kg/force	≥26kg/force
Female	<18kg/force	≥18kg/force

Source: Asian Working Group of Sarcopenia

The data obtained was then recorded in the self-administered questionnaire as in Appendix VI (Part E).

3.7 Data Collection

The study was conducted between August 2020 and October 2020. Approvals from the National Medical Research Register (NMRR) and Ethics Committee for Research involving Human Subjects in UPM (JKEUPM) were obtained before the data collection. Before beginning the interview, the consent form was given out to the subjects as they were explained about the study and confidentiality of the data. The subject was also given an ID number. Next, once the consent was granted, the medical record and bed head ticket was looked through to recruit information on sociodemographic factors, medical background and biochemical data. Meanwhile, before proceeding with physical assessment, a face-to-face interview was done to fill in the missing information on the three variables information.

Meanwhile, anthropometry measurements on the subjects alongside the hand grip strength measurement were done next. Finally, the session with each subject proceeded with a face-to-face interview to ask the questions pertaining perceptions towards oral health and a 24 hour dietary recall of the previous hospitalization day. The session was concluded with the final section which was the malnutrition risk assessment by using the MNA-SF form. The subjects were informed about another day of follow up to record their next day dietary recall. The estimated time to complete the session was 45 minutes. Finally, after completing the questionnaire, the data was inserted into SPSS for further analysis. The hospitals were alternated during the data collection period where each hospital was visited twice in a row to complete the two days dietary recall.

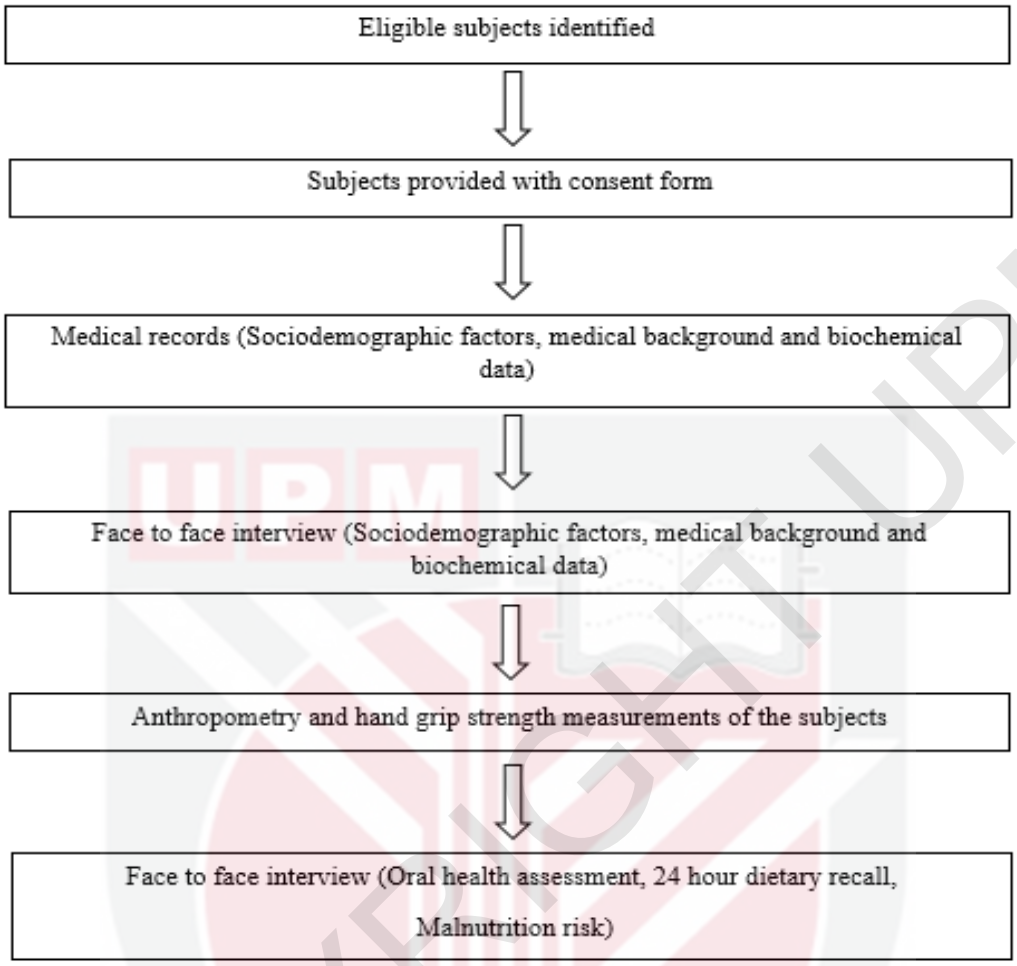

Figure 3.2: Study procedures

3.8 Pre-Test

A pre-test for the questionnaires was conducted prior to the data collection. Approximately 5 subjects which was 10 % of total subjects were included in the pre-test where these data weren't included in the actual data collection result. Pre-test helped to identify error in the instruments besides assessing either the questionnaire was understandable and suitable for the study population. Time needed for each session was also estimated through pre-testing.

3.9 Data Analysis

SPSS software version 26.0 was used to analyse the data. The descriptive statistics of the data was computed including the mean, frequencies and percentage alongside standard deviation and minimum and maximum value of the data through a descriptive analysis. After checking for the normality, the inferential statistic to analyse the association was carried out where association between continuous variables was analysed by Pearson Moment Product Correlation test and Spearman Rho Correlation test analysis was used for the association analysis of the continuous variable with ordinal variable such as educational level. Significant level at $p<0.05$ was set to determine the significance of the association.

3.10 Confidentiality and Security of Documents and Data

All the information of the subjects and their data were stored in a safe manner and in high confidentiality, according to the law and regulations. The identity of the subjects was hidden too as the subjects was coded with ID Number where no name, identification card number, patient ID or the bed number was disclosed. The study data and questionnaires weren't returned to the subjects too. Besides, the questionnaires were kept safe according to the institutional policy for 3 years where after the period, the data will be destroyed safely. Finally, while presenting the data too, the subjects' identity won't be disclosed in order to protect confidentiality.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter discusses the result of this study based on the interpretation and analysis of the data collected from a sample of hospitalized elderly around Klang Valley. There were 57 respondents recruited in this study (response rate of 107.5%).

Overall, there are two sections in this chapter. The first section explains the first and second objective of this study which is to assess the sociodemographic factors, medical background, anthropometry data, biochemical markers level, perception towards oral health, dietary assessment, malnutrition risk and hand grip strength among hospitalized elderly in Klang Valley hospitals.

Meanwhile the second section focuses on the third objective which is to determine the associations between sociodemographic factors, medical background, anthropometry data, biochemical markers, perception towards oral health, dietary assessment and malnutrition risk with the hand grip strength among hospitalized elderly in Klang Valley hospitals.

4.2 Sociodemographic factors

The main sociodemographic characteristics information that was obtained in this study were age, gender, ethnicity and educational level. Table 4.1 below shows the sociodemographic characteristics of elderly patients in hospitals around Klang Valley. Based on the demographic information, it was observed that the mean age of the subjects recruited in this study was 72.3 $\pm$ 7.31 years which comes in range between 60 to 86 years old. A study carried out by Riviati et al.

(2017) had found an almost similar mean age in their study among geriatric patients in Indonesia which was 70 years old with a larger sample size of 352 whereby, another study by Ong et al. (2017) in Singapore among 84 community dwelling elderly had found even lower mean of age which was 68 despite a broader range of participants age up to 105 years old. Therefore, geriatrics patients age range are mostly at 70 years old.

Meanwhile, it was found that the majority of subjects recruited in this study were female. Previous research had also found a similar result where the study by Bentli et al. (2019) in Turkey among 65 nursing home elderly had also managed to recruit more female subjects in their study as compared to male subjects. However, in contrast, the study by Akbar and Setiati (2018) in Indonesia among geriatric patients had recruited more male subjects as compared to female where their sample size were also larger, which was 98 subjects.

In terms of ethnicity, most of the subjects were Malay where it was followed by Chinese and finally, Indians. There was also 1.8% of subjects from other ethnicities category. However, there was not a big gap between the categories of ethnic for the three-majority groups making a good mixture of ethnics in the results allowing the data to be conclusive of ethnicity. This proportion of ethnicity was found contradict to two studies carried out in Asia where both the study by Lam et al. (2016) in Malaysia and Ong et al. (2017) in Singapore had found majority of their subjects to be Chinese. However, as the study by Lam et al. (2016) was carried out among outpatient elderly while Ong et al. (2017) study was among community dwellers, the difference of proportion might be due to the background of the study subjects. Besides, the study by Lam et al. (2016) was done in two areas which are Klang Valley, Selangor and Bahau, Negeri Sembilan whereas this study was done only in Klang Valley.

The final sociodemographic characteristic was the educational level of the subjects. As the subjects were categorised into 4 categories, the majority of the subjects had received secondary level of education (47.4 %) while the least proportion was of tertiary level of education (7 %). Therefore, the majority of the subjects which was 70% of them had received formal education. Similarly, a study by Yunus et al. (2017) in Malaysia had found secondary level as the most prevalent educational status among elderly patients too.

Table 4.1: Sociodemographic characteristics of the subjects (N=57)

Characteristics	**Mean + SD**
Age (Years)	72.27 + 7.31
	N (%)
Gender	
Male	24 (42.1)
Female	33 (57.9)
Ethnicity	
Malay	23 (40.4)
Chinese	18 (31.6)
Indian	15 (26.3)
Others	1 (1.8)
Educational level	
No formal education	17 (29.8)
Primary level	9 (15.8)
Secondary level	27 (47.4)
Tertiary level	4 (7.0)

4.3 Medical background

The data that were obtained from the subjects on medical history included the type of comorbidities, number of comorbidities and the number of medication drugs that they consumed. From Table 4.2 below, most of the elderly had two comorbidities while the highest number was 5 where some had no comorbidities. Meanwhile, the study by Akbar & Setiati (2018) found the same range of comorbidities among elderly too where majority of their subjects either had two or three accompanied comorbidities. On the other hand, most of the elderly were on four medication drugs

where the highest number being up to 13 medicines which included their short- and long-term medicines. Comparably, Volaklis et al. (2016) in their study among elderly in Germany had found that the majority of their subjects were on four medication drugs too despite having a larger sample size of 1079 compared to this study.

Table 4.2 also shows the type of comorbidities among the subjects where the most common disease among them was Hypertension followed by Diabetes Mellitus. Chronic Kidney Disease and Dyslipidaemia had a similar and smallest proportion where only 21.5 % of the elderly had them which was opposite of the highest proportion of 75.4%. A previous study by Kim et al. (2019) in Korea had also found that the highest prevalence of disease among elderly patients was Hypertension disease followed by Diabetes Mellitus making them two most common diseases among hospitalized elderly in Asia. This trend is also similar to the National Health Morbidity Survey of 2018, where Hypertension were found to be most prevalent among Malaysian elderly followed by Diabetes. There were a small proportion of other diseases too among the elderly as shown in the table below which included dementia and small bowel obstruction.

Table 4.2: Medical background of the subjects (N=57)

Medical history	Mean + SD	Range
Number of comorbidities	2.12 + 1.07	0 – 5
Number of medication drugs	4.61 + 2.87	0 – 13
	N (%)	
Presence of polypharmacy	23 (40.4)	
Diabetes Mellitus	31 (54.4)	
Hypertension	43 (75.4)	
Chronic kidney disease	12 (21.1)	
Dyslipidaemia	12 (21.1)	
Cardiovascular disease	20 (35.1)	
Other diseases	2 (3.5)	

4.4 Anthropometry data

The mean weight among the subjects was 55.49 ± 14.34 kg whereas the lowest weight was 28.4 kg while the highest was 92 kg. Meanwhile, the mean height of the subjects was 155.79 ± 10.26 cm which ranged from 130.3 cm to 185 cm. Meanwhile, the mean BMI among the subjects was 22.92 ± 6.78 kg/m^2 which falls under normal BMI category ranging from 19.90 to 53.80 kg/m^2. Lastly, in terms of body fat percentage as shown in Table 4.3, the mean body fat percentage of the subjects was 29.25 ± 9.10 % with the lowest being 10 %.

Table 4.3: Anthropometric data of the subjects (N=56)

Anthropometric measurements	Mean ± SD	Range
Weight (kg)	55.49 ± 14.34	28.40 – 92.00
Height (cm)	155.75 ± 10.26	130.30 – 185.00
Body Mass Index (BMI) (kg/m2)	22.92 ± 6.78	12.90 – 53.80
Body fat percentage (%)	29.25 ± 9.10	10.00 – 48.00

According to Figure 4.1, where the BMI was classified according to WHO classification, the majority of the subjects had normal BMI followed by being underweight and overweight. The lowest number was in the obese category. According to NHMS (2018), only 40 % of Malaysian elderly have a normal weight status which is similar to this study result, as only 45.6 % had normal BMI despite being the highest among all the categories, while the rest 54.4 % had abnormal BMI status similar to 60 % abnormal BMI prevalence found among Malaysian elderly in NHMS 2018. This can be associated with the caution of Sarcopenic obesity among elderly which can be concurrent with the changes in their body composition with increasing age (Zamboni & Mazzali, 2012).

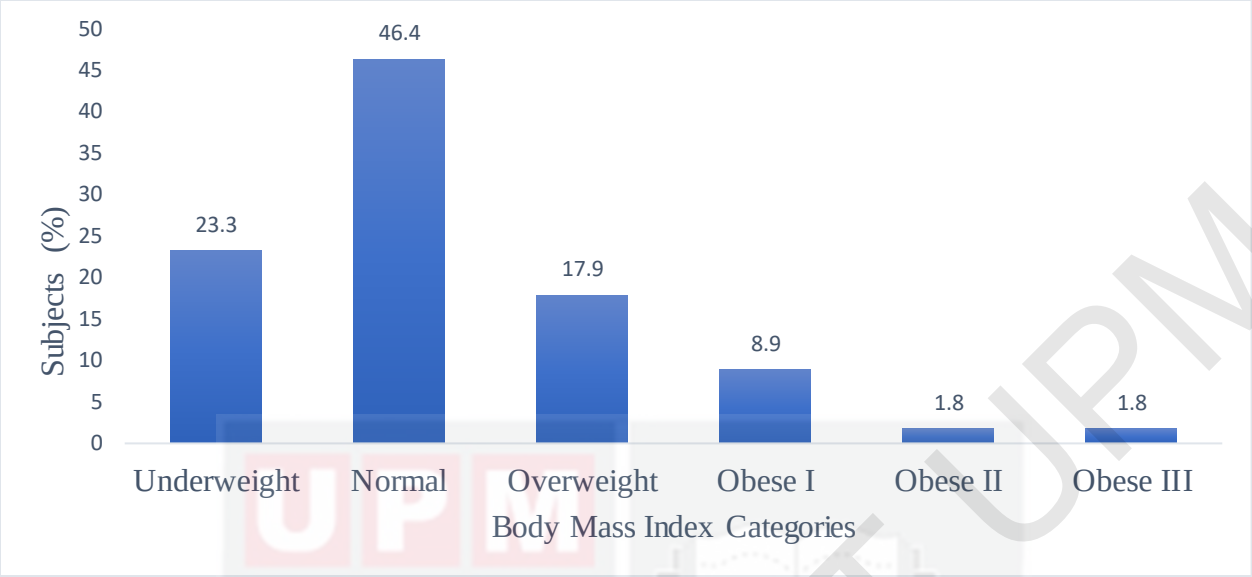

Figure 4.1: Percentage of BMI category according to the WHO BMI Chart among the subjects (N=56)

As the body fat percentage of the subjects was classified according to cut off as proposed by Gallagher et al. (2000), majority of the subjects had a normal level of body fat percentage followed by very high and high. The least number of subjects were in low body fat percentage category with only 12.7 % proportion. Therefore, only 38.2 % of the subjects which is less than half of them have a normal body fat percentage while the rest had elevated body fat percentage level. Relating back with sarcopenic obesity among elderly, elderly with high body fat percentage are at higher risk of having various health outcomes and diseases due to the sarcopenic obesity which increases morbidity and mortality risk among them (Chang et al., 2012).

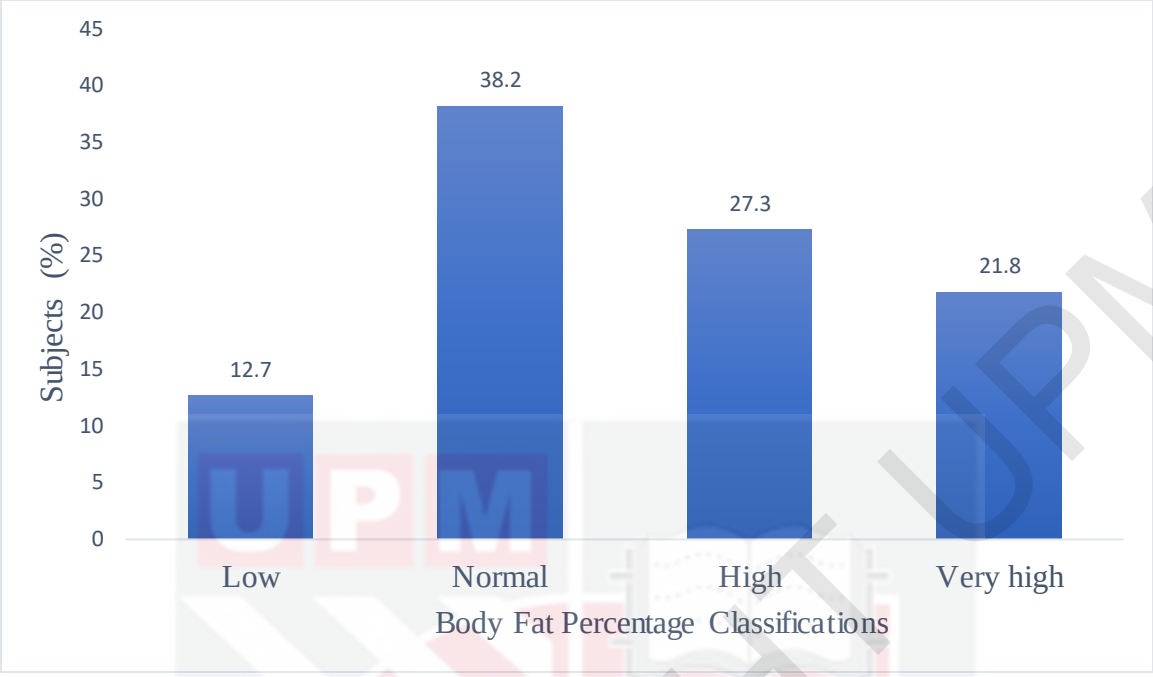

Figure 4.2: Body fat percentage classifications accordingly as proposed by Gallagher et al. (2000) among the subjects (N=56)

4.5 Biochemical markers

According to Table 4.4, the mean serum albumin value among the subjects was 30.98 ± 6.77 g/L which falls under lower-level value. Meanwhile, most of the subjects have a low serum albumin (68%) marking possibilities of malnutrition or inflammation among them whereas only 32% have normal serum albumin level. This result was opposite of the results found by Reijnierse et al. (2015) among 271 elderly in Europe as they found serum albumin level to be normal among their subjects which might differ with this study due to the background difference as this study recruited hospitalized patients while Reijnierse et al. (2015) studied community-dwelling elderly whereas, inflammation is common among hospitalized elderly.

Furthermore, Table 4.4 also shows that the mean haemoglobin level among the subjects was 11.65 ± 2.15 g/dL. After classifying into normal and elevated level according to gender, most of

the subjects had low level of haemoglobin which was contrary to previous study by Yusof et al. (2018) among Malaysian elderly living in community and the study by Yamada et al. (2015) among elderly women in Japan. Both the previous studies found a lower prevalence of low hemoglobin level compared to normal level among their subjects. However, as this study was carried out among elderly admitted in hospitals, the low hemoglobin level might be due to their medical condition and poor health status (Randi et al., 2020).

Table 4.4: Biochemical data of the subjects (N=49)

Biochemical data	Mean ± SD	Range
Serum albumin level (g/L)	30.98 ± 6.77	11.00 – 46.00
Haemoglobin level (g/dL)	11.65 ± 2.15	6.50 – 39.00
Biochemical markers classifications	**N (%)**	
Serum albumin level		
Low (< 35 g/L)	34 (68.0)	
Normal (35 – 50 g/L)	16 (32.0)	
Haemoglobin level		
Low (M = < 14 g/dL, F= < 12 g/dL)	39 (70.9)	
Normal (M = 14 – 18 g/L / F = 12 – 16 g/L)	16 (29.1)	

4.6 Perceptions towards Oral Health

According to Table 4.5 below, the mean score of the subjects on perception towards oral health is 44.21 ± 7.06 which falls under the category of low perception with a maximum value of 55 and minimum value of 27. Meanwhile, as seen in Table 4.5 too, all the subjects had a low perception towards oral health (100%). As reported by the subjects, most of the elderly were on poorly fitted dentures which increased their discomfort and pain while eating. Moriya et al. (2012) had concluded in their study that a low GOHAI score among elderly indicates a lower physical status and would impact their dietary intake which was seen to be prevalent among hospitalized elderly in this study.

Table 4.5: Perceptions towards oral health of the subjects (N=57)

	Mean ± SD	Range
Perceptions towards Oral Health	44.21 ± 7.06	27 – 55
Perceptions towards Oral Health classifications	**N (%)**	
Low (12 – 56)	57 (100.0)	
High (> 56)	0 (0.0)	

4.7 Dietary assessment

Table 4.6 below shows the dietary assessment results of the subjects which included their energy and protein requirement, intake and adequacy. The mean of energy intake is lower than the mean of energy requirement. Similarly, the mean of protein intake is lower than the mean of protein requirement. Meanwhile, according to the comparison between the dietary intake and 100% of the requirement, it was found that the majority of the subjects had inadequate energy and protein intake where both the energy and protein adequacy mean lies in the range of 60%.

As most of the subjects had reported loss of appetite and almost half of them needed feeding assistance, it was also concluded by Patel & Martin (2008) that among hospitalized patients, the three main causes that could lead to reduced and inadequate energy and protein intake are losing appetite, medical illness and oral problem. Among Malaysian hospital elderly, inadequate energy and protein intake had been found to be common and concerning as was studied by Kong et al. (2019) in 21 public hospitals in Malaysia. Kong et al. (2019) found that only 32 % of their subjects had adequate energy intake while only 27% had adequate protein intake where besides acknowledging the medical condition related causes, factors such as the patients lack preference over hospital food was also highlighted and reviewed through past research as one of the reason on limiting intake in hospital.

Meanwhile, when further analysed based on the dietary recall, only a small proportion of the subjects were on oral nutrition support which included Ensure Gold, Nutren Diabetic and Glucerna. As the dietary intake was compared, those on oral nutrition support were found to have higher energy and protein intake as compared to those not on oral nutrition support. Thus, oral nutrition support which compensated for the energy and protein intake that was to be achieved through normal food diet can helps in increasing energy and protein intake among hospitalized patients (Ferreira et al., 2020).

Table 4.6: Dietary assessment of the subjects (N=55)

	Mean ± SD
Dietary requirement	
Energy (kCal)	1664.82 ± 430.15
Protein (g)	66.59 ± 17.21
Dietary intake	
Energy (kCal)	968.97 ± 315.83
Protein (g)	36.56 ± 15.59
Dietary adequacy	
Energy (%)	61.19 ± 24.88
Protein (%)	59.74 ± 34.26
Hospital intake + ONS	
Energy (kcal)	1007.84 ± 378.44
Protein (g)	42.36 ± 18.33
Hospital diet	
Energy (kcal)	954.75 ± 293.67
Protein (g)	34.44 ± 14.12
	N (%)
Inclusion of ONS	
Yes	15 (26.3)
No	42 (73.7)
Feeding assistance	
Yes	20 (37.7)
No	33 (62.3)

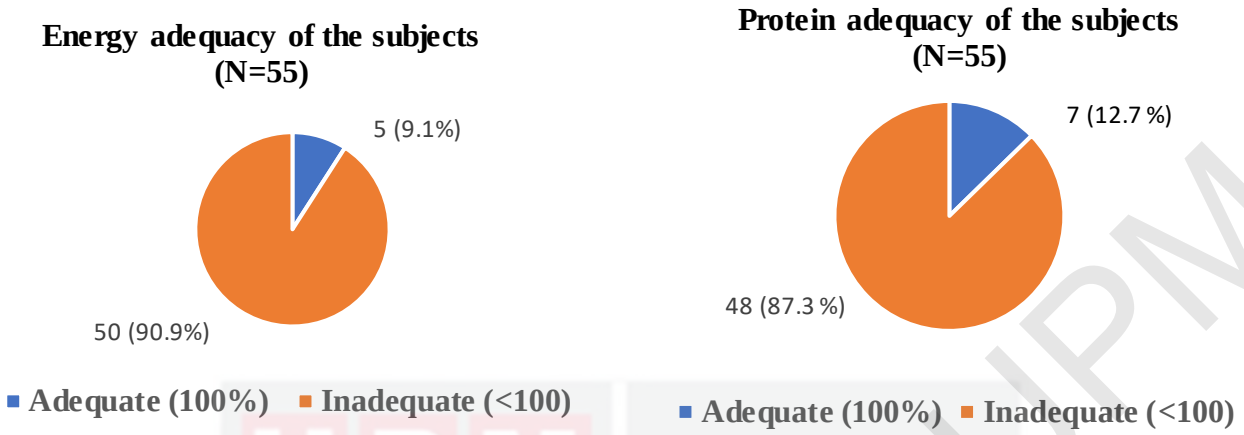

Figure 4.3: Dietary adequacy among the subjects (N= 55)

4.8 Malnutrition risk

Table 4.7 shows the MNA-SF score obtained by the subjects through malnutrition risk assessment. The mean score is 9.93 $\pm$ 2.53 which falls under the category of at risk of malnutrition while the minimum value was 1 and maximum value was 14. The total score of all subjects was further classified into three categories as shown in Table 4.7 below. Less than half of the subjects had normal nutritional status resulting in more than half of them being either malnourished or at risk of it. Further classified, the biggest proportion of subjects were at risk of malnutrition.

In contrast, the study by Bentli et al. (2019) among nursing home elderly in Turkey had found that most of the elderly had a normal nutritional status followed by being at risk of malnutrition. Meanwhile, Zhang et al. (2017) had found that hospitalized elderly was at 4 times higher risk of malnutrition at hospital admission as they found that the majority of their subjects (64 %) which were hospitalized elderly were at risk of malnutrition too. Therefore, Zhang et al. (2017) findings supported the conclusion that hospitalized elderly are prone to hospital malnutrition by being at high risk of malnutrition. Loss of appetite that causes the hospitalized elderly to consume least

food is a major cause of hospital malnutrition besides health factors such as inflammation (Shahar et al., 2002). Besides, reduced food intake that is prevalent among hospitalized elderly due to chewing difficulty or swallowing pain can also lead to malnutrition.

Table 4.7: Malnutrition risk of the subjects (N=57)

Malnutrition risk	**Mean ± SD**	**Range**
MNA-SF score	9.93 ± 2.53	1- 14
MNA classification		**N (%)**
Normal nutritional status (12-14)		16 (28.1)
At the risk of malnutrition (8-11 points)		33 (57.9)
Malnourished (0-7 points)		8 (14.0)

4.9 Hand grip strength

According to Table 4.8 below, the mean value of hand grip strength among the subjects was 8.27± 6.55 kg/force which falls under the category of low hand grip strength. Therefore, as seen in the same table, most of the subjects had a low hand grip strength (94.7%) which was classified according to cut-off by Asian Working Group of Sarcopenia (2014) while only a small number of subjects (5.3%) had normal hand grip strength. Similarly, in the study by Akbar and Setiati (2018) who compared the hand grip strength with AWGS cut off among geriatric patients too, had found that most of their subjects had low hand grip strength.

Meanwhile, as it was further analysed, hand grip strength mean was found to be higher among hospitalized elderly men than women which was similar to finding of Wiraguna and Setiati (2018) in Indonesia among outpatient elderly where men had higher hand grip strength, although majority of the elderly had lower hand grip strength too. Hand grip strength was also analysed according to inclusion of ONS in the subjects diet where the value was found to be higher among those without

ONS which was different with the study by Cramer et al. (2016) as they found hand grip strength to be higher among those receiving ONS, precisely, high protein ONS.

Furthermore, another study by Martín-Ponce et al. (2014) among hospitalized elderly had found that almost half of their subjects (45 %) who were 60 years and above had hand grip strength below normal value. Therefore, a low hand grip strength is prevalent among elderly patients indicates lower muscle strength and muscle functionality among hospitalized elderly and it can also be influenced by their reason of hospital admission where in this current study, some of the most common reason was asthma attacks, fall accidents, severe inflammation, hyponatremia and hyponoturia.

Table 4.8: Hand grip strength of the subjects (N=56)

	Mean ± SD
Hand grip strength (kg/force)	
Total	8.28 ± 6.92
Males	10.65 ± 8.43
Females	6.56 ± 5.05
Among subjects on ONS	5.29 ± 5.75
Among subjects without ONS	9.34 ± 7.05
Hand grip strength classifications	**N (%)**
Low (M < 26 kg/force; F <18 kg/force)	54 (94.7)
Normal (M ≥ 26 kg/force; F ≥ 18 kg/force)	3 (5.3)

4.10 Factors associated with hand grip strength

a) Association between sociodemographic characteristics and hand grip strength of hospitalized elderly patients in hospitals around Klang Valley.

Based on Table 4.9, the Pearson Moment Product correlation test was conducted to study the association between age and hand grip strength of the subjects while Spearman Rho correlation test was carried out to study the association with educational level. The results showed that there were significant associations of age ($r=-0.370$, $p<0.05$) and educational level ($r=0.471$, $p<0.05$) with hand grip strength among the hospitalized elderly. However, further bilateral analysis for categorical variables which were gender and ethnicity was not suitable to be done as most of the hand grip strength value were categorized in the low hand grip strength category (95%).

Table 4.9: Association between sociodemographic characteristics and hand grip strength

Sociodemographic Characteristics	*r-value*	*p-value*
Age (Years)	**-0.370**[a]	**0.005***
Educational level	**0.471**[b]	**0.000***

* Significant value at $p<0.05$
* [a] p-value from Pearson Moment Product Correlation test
* [b] p-value from Spearman Rho Correlation test

Increasing age causes a decline in functional capacity of humans, and loss of muscle strength is one of the most common and obvious signs of old age. Therefore, as supported by previous studies that had found age to be associated with hand grip strength too, the results indicated that hand grip strength decreased with age because aging affected all organ systems in the body, including musculoskeletal, vascular and nervous system, resulting in a decrease in muscle mass and ability to activate muscles, reflected as decreased hand grip strength among the elderly (Ong et al., 2017b). Furthermore, since the musculoskeletal system was affected by ageing and the medical status of the hospitalized elderly, a deterioration in hand structure and function, which included

muscles, joints, nerves, and blood vessels, may affect hand grip strength as well (Ong et al., 2017b).

Therefore, finding of this study had been found to be consistent with the study by Bohannon (2017) where age had been found to affect hand grip strength in a negative correlation as they found hand grip strength to be significantly different among their youngest age participants (20-29 years) with oldest aged participants where the changes was more obvious in the oldest group (60 - 79 years). Besides, another study by Alqahtani et al. (2019) had also found an association between age and hand grip strength of the elderly as they justified that the quality and quantity reduction of nerve information transfer with increased age and degenerative changes in organ systems causes hand grip strength decline that resulted in their oldest participants to have a weaker grip strength compared to their younger participants. In accordance with this study, Kim et al. (2018) also found an association between hand grip strength and age, whereby the decline rate of hand grip strength accelerates from the age of 60 concurrent with the current study population.

Finally, previous studies had also found educational level to affect the hand grip strength of the elderly as it interfered with the nutritional knowledge and the acknowledgement of the importance to maintain a good physical status which concluded a similar relationship in this current study (Kim et al., 2019). Besides, elderly who were more educated tend to be more health conscious and curious over their health including their food intake, medication and functional status. However, study by Mohd Hairi et al. (2010) among European elderly had found no significant association between educational level with hand grip strength of elderly as it was considered as an early life influence which might not hold a strong influence at the older age.

b) Association between medical background and hand grip strength of hospitalized elderly patients in hospitals around Klang Valley.

Table 4.10 showed that there were no significant associations between number of comorbidities (r= -0.058, p>0.05) and number of medications (r= -0.098, p>0.05) with hand grip strength of the hospitalized elderly.

Table 4.10: Association between medical background and hand grip strength

Medical background	*r-value*	*p-value*
Number of comorbidities	-0.058	0.669
Number of medications	-0.098	0.466

*Pearson-moment product correlation test; significant value at p<0.05

A past study by Pessini et al. (2016) found that the number of chronic diseases was associated with hand grip strength among elderly as there was an active interaction between different diseases that resulted in a deterioration of muscle function. However, as this association was not found significant in the current study, Pessini et al. (2016) had also justified that besides the interaction among the diseases, the severity and stage of those diseases also contributed to the association in their study. A KORA-age study by Kim et al. (2019) had also found no association between comorbidities and hand grip strength among elderly except for diabetes. Diabetes presence was found to be associated with hand grip strength in previous studies as the insulin resistance that occurred among diabetic elderly leads to muscle weakness. However, another study carried out in China by Cheung et al. (2013) had found a similar result with this study where no significant association was found of hand grip strength with any of the diseases either by number or presence.

Meanwhile, as increased number of medications and presence of polypharmacy had knowingly resulted in hand grip strength decline in previous studies by Sganga et al. (2014) and Love et al. (2020), the result was found to be in contrast with this study. Love et al. (2020) had found that the

different medications such as anti-hypertensive drugs and ACE inhibitors might have different mechanisms affecting hand grip strength which need to be further investigated. Meanwhile, Volaklis et al. (2018) had found that there was no difference in hand grip strength between those on plenty number of medication drugs which is similar to this current study.

c) Association between anthropometry assessment and hand grip strength of hospitalized elderly patients in hospitals around Klang Valley.

Table 4.11 below showed association of anthropometry assessments with hand grip strength among the subjects. There were no significant associations found between anthropometry assessments with the hand grip strength ($p>0.05$).

Table 4.11: Association between anthropometry assessment and hand grip strength

Anthropometry assessment	***r-value***	***p-value***
Height (cm)	0.111	0.415
Weight (kg)	0.152	0.263
Body Mass Index (kg/m^2)	0.118	0.386
Body fat percentage (%)	0.061	0.660

*Pearson-moment product correlation test; significant value at $p<0.05$

Some of the previous studies had found significant associations between height, weight, body mass index and body fat percentage with hand grip strength (Mendes et al., 2017; Ong et al., 2017; Pengpid & Peltzer, 2018). Low height was found to cause poor grip strength among elderly due to the reduced bone mass and impaired bone structure which are related to muscle strength and function including hand grip strength, besides having shorter trunks and arms leads to a reduced arm force (Mendes et al., 2017). Meanwhile, having low height and weight, especially being underweight were found to have significant effects on grip strength (Pengpid & Peltzer, 2018).

However, these studies results were inconsistent with this study where no significant association was found in this study.

Keevil et al. (2015) who studied the relationship between weight, BMI and body fat with hand grip strength had justified that total weight measure among the elderly might have an error as there was no distinguish between fat mass and fat free mass in the measure. Meanwhile, while having higher body fat is common among elderly and central obesity with high level of abdominal fat, the abdominal fat secretes hormones such as cytokines that lower muscle mass in the body causing a reduced grip strength. Kim et al. (2018) found that the elderly body composition changes gradually yet significantly with age which affected their muscle strength. Therefore, the factors such as fat distribution, difference in fat and fat free mass and the type of obesity that the elderly might have affects the underlying mechanisms in the association of anthropometry assessments with hand grip strength. Similar to this study, Lad et al. (2013) had also found no significant association between body fat percentage with hand grip strength while studies by Alqahtani et al. (2019) and Yamada et al. (2015) had found no significant association between body mass index with hand grip strength.

d) Association between biochemical markers and hand grip strength of hospitalized elderly patients in hospitals around Klang Valley.

Pearson Moment Product correlation test was carried out to find the association between serum albumin and haemoglobin level with the hand grip strength. However, there were no significant associations found between serum albumin ($r=0.199$, $p>0.05$) or haemoglobin level ($r=0.012$, $p>0.05$) with hand grip strength of the hospitalized elderly.

Table 4.12: Association between biochemical markers and hand grip strength

Biochemical markers	*r-value*	*p-value*
Serum albumin level	0.199	0.166
Haemoglobin level	0.012	0.929

*Pearson-moment product correlation test; significant value at $p<0.05$

Significant association of both serum albumin and haemoglobin level had been found with hand grip strength among Japanese elderly women by Yamada et al. (2015) as they justified that both low haemoglobin level and elevated albumin level interrupted with maximal capacity of musculoskeletal system resulting in decreased grip strength. Besides, Hirani et al. (2016) had also found in their study that haemoglobin level lower than 14.2 g/dL was associated with poor grip strength. However, as majority of the hospitalized elderly recruited in this study had low haemoglobin level, non-significant association was found which was similar to the study by Payne et al. (2018) where they found that the relationship between haemoglobin level and hand grip strength especially among frail individuals which was common sign among the hospitalized elderly in this study, there were other confounding factors which affected the association such as their medical condition and comorbidities.

Meanwhile, Kitamura et al. (2012) had also found no significant association between serum albumin level with hand grip strength among elderly in Japan as they mentioned that weakness among elderly might affect both the inflammation status and physical status including hand grip strength which makes the association between these two factors not significant. Besides, this study had also found parallel result with Reijnierse et al. (2015) where in their study, among the elderly, no significant association was found between albumin level and hand grip strength where Reijnierse et al. (2015) highlighted that more explanation should be derived to explain the causal

relationship in the mechanism of association between albumin level and hand grip strength among elderly.

e) Association between perception towards oral health and hand grip strength of hospitalized elderly patients in hospitals around Klang Valley.

According to the Pearson Moment Product test that was carried out to find the association between perception towards oral health with hand grip strength among the subjects, a significant association was found ($r=0.370$, $p<0.05$).

Table 4.13: Association between perception towards oral health and hand grip strength

Perception towards oral health	***r-value***	***p-value***
GOHAI score	0.370	**0.005***

*Pearson-moment product correlation test; significant value at $p<0.05$

A previous study carried out by Moriya et al. (2012) had found a significant association between GOHAI score with hand grip strength among elderly too. The positive relationship was significant which indicated a better perception towards oral health affected hand grip strength of the hospitalized elderly positively. Moriya et al. (2012) had justified the mechanism behind this significant relationship was the masticatory ability and willingness among elderly where any pain while masticating especially if the elderly had poorly fitted dentures will interrupt muscle activity through peripheral orofacial sensory inputs. The peripheral orofacial sensory inputs influence the motor neural control of muscles in other body parts as well including the hand which resulted in a reduced grip strength. Besides, having pain or discomfort in oral cavity will influence the maximum voluntary force that the elderly would put on their grip dynamometer through the signal of peripheral orofacial sensory inputs (Moriya et al., 2012 & Tôrres et al., 2015).

Besides, other studies in accordance with oral health including the number of teeth among the elderly and perceived chewing ability with hand grip strength had also found significant association supporting the relationship between hand grip strength and the perception towards oral health (Moriya et al., 2011 & Shin., 2018). Furthermore, a decreased chewing ability that is reduced with dental pain when paired with other health problems among the hospitalized elderly would also interrupt the eating habits among the elderly where their intake reduced in terms of fruits, vegetables and meat (Kim et al., 2019). Therefore, the poor intake would also lead to weakness that caused a decrease in the grip strength. Thus, a low perception towards oral health due to pain and reduced ability to eat proper meals would cause a lower grip strength among hospitalized elderly which was found significant in this study.

f) Association between dietary assessment and hand grip strength of hospitalized elderly patients in hospitals around Klang Valley.

According to Table 4.14, a significant association was found between energy intake and hand grip strength ($r=0.367$, $p<0.05$). However, no significant associations were found between protein intake ($r=0.068$, $p>0.05$), energy adequacy ($r=0.171$, $p>0.05$) and protein adequacy ($r=0.166$, $p>0.05$) with hand grip strength.

Table 4.14: Association between dietary assessment and hand grip strength (HGS)

Dietary assessments	***r-value***	***p-value***
Dietary intake		
Energy intake (kcal)	**0.367**	**0.005***
Protein intake (g)	0.068	0.617
Dietary adequacy		
Energy adequacy (%)	0.171	0.213
Protein adequacy (%)	0.166	0.226

*Pearson-moment product correlation test; significant value at $p<0.05$

Previous study by Jang & Ryu (2020) among Korean elderly women had found significant associations between energy and protein intake with hand grip strength which differ with this current study where only significant association with energy intake was found. Similarly, Tak et al. (2018) had also found a significant association of energy intake with hand grip strength in a positive relationship similar as this current study which indicates higher energy intake would lead to better grip strength. Low energy intake which seems to be prevalent among hospitalized elderly could affect the hand grip strength as it interferes with the synthesis of muscle protein where this interruption could reduce muscle activity (Doyev et al., 2021). The reduced efficiency of muscle to work caused poor grip strength initiation by the elderly. Besides, having low energy intake also caused the body to catabolize muscles to produce energy to meet the daily need in order to carry out basic daily activities. Meanwhile, as low energy intake could affect hand grip strength, the adequacy of energy intake according to the requirement was also found to be associated in the study by Akbar and Setiati (2018). This is because a prolonged deficiency in energy intake could bring in the confounding factor such as malnutrition due to muscle catabolism and wasting.

Meanwhile, some of the previous studies had found significant relationships of hand grip strength with protein intake and protein adequacy which is inconsistent with this current study. Kim et al. (2019) had found that besides energy, protein also played an important role in improving grip strength among elderly. A high protein intake helped to stimulate muscle synthesis besides being the main component in muscle build up, thus causing a rise in muscle function integrity (Doyev et al., 2021). This improved muscle synthesis will then improve grip strength among elderly. However, Hojfeldt et al. (2020) who found no significant association of protein intake with hand grip strength had highlighted that important factors such as the type and pattern of protein distribution could be the underlying causes to affect the association. Meanwhile, although

Mishra et al. (2018) found adequate protein intake above 25 g led to higher grip strength among the elderly, Zhu et al. (2015) found no improvement in hand grip strength result among their subjects despite protein supplementation to reach adequate protein intake where it can be concluded that despite protein intake having positive relationship with hand grip strength, other factors such as micronutrients role and protein pattern can affect the mechanism too.

g) Association between malnutrition risk and hand grip strength of hospitalized elderly patients in hospitals around Klang Valley.

The analysis resulted in no significant association between malnutrition risk assessed through MNA-SF score with hand grip strength despite having a positive correlation ($r=0.143$, $p>0.05$).

Table 4.15: Association between malnutrition risk and hand grip strength (HGS)

Malnutrition risk	***r-value***	***p-value***
MNA-SF score	0.143	0.288

*Pearson-moment product correlation test; significant value at $p<0.05$

The current finding has been found inconsistent with some of the previous studies that found hand grip strength to be significantly associated with malnutrition risk where multiple methods was used to assess malnutrition risk including MNA and SGA form (Riviati et al., 2017; Zhang et al., 2017). Zhang et al. (2017) had found that a low hand grip strength was a strong predictor of malnourishment among the elderly especially hospitalized elderly. Malnutrition causes depletion in muscle protein supply which is the major energy supply for muscle movement including grip thus, hand grip strength of the elderly decreases. Besides, weight loss and muscle mass loss which are the two common components among malnourished elderly may cause loss in hand grip strength too (Akbar & Setiati, 2018). However, a study carried out by Charlton et al. (2015) among Australian elderly with larger sample size also found no significant association between malnutrition risk (MNA-SF score) with hand grip strength among the elderly.

CHAPTER 5

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1 Conclusion

A good and normal hand grip strength is important among hospitalized elderly to improve their functional status, muscle strength and quality of life which would help to lower the risk of hospital readmission among them. This study revealed that among hospitalized elderly in Klang Valley hospitals, 95 % of them had low hand grip strength while 5 % had normal grip strength, indicating majority of them having poor result in hand grip strength which was assessed by using Jamar Plus+ Digital Handgrip Dynamometer. Thus, most of them have poor muscle strength, functionality and quality of life which needs to be prioritized. Factors such as age, educational level, perception towards oral health and energy intake were found to be associated significantly with hand grip strength. However, the other factors were found to have no significant associations including medical background, anthropometry assessments including height, weight, body mass index and body fat percentage, biochemical markers such as albumin and haemoglobin level, protein intake, dietary adequacy and malnutrition risk. Thus, as low hand grip strength was found to be common among hospitalized elderly, hand grip strength and its associated factors should be given importance in effort to reduce risk of hospital readmission among hospitalized elderly which finally reduces in-hospital mortality risk among the elderly by focusing on the factors found to have significant relationship with hand grip strength and enlarging studies to study the other factors.

5.2 Limitations of the study

As the sample size obtained was small (N=57), the result could not be generalized for the whole population of elderly admitted in Klang Valley hospitals. Besides, in terms of the assessments of the components included in this study, there was a limitation in terms of the data collection where the biochemical data was not available for all subjects which depended on the report of assessments carried out during their hospitalization by their health care specialists. Next, as during the dietary recall, there might be factors such as distractions or recall bias, there was underreporting reported in the dietary intake among the subjects (30%).

This study also did not carry out subjects screening according to the reason of hospital admission for subject inclusions criteria. Finally, as this study was conducted among elderly, the difficulty to focus and cooperate in recall activities for dietary recall, malnutrition risk and answering some of the oral health perceptions questions might have been difficult for the subjects.

5.3 Recommendations

Future studies are encouraged to be done in this field to get more conclusive data by using a larger sample size and including more confounding factors to study the associations, especially among hospitalized elderly in Klang Valley. Thus, future studies are also recommended to include other components as well such as Instrument of Daily Living Activity and physical activity, to assess the association of dietary assessments and malnutrition risk with hand grip strength in effects of the functional status and physical activity of the elderly. Besides, the screening of reason of admission which varies among the elderly is also recommended to be included to narrow the scope of subject inclusion criteria which will be helpful in achieving more conclusive and accurate data in terms of the hand grip strength.

Besides conducting more research, health care professionals are also recommended to carry out intervention strategies by giving more focus on the factors that could help to improve hand grip strength among elderly as preventive measure such as carrying out oral health assessment and care. As dietary inadequacy was also found prevalent in the results, preventive measures to avoid this could be taken by addressing their mealtime assistance and nutrition support indention. Hence, more research and intervention strategies alongside preventive measures in addressing the issues related to hand grip strength should be thoroughly done among hospitalized elderly in Malaysia to ensure we could achieve a healthy ageing nation with lower hospital readmission risk and better functionality, muscle strength, quality of life and health status.

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APPENDIX I

National Medical Research Registry (NMRR) Approval Letter Approval Letter

JAWATANKUASA ETIKA & PENYELIDIKAN PERUBATAN
(*MEDICAL RESEARCH & ETHICS COMMITTEE*)
KEMENTERIAN KESIHATAN MALAYSIA
MINISTRY OF HEALTH MALAYSIA
Kompleks Institut Kesihatan Negara (NIH)
No.1, Jalan Setia Murni U13/52,
Seksyen U13 Bandar Setia Alam,
40170 Shah Alam, Selangor. Tel.: +(6)03-33628888/ 33628205

Ref. : KKM/NIHSEC/P20-695(12)
Date : **29-May-2020**

DR. NORAIDA OMAR
UNIVERSITY PUTRA MALAYSIA (UPM)

Dear Dato'/ Dr/ Sir/ Madam,

LETTER OF ETHICAL APPROVAL: NMRR-20-308-52632 (IIR)
FACTORS ASSOCIATED WITH MALNUTRITION AMONG GERIATRIC PATIENTS IN PUBLIC HOSPITALS IN THE KLANG VALLEY

This letter is made in reference to the matter above.

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

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

Hospital Kuala Lumpur
Dr. Noraida Omar (Principal / Coordinating Investigator)
Shazli Illyani Binti Mohamad Shafiee
Siti Hazimah Binti Nor'hisham

Hospital Selayang
Dr. Noraida Omar (Principal / Coordinating Investigator)
Shazli Illyani Binti Mohamad Shafiee
Siti Hazimah Binti Nor'hisham

Hospital Sungai Buloh
Dr. Noraida Omar (Principal / Coordinating Investigator)
Shazli Illyani Binti Mohamad Shafiee
Siti Hazimah Binti Nor'hisham

Hospital Tengku Ampuan Rahimah Klang
Dr. Noraida Omar (Principal / Coordinating Investigator)
Shazli Illyani Binti Mohamad Shafiee
Siti Hazimah Binti Nor'hisham
Ref : KKM/NIHSEC/P20-695(12)

University Malaya Medical Centre (UMMC)
Dr. Noraida Omar (Principal / Coordinating Investigator)
Shazli Illyani Binti Mohamad Shafiee
Siti Hazimah Binti Nor'hisham

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

Documents received and reviewed with reference to the above study:

1. Cover letter to MREC (Version 3, dated 28-05-2020)
2. Declaration of Conflict of Interest (COI) (Version 3, dated 28-05-2020)
3. Protocol (Version 4, dated 28-05-2020)
4. English: Patient Information Sheet/ Informed Consent Form (Version 4, dated 28-05-2020)
5. Malay: Patient Information Sheet/ Informed Consent Form (Version 4, dated 28-05-2020)
6. Questionnaire (Version 4, dated 28-05-2020)
7. Follow-up Review Report (Version 1, dated 28-05-2020)
8. IA-HOD-IA, CV and GCP Certification of:
   - Dr. Noraida Omar
9. IA-HOD-IA and CV of:
   - Shazli Illyani Binti Mohamad Shafiee
   - Siti Hazimah Binti Nor'hisham

5. Please note that the approval is valid until **28-May-2021**.The following are to be reported upon receiving ethical approval. Required forms can be obtained from the Medical Research Ethics Committee (MREC) website (**http://www.nih.gov.my/mrec**).

i. **Continuing Review Form** has to be submitted to MREC within 2 months (60 days) prior to the expiry of ethical approval.
ii. **Study Final Report** upon study completion to the MREC.
iii. Ethical approval is required in the case of **amendments/ changes** to the **study documents/ study sites/ study team**. MREC reserves the right to withdraw ethical approval if changes to study documents are not completely declared.
iv. **Applicable for Clinical interventional Studies only:** Report occurrences of **all Serious Adverse Events (SAEs), Suspected Unexpected Serious Adverse Reaction (SUSARs)** and **Protocol Deviation/Violation** at all MREC approved sites to MREC. 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 7 calendar days from awareness of event by investigator, followed by a complete report within 8 additional calendar days.

6. There will be **423 subjects/ patients/ respondents** targeted to be enrolled in this study within Malaysia.

7. Please take note that the reference number of this letter must be stated in all future correspondence related to this study to facilitate the administrative processes.

Ref : KKM/NIHSEC/P20-695(12)

APPENDIX II

Approval Letter from NMRR (Amendment)

JAWATANKUASA ETIKA & PENYELIDIKAN PERUBATAN
(*Medical Research & Ethics Committee*)
KEMENTERIAN KESIHATAN MALAYSIA
d/a Kompleks Institut Kesihatan Negara
Blok A, No 1, Jalan Setia Murni U13/52,
Seksyen U13, Bandar Setia Alam,
40170 Shah Alam, Selangor.
Tel: 03-3362 8888/8205

Ref : KKM/NIHSEC/ P20-695
Date: 30-October-2020

DR NORAIDA OMAR UNIVERSITY PUTRA MALAYSIA (UPM)

Dear Sir/ Mdm,

AMENDMENTS FOR STUDY: NMRR-20-308-52632 (IIR)
Protocol No :
Factors associated with malnutrition among geriatric patients in public hospitals in the Klang Valley
Your amendment submission dated 22-October-2020 is referred.

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

1. Kertas kerja projek (versi 5, bertarikh 15 Oktober 2020)
2. Risalah maklumat peserta dan borang persetujuan peserta (Bahasa Inggeris) (versi 5, bertarikh 15 Oktober 2020)
3. Risalah maklumat peserta dan borang persetujuan peserta (Bahasa Melayu) (versi 5, bertarikh 15 Oktober 2020)
4. Addition of new investigators:

Investigators	Study Sites	Investigators' role	Investigator's document
Anis Syakirah Binti Zainol	Hospital Kuala Lumpur, Hospital Selayang, Hospital Sungai Buloh, Hospital Tengku Ampuan Rahimah Klang	Co / Sub Investigator at the site	CV
Khairunisar-E-Rashim Binti Mohammed Yusufirashim	Hospital Kuala Lumpur, Hospital Selayang, Hospital Sungai Buloh, Hospital Tengku Ampuan Rahimah Klang	Co / Sub Investigator at the site	CV

5. Jumlah responden yang diperlukan:
   a. 352 subjek

APPENDIX IV

Consent Form

(English Version)

PARTICIPANT INFORMATION SHEET AND INFORMED CONSENT FORM *(for adult subjects)*

1. Title of study: Hand grip strength and its associated factors among hospitalized elderly in Klang Valley hospitals.

2. Name of investigator and institution:

Investigator	Institution
Khairunisar-E-Rashim Binti Mohammed Yusufirashim	Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.
Dr. Noraida Omar. (Supervisor)	Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

3. Name of sponsor: Fundamental Research Grant Scheme (FRGS).

4. Introduction:

It is important that you understand why the research is being done and what it will involve. Please take your time to read through and consider this information carefully before you decide if you are willing to participate. Ask the study staff if anything is unclear or if you would like more information. After you are properly satisfied that you understand this study, and that you wish to participate, you must sign this informed consent form.

Your participation in this study is voluntary. You do not have to be in this study if you do not want to. You may also refuse to answer any questions you do not want to answer. If you volunteer to be in this study, you may withdraw from it at any time. If you withdraw, any data collected from you up to your withdrawal will still be used for the study. Your refusal to participate or withdrawal will not affect any medical or health benefits to which you are otherwise entitled.

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

5. What is the purpose of the study?

The purpose of this study is to understand the body composition of geriatric patients. This research is necessary to improve the understanding of geriatric malnutrition.

This research will be conducted for duration of 2 years (01/03/2020 until 31/08/2022). The expected number of participants is 423 individuals.

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

The study procedures of this research are as follows:

a) **Medical Record :** Investigators will access your medical background, biochemical data and sociodemography through the hospital's system.

b) **Measurements :** Investigators will have measurements of your anthropometry (height, weight, mid upper arm circumference, calf circumference, percentage of body fat) and functional status (hand-grip strength, feeding and visual status).

c) **Interview :** You will be interviewed by one of the investigators on your sociodemography and 24-hour dietary intake in the hospital.

d) **Questionnaire :** You will be given survey forms to be answered. Survey forms included are the Geriatric Oral Health Assessment Index (GOHAI) and Mini Nutritional Assessment-Short Form (MNA-SF).

It is important that you answer all of the questions asked by the study staff honestly and completely which will take about 45 minutes of your time.

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

This study only involves body measurements and completion of questionnaire. Participation to this study will not affect your treatment, and the risk is minimal.

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

Participants will be informed on their current nutritional status. Any at risk patients will be referred to the doctor/dietitian for further management. Participants will also receive honorarium of RM 20.00 cash upon completion of the study. Furthermore, information obtained from this study will help improve the treatment or management of geriatric malnutrition.

9. Who is funding the research?

This study is sponsored by Fundamental Research Grant Scheme (FRGS).

10. Will my medical information be kept private?

All your information obtained in this study will be kept and handled in a confidential manner, in accordance with applicable laws and/or regulations. When publishing or presenting the study results, your identity will not be revealed without your expressed consent. Individuals involved in this study, qualified monitors and auditors, and governmental or regulatory authorities may inspect the study data, where appropriate and necessary.

11. Who should I call if I have questions?

If you have any questions about the study or if you think you have a study related injury and you want information about this study, please contact the following investigators:

Name of Investigator	Telephone No.
Khairunisar-E-Rashim Binti Mohammed Yusufirashim	011-35379116
Dr. Noraida Omar (Supervisor)	019-2252902

If you have any questions about your rights as a participant in this study, please contact: The Secretary, Medical Research & Ethics Committee, Ministry of Health Malaysia, at telephone number 03-3362 8407/8205/8888/8100

INFORMED CONSENT FORM

Title of Study: Hand grip strength and its associated factors among hospitalized elderly in Klang Valley hospitals.

By signing below, I confirm the following:

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

Subject:

Signature: Name:

I/C number: Date:

Investigator conducting informed consent:

Signature: Name:

I/C number: Date:

Impartial witness:

Signature: Name:

I/C number: Date:

APPENDIX V

Consent form

(Malay Version)

RISALAH MAKLUMAT PESERTA DAN BORANG PERSETUJUAN atau KEIZINAN PESERTA

(untuk subjek dewasa)

1. Tajuk penyelidikan: Kekuatan genggaman tangan dan factor-faktor yang mempengaruhinya dalam kalangan pesakit warga tua di hospital sekitar Lembah Klang

2. Nama Institusi and nama penyelidik:

Penyelidik	Institusi
Khairunisar-E-Rashim Binti Mohammed Yusufirashim	Jabatan Pemakanan dan Dietetik, Fakulti Perubatan Dan Sains Kesihatan, Universiti Putra Malaysia.
Dr. Noraida Omar (Penyelia)	Jabatan Pemakanan dan Dietetik, Fakulti Perubatan Dan Sains Kesihatan, Universiti Putra Malaysia.

3. Nama penaja: Fundamental Research Grant Scheme (FRGS).

4. Pengenalan:

Risalah ini menjelaskan hal-hal berkenaan penyelidikan tersebut dengan lebih mendalam dan terperinci. Amat penting anda memahami mengapa penyelidikan ini dilakukan dan apa yang dilakukan dalam penyelidikan ini. Sila ambil masa yang secukupnya untuk membaca dan mempertimbangkan dengan teliti penerangan yang diberi sebelum anda bersetuju untuk menyertai penyelidikan ini. Jika ada sebarang kemusykilan ataupun maklumat lanjut yang anda ingin tahu, anda boleh bertanya dengan mana-mana kakitangan yang terlibat dalam penyelidikan ini. Setelah anda berpuas hati bahawa anda memahami penyelidikan ini, dan anda berminat untuk turut serta, anda dikehendaki untuk menandatangani Borang Persetujuan atau Keizinan Peserta, pada muka surat akhir risalah ini.

Penyertaan anda dalam penyelidikan ini adalah secara sukarela. Anda tidak perlu menyertai penyelidikan ini jika anda tidak mahu. Anda juga mempunyai hak untuk tidak menjawab mana mana soalan yang anda tidak mahu jawab. Anda juga boleh menarik diri daripada penyelidikan ini pada bila-bila masa sahaja. Jika anda menarik diri, segala maklumat yang telah diperolehi sebelum anda menarik diri tetap akan digunakan dalam penyelidikan ini. Jika anda tidak mahu menyertai ataupun menarik diri dari penyelidikan ini, tindakan anda tidak akan menjejaskan segala hak dan keistimewaan perubatan kesihatan yang selayaknya anda terima.

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

5. Apakah tujuan penyelidikan ini dilakukan?

Tujuan penyelidikan ini dilakukan adalah untuk memperoleh data tentang komposisi badan dalam kalangan pesakit geriatric. Penyelidikan ini diperlukan kerana dapat memberikan pemahaman yang

lebih lanjut berkenaan malnutrisi dalam kalangan pesakit geriatruik. Penyelidikan ini akan berlangsung selama 2 tahun (01/03/2020 sehingga 31/08/2022). Dijangka bahawa 423 individu akan mengambil bahagian dalam kajian ini.

6. Apakah tanggungjawab saya sewaktu menyertai penyelidikan ini?

Prosedur penyelidikan ini adalah seperti berikut:

a) **Rekod Medikal :** Penyelidik akan mengakses latar belakang medikal, keputusan ujian darah dan latar belakang sosiodemografi subjek.

b) **Pengukuran :** Penyelidik akan mengambil ukuran antropometri (tinggi, berat, ukurlilit pertengahan lengan atas, ukurlilit betis, peratusan lemak dalam badan dan penurunan berat badan) dan status fizikal subjek (kekuatan genggaman tangan, status pemakanan dan penglihatan).

c) **Temuduga :** Subjek akan ditemuduga oleh penyelidik berkenaan sosiodemografi dan 24 jam rekod pemakanan di hospital.

d) **Borang soal selidik :** Subjek akan diberikan borang soal selidik untuk dijawab. Borang soal selidik yang akan diberikan adalah berkenaan Kualiti Hidup Berkaitan Kesihatan Mulut (GOHAI) dan Penilaian Nutrisi Mini versi Ringkas (MNA-SF).

Adalah amat penting anda menjawab kesemua soalan yang dikemukakan oleh kakitangan penyelidikan dengan jujur dan lengkap yang akan mengambil masa selama 45 minit.

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

Penyelidikan ini hanya memerlukan peserta untuk menjawab soalan dan ukuran komposisi badan. Risiko untuk penyertaan penyelidikan ini yang adalah minima dan tidak akan menjejaskan rawatan anda.

8. Apakah manfaatnya saya menyertai kajian ini?

Peserta yang terlibat dapat mengetahui status nutrisi semasa. Peserta yang didapati mempunyai berisiko akan dirujuk kepada doktor/dietitian. Peserta juga akan diberikan honorarium sebanyak RM 20.00 tunai sekiranya peserta menjawab soalan dengan lengkap. Segala maklumat yang diperolehi daripada penyelidikan ini akan dapat membantu dalam penambahbaikan kaedah rawatan dan pengurusan pemakanan dalam kalangan pesakit geriatrik.

9. Siapakah yang membiayai penyelidikan ini?

Kajian ini ditaja oleh Fundamental Research Grant Scheme (FRGS). Anda tidak akan dibayar untuk menyertai kajian ini.

10. Adakah maklumat saya akan dirahsiakan?

Segala maklumat anda yang diperolehi dalam penyelidikan ini akan disimpan dan dikendalikan secara sulit, bersesuaian dengan peraturan-peraturan dan/ atau undang-undang yang berkenaan. Sekiranya hasil penyelidikan ini diterbitkan atau dibentangkan kepada orang ramai, identiti anda tidak akan didedahkan tanpa kebenaran anda terlebih dahulu. Pihak-pihak tertentu seperti individu yang terlibat dalam penyelidikan ini, juruaudit dan jurupantau yang terlatih, pihak berkuasa kerajaan atau undang-undang, boleh memeriksa maklumat atau data kajian jika diperlukan.

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

Sekiranya anda mempunyai sebarang pertanyaan mengenai penyelidikan ini atau jika anda mengesyaki anda mengalami kecederaan yang terhasil daripada penyelidikan ini dan mahukan maklumat tentang rawatannya, anda boleh menghubungi penyelidik-penyelidik berikut:

Penyelidik	Nombor Telefon
Khairunisar-E-Rashim Binti Mohammed Yusufirashim	011-35379116
Dr. Noraida Omar (Penyelia)	019-2252902

Jika anda mempunyai sebarang pertanyaan berkaitan dengan hak-hak anda sebagai pesakit dalam penyelidikan ini, sila hubungi: Setiausaha, Jawatankuasa Etika & Penyelidikan Perubatan, Kementerian Kesihatan Malaysia, melalui talian telefon 03-3362 8407/8205/8888.

BORANG PERSETUJUAN/ KEIZINAN PESERTA

Tajuk penyelidikan: Kekuatan genggaman tangan dan factor-faktor yang mempengaruhinya dalam kalangan pesakit warga tua di hospital sekitar Lembah Klang

Dengan menandatangani di bawah, saya mengesahkan bahawa :

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

Subjek :

Tandatangan: Nama:

Nombor K/P: Tarikh:

Penyelidik yang mengendalikan proses menandatangani borang keizinan:

Tandatangan: Nama:

Nombor K/P: Tarikh

Saksi tidak-berpihak/adil:

Tandatangan: Nama:

Nombor K/P: Tarikh:

APPENDIX VI

Questionnaire

RESPONDENT ID:

FAULTY OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF DIETETICS

QUESTIONNAIRE

Title:

HAND GRIP STRENGTH AND ITS ASSOCIATED FACTORS AMONG HOSPITALIZED ELDERLY IN KLANG VALLEY HOSPITALS

Researcher : Khairunisar-E-Rashim Binti Mohammed Yusufirashim

Matric no. : 198804

Program : Bachelor of Science. (Dietetics)

Supervisor : Dr. Noraida Omar

Sila isi maklumat pada tempat kosong atau tanda (/) pada pilihan yang paling sesuai dengan anda.
Please fill in the blank or tick (/) the answers that best applies to you.

PART A : Sociodemographic profiles			
1.	Age		_____ years old
2.	Sex		Male
			Female
3.	Ethnicity		Malay
			Chinese
			Indian
			Others :_____
4.	Educational level		Non-formal education
			Primary
			Secondary
			Tertiary

PART B: Medical Background			
1.	Comorbidity		Diabetes Mellitus
			Hypertension
			Chronic Kidney Diseases
			Dyslipidemia
			Cardiovascular disease
			Cancer
			Others: _____
2.	Number of diseases		
3.	Number of prescribed medication		

PART C: Anthropometry assessment						
		1st reading	2nd reading	Average	Remarks	
1.	Height (cm)					Current height
	Knee height (cm)					Estimated height
2.	Body weight (kg)					
3.	Body Mass Index (BMI) (kg/m^2)					Underweight
						Normal
						Overweight
						Obese
4.	Mid Upper Arm Circumference (MUAC) (cm)					
5.	Calf Circumference (CC) (cm)					
6.	Body fat percentage (%)					

PART D: Biochemical indicators		**Date :**
Biochemical Tests	**Normal Values**	**Readings**
Albumin	35 – 50 g/L	
Haemoglobin	Male : 14 – 18 g/dL Female : 12 – 16 g/dL	

PART E: Hand Grip Strength				
Readings (kg)	Right	1st reading	2nd reading	Average
	Left	1st reading	2nd reading	Average

PART F: Perception towards Oral health						
Geriatric Oral Health Assessment Index (GOHAI) **Please tick (√) the appropriate box for each of the following questions**						
No	**In the past 3 months:**	**Always**	**Often**	**Sometimes**	**Seldom**	**Never**
1	How often were your teeth or gums sensitive to hot, cold, or sweets?					
2	How often did you use medication to relieve pain or discomfort from around your mouth?					
3	How often did you limit the kinds or amount of food you eat because of problems with your teeth or dentures?					
4	How often were you able to eat anything without feeling discomfort?					
5	How often were you able to swallow comfortably?					
6	How often do you have trouble biting or chewing any kinds of food, such as tough meat or apples?					
7	How often have your teeth or dentures prevented you from speaking the way you wanted?					
8	How often did you limit contacts with people because of the condition of your teeth or dentures?					
9	How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures?					

10	How often did you feel nervous or self-conscious because of problems with your teeth, gums, or dentures?					
11	How often were you worried or concerned about the problems of your teeth, gums, or dentures?					
12	How often were you pleased or happy with the look of your teeth and gums, or dentures?					

PART G: Dietary Intake (24-hour dietary recall)

HOSPITAL FOOD (DAY 1)

Type of diet received **: _____** **Date: _____**

Patient's energy requirement (kcal) **: _____**

Patient's protein requirement (g/kcal) *:* **_____**

Mealtime	Food/beverages/supplement	Preparation method	Amount consumed

Remarks:

_____

_____

Outside food

Mealtime	Food/Beverages/Supplement	Preparation method/ Brand name	Amount

HOSPITAL FOOD (DAY 2)

Type of diet received **: _____ Date: _____**

Patient's energy requirement (kcal) **: _____**

Patient's protein requirement (g/kcal) *:* **_____**

Mealtime	Food/beverages/supplement	Preparation method	Amount consumed

Remarks:

_____

_____

Outside food

Mealtime	Food/Beverages/Supplement	Preparation method/ Brand name	Amount

PART H: MINI NUTRITION ASSESSMENT SHORT FORM (MNA-SF) Please tick (/) the appropriate box for the following question.		
SCREENING	**SCORE**	
1. Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?		0 = severe decrease in food intake
		1 = moderate decrease of food intake
		2 = no decrease in food intake
2. Weight loss during the last 3 months.		0 = weight loss greater than 3 kg
		1 = does not know
		2 = weight loss between 1 and 3 kg
		3 = no weight loss
3. Mobility		0 = bed or chair bound
		1 = able to get out of bed / chair but does not go out
		2 = goes out
4. Has suffered psychological stress or acute disease in the past 3 months?		0 = yes
		2 = no
5. Neuropsychological problems		0 = severe dementia or depression
		1 = mild dementia
		2 = no psychological problems
6. Body mass index: _____		0 = BMI less than 19
		1 = BMI 19 to less than 21
		2 = BMI 21 to less than 23
		3 = BMI 23 or greater
If BMI is not available, replace question 6 with question 7 ***Do not answer question 7 if question 6 is completed***		
7. Calf circumference (cm): _____		0 = CC less than 31
		3 = CC 31 or greater

TOTAL SCORE: _____

Screening score (max. 14 points)	Nutritional status	
12 – 14 points	Normal	
8 – 11 points	At risk	
0 – 7 points	Malnourished	

APPENDIX VII

Originality Report

Thesis

ORIGINALITY REPORT

15%	9%	12%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	pubmed.ncbi.nlm.nih.gov Internet Source	1%
2	F J Umam, S Setiati. "Association between type II diabetes mellitus and hand grip strength in the elderly", Journal of Physics: Conference Series, 2018 Publication	1%
3	www.science.gov Internet Source	1%
4	www.mdpi.com Internet Source	<1%
5	academic.oup.com Internet Source	<1%
6	Bernhard Fink. "Digit ratio and hand-grip strength in German and Mizos men: Cross-cultural evidence for an organizing effect of prenatal testosterone on strength", American Journal of Human Biology, 11/2006 Publication	<1%