ORIGINAL ARTICLE

Handgrip Strength Assessment and Its Associated Factors among Hospitalized Elderly in Klang Valley Hospitals

Khairunisar-E-Rashim Mohammed Yusufirashim[1], Noraida Omar[1,2], Shazli Illyani Mohamad Shafie[1], Siti Hazimah Nor'hisham[1]

[1] Department of Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Selangor, Malaysia.
[2] Malaysian Research Institute on Ageing (MyAgeing), Universiti Putra Malaysia, Selangor, Malaysia.

ABSTRACT

Introduction: Handgrip strength is a crucial biomarker of aging. Poor handgrip strength among hospitalized elderly increases the risk of health complications leading to a higher risk of hospital readmissions and mortality. This study aimed to determine handgrip strength among hospitalized elderly in Klang Valley hospitals alongside its associated factors. **Methods:** A total of 57 subjects were recruited for this study. Face-to-face interviews and physical assessments were conducted to obtain data on sociodemographic factors, medical background, anthropometry assessments and biochemical markers level. Dietary intake was obtained through two days of 24-hour dietary recall while tools such as Global Oral Health Assessment Index (GOHAI) and Mini Nutrition Assessment- Short Form (MNA-SF) were used to assess perception towards oral health and malnutrition risk, respectively. Reference value from the Asian Working Group of Sarcopenia (2014) was used to compare handgrip strength. **Results:** 94.7% of the subjects were found to have low handgrip strength with a mean value of 8.28 $\pm$ 6.92 kg/force. Factors including age (r=-0.370, p=0.005), educational level (r=0.471, p=<0.0005), perception towards oral health (r=0.370, p=0.005) and energy intake (r=0.367, p=0.005) were significantly associated with handgrip strength. Meanwhile, other variables were not significantly associated. **Conclusion:** The majority of the subjects had poor handgrip strength. Factors such as age, educational level, perception towards oral health and energy intake were significantly associated with handgrip strength while the rest were non-significantly associated. Thus, more research and intervention strategies should be done to improve handgrip strength among hospitalized elderly to achieve a healthy aging nation.
Malaysian Journal of Medicine and Health Sciences (2022) 18(6):115-124. doi:10.47836/mjmhs18.6.17

Keywords: Handgrip strength, Muscle strength, Elderly

Corresponding Author:
Noraida Omar, PhD
Email: noraidaomar@upm.edu.my
Tel: +603 97692463

INTRODUCTION

The elderly population is expanding all around the world and it is expected that by the year 2050, there would be 22% of the elderly population in the world. Meanwhile, Malaysia itself is expecting to be an 'aged' nation by the year 2030 (1). With this increasing number, common health-related concerns of the elderly are often related to their muscle strength, functional status and their quality of life. Handgrip strength is an indicator of all these components among the elderly and it is widely accepted as a 'vital sign' of the elderly's health and a crucial aging biomarker (2). Handgrip strength is measured through isometric muscle contraction where the maximum force applied by a person through a grip on the assessment tool to resist the stationery grip resistance gives the reading (3). Hence, as the elderly age and the neural and muscular decline occur in their body that results in a reduced force, it affects the handgrip strength which is also used as one of the diagnostic criteria in diagnosing Sarcopenia. Sarcopenia is a skeletal muscle disorder that can lead to frailty if it is left untreated and it can affect the overall quality of life of the elderly (4). The Federal National Health Institutes had found that among the United States elderly, 5 % were having a weak grip strength while it was prevalent as 19 % among the older old (5). Meanwhile, in Asian studies, poor grip strength was also found to be common such as among Korean elderly (32%) and Indonesian hospitalized elderly (43.8%) (6,7).

Besides, poor handgrip strength among the elderly after a recent hospital admission interrupts their efficiency to carry out important daily routines for recovery at home such as preparing and eating home-cooked meals and moving around where having this limitation leads to poor recovery and poor nutritional status which eventually could end up with hospital readmission. Consequently, among the Malaysian elderly, the hospital admission rate

was prevalent at 16% according to the Institute for Health System Research & Institute for Health Policy in 2013 where the biggest concern among this population is the risk of hospital readmission (8). Meanwhile, according to a research on hospitalized elderly in Malaysia, most of the elderly were either malnourished or at moderate risk of malnutrition (9,10). Hence, the high prevalence of malnutrition among hospitalized elderly and their poor functional status at discharge had been the major issues leading to a higher risk of hospital readmission where both nutritional status and functional status were related to a poor grip strength during hospitalization (7,11).

Therefore, to improve the quality of life among the elderly and their ability to carry out daily routines independently to promote recovery, handgrip strength had been the focus of health indicators among the elderly. Handgrip strength 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 (12). However, most of the research was conducted among community-dwelling elderly. Thus, this study aimed to assess handgrip strength among hospitalized elderly as well as the factors associated with handgrip strength to promote future actions to cater to the issues that derive from poor handgrip strength.

MATERIALS AND METHODS

Study Population and Design

This study was conducted among elderly of aged 60 and above hospitalized in Klang Valley hospitals including Hospital Sungai Buloh, Hospital Kuala Lumpur and Hospital Tengku Ampuan Rahimah. It was a cross-sectional study as data was taken from subjects at one specific time and location. Ethical approval was obtained from NMRR (National Medical Research Registry) (Project reference number: NMRR-20-308-52632) and JKEUPM (Ethics Committee for Research involving Human Subjects in UPM) (Project reference number: JKEUPM-2020-278). This study used a non-probability sampling design which included both purposive and convenience sampling. Using the purposive sampling method, the geriatric ward was selected for this study. Meanwhile, elderly patients who agreed to participate in this study and met all the criteria were conveniently selected. The sample size was calculated by using a 1.96 confidence level, 0.84 power test score and correlation coefficient of 0.411 obtained from a previous correlation study (13). After adding in 20% of the non-response rate, the desired sample size was 53 subjects. The inclusion criteria for subjects included Malaysian citizens aged 60 and above who could communicate in either Malay or English besides being on an oral hospital diet for at least two days with or without oral nutrition supplement (ONS) and had been admitted to the hospital for more than 48 hours. Meanwhile, subjects who were on enteral or parenteral feeding were excluded from this study. Besides, subjects who were critically or mentally ill or had been admitted for less than 48 hours were excluded too. A total of 57 subjects (107.5%) agreed to participate in this study whereas before participating, subjects were given time to read through the information sheet and sign the information sheet and consent form after understanding the terms of the study. Data collection was conducted between August 2020 and October 2020 which was during the Conditional Movement Control Order period in Malaysia due to the Covid-19 pandemic. A total of seven (7) domains of variables were measured which included sociodemographic factors, medical background, anthropometry assessments, biochemical markers level, perception towards oral health, dietary assessments and malnutrition risk where these variables were chosen considering the availability of data and the possibility of obtaining the data from the subjects non-invasively and through safe contact with the subject.

Measurements

Sociodemographic Factors

Information was obtained from the patient medical records including age, gender, ethnicity and educational level. A face-to-face interview was conducted if there was a lack of information in the patient record.

Medical Background

Medical background information was obtained through the medical records and their bedhead ticket. To complete the missing information, an interview method was carried out too. The information in this context included the type and number of co-existing diseases the subjects had and the number of medication drugs that they consumed. After obtaining the data, they were categorized as on polypharmacy for those who were on five or more medication drugs (14).

Anthropometry Assessments

Data on anthropometry assessments were obtained from the physical assessments which included weight, height, body mass index (BMI) and body fat percentage. For non-ambulatory subjects, weight was estimated using the formula by measuring mid-upper arm circumference and calf circumference. Meanwhile, knee height was measured to estimate height for non-ambulatory subjects. BMI was classified according to the cut-off proposed by World Health Organization to determine weight categories which were underweight if below 18.5 kg/m^2, normal category for 18.5 to 24.9 kg/m^2, overweight for 25.0 to 29.9 kg/m^2 and obese if 30.0 kg/m2 or above (15). Body fat percentage was measured using Bioelectrical Impedance Analysis to measure the definite value of body fat percentage and classified either as low (<13.0% for males and < 24.0% for females), normal (between 13.0% to 24.9% or 24.0% to 35.9%, for males and females respectively), high (between 25.0% to 29.9% or 36.0% to 41.9%, for

males and females, respectively) or very high category if the percentage exceeds the high level of body fat percentage (16).

Biochemical Markers Level

The biochemical data were recorded through the medical record or their bedhead ticket. The biochemical data included the serum albumin level and hemoglobin level. After obtaining the value, the data were classified as normal and abnormal after being compared with standard laboratory normal values where the normal value for serum albumin level was between 35 to 50 g/L while the normal value for hemoglobin level was between 14 to 18 g/dL and between 12 to 16 g/dL for males and females, respectively.

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 a 0.79 Cronbach alpha value (17). The GOHAI had 12 questions and three sections of assessments, which included four items on oral physical function, five items on psychological function dimensions and three items of questions on pain or discomfort (18). The score was ranged and labelled as 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 accumulated to note the total score where 12 was the lowest score a subject could obtain while 60 was the highest. A score between 12 to 56 was categorized as low while above 56 was high.

Dietary Assessments

Dietary intake of the subjects was taken by the 24-hour dietary recall of the patients for two days as it was a flexible method to accurately record their dietary intake in the cross sectional study (13). Whereas, two days dietary intake were taken to increase the accuracy of dietary intake data obtained through the average intake. The dietary intake was obtained from patients who had taken at least two days of hospital meals. The type of diet received, method of preparation, amount consumed alongside any outside food consumed by the subject and ONS were noted too to further aid in the result discussion. The total energy intake and protein intake were 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 (19). The dietary requirement of the subjects was calculated using the formula which was derived from the ESPEN guidelines on clinical nutrition and hydration of geriatric patients (20). Finally, dietary adequacy was determined by comparing the intake with 100% of the requirement.

Malnutrition Risk

The 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 wherein the latest revision, it incorporated either BMI or calf circumference as the sixth aspect (21). 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 a sensitivity of 93.2% to detect malnutrition (22). There were seven questions in MNA-SF where the lowest total score was zero while the highest was 14. The total score was categorized into three categories which were malnourished (0-7), at risk of malnutrition (7-11) and normal (12-14).

Handgrip Strength

Handgrip strength was measured by using Jamar Plus+ Digital Handgrip Dynamometer. The measurement was taken at the nearest 0.1 kg as the handgrip strength value. Before measuring handgrip strength, the subjects were asked to position their elbow at 90-degree position. 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 the maximum force on the grip handle (23). Both hands measurement was taken twice which started with the right hand and alternated with the left hand. The grip force was applied for around 3 to 5 seconds by the subjects. Next, the average of the measurements from both hands were calculated. The total handgrip strength (HS) was taken based on the highest value between both hands and if the patient was able to grip only by a hand, then the measurement from the single hand was taken as the total HS (24). Besides, the tool was sanitized before and after taking the measurements. The validated cut-off point by the Asian Working Group of Sarcopenia (AWGS) for grip strength categorization was used to determine the handgrip strength cut-off where $\geq$26kg/force and $\geq$18kg/force were normal handgrip strength cut-off for males and females, respectively (25).

Statistical Analysis

IBM SPSS software version 26.0 was used to analyse the data. The descriptive statistics of the data were computed including the mean, frequencies and percentage alongside standard deviation and range of the data through descriptive analysis. Independent Sample T-Test was conducted to analyse the difference in handgrip strength between male and female subjects where a significant level at $p<0.05$ was set as a significant different value. After checking for the normality, the inferential statistic to analyse the association was carried

out where the associations between continuous variables were analysed by Pearson Moment Product Correlation test and Spearman Rho Correlation test analysis was used for the association analysis of the continuous variable with an ordinal variable such as educational level. A significant level of $p<0.05$ was set to determine the significance of the association.

RESULTS

Table I shows the sociodemographic factors and medical background of the subjects. The subjects who participated in the study were between the age range of 60 to 86 years with a mean age of 72.3 ± 7.31 years. Meanwhile, the majority of the subjects were female (57.9 %). According to ethnicity, most of the subjects were Malay (40.4%), followed by Chinese (31.6 %), Indian (26.3 %) and a small number was of the 'other' ethnicity category (1.8 %). In terms of educational level, almost half of the subjects had received secondary level education (47.4 %) while only a small number of subjects had tertiary level education (7.0 %).

According to the medical background, most of the elderly had two comorbidities with a mean of 2.12 ± 1.07 while the highest number was 5 where some of them had no comorbidities. On the other hand, most of the elderly were on four medication drugs with a mean of 4.61 ± 2.87 where the highest number was 13 medicines which included short- and long-term medicines. However, less than half of the subjects were on polypharmacy (40.4%). Meanwhile, the highest prevalence disease among the subjects was hypertension (75.4 %), followed by diabetes (54.4%). Some of the subjects also had dyslipidemia, cardiovascular disease, chronic kidney disease and other diseases such as short bowel syndrome.

Based on Table II, the mean body mass index (BMI) was 22.92 ± 6.78 kg/m2 ranging between 19.90 to 53.80 kg/m2 with 46.4 % of them having normal BMI, followed by being underweight (23.3 %) and overweight (17.9 %). Meanwhile, for body fat percentage measurement, 38.2 % had normal body fat percentage followed by high body fat percentage (27.3 %), very high body fat percentage (21.8 %) and low body fat percentage (12.7 %). Most of the subjects presented abnormal biochemical marker reading where 68.0 % of them had low serum albumin level and 70.9 % of them had low hemoglobin level. According to the perception towards oral health, all subjects (100 %) had a score below 56 indicating a low perception towards oral health with the highest GOHAI score being 55.

Table I: Sociodemographic factors and medical background of the hospitalized elderly (N=57)

Characteristics	N (%)	Mean ± SD
Age (Years)		72.27 + 7.31
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)	
Medical background		
Number of comorbidities		2.12 ± 1.07
Number of medication drugs		4.61 ± 2.87
Hypertension	43 (75.4)	
Diabetes	31 (54.4)	
Dyslipidemia	12 (21.1)	
Cardiovascular disease	20 (35.1)	
Chronic kidney disease	12 (21.1)	
Other diseases	2 (3.5)	
Polypharmacy	23 (40.4)	

Table II: Anthropometry assessments, biochemical markers level, perception towards oral health, dietary assessments and malnutrition risk of the hospitalized elderly (N=57)

Characteristics	Mean ± SD
Anthropometric	
Weight (kg)	55.49 ± 14.34
Height (cm)	155.75 ± 10.26
Body mass index (kg/m2)	22.92 ± 6.78
Body fat percentage (%)	29.25 ± 9.10
Biochemical markers level	
Serum albumin (g/L)	30.98 ± 6.77
Hemoglobin (g/dL)	11.65 ± 2.15
Perception towards oral health	
Total GOHAI score	44.21 ± 7.06
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
Malnutrition risk	
Total MNA-SF Score	9.93 ± 2.53

Meanwhile, Table II also shows the dietary assessment among the subjects where most of them had inadequate energy intake (90.9%) and inadequate protein intake (87.3%). Besides, less than half of them received ONS in their hospital diet (26.3 %) and needed feeding assistance (37.7%). The mean MNA-SF score among the subjects was 9.93 ± 2.53 which falls under the category of at risk of malnutrition where most of them were at risk of malnutrition (57.9%) while 14 % of the subjects were malnourished.

According to Table III, the mean value of handgrip strength among the subjects was 8.28 ± 6.92 kg/force which falls under the category of poor handgrip strength. Therefore, most of the subjects had poor handgrip strength (94.7%) while only a small number of subjects (5.3%) had normal handgrip strength. Meanwhile, as it was further analyzed, the handgrip strength mean was found to be higher among hospitalized elderly men compared to the women and those without ONS inclusion in their hospital diet. Besides, the subjects who had normal handgrip strength were all male subjects.

Referring to Table IV, this study found a significant association between age and educational level with the handgrip strength of the subjects ($p<0.0005$). The number of comorbidities and medication drugs were not significantly associated with handgrip strength ($p>0.05$). Similarly, no significant association was found between biochemical markers level such as serum albumin and hemoglobin level or anthropometry assessments including weight, height, BMI and body fat percentage with handgrip strength of the subjects ($p>0.05$). Meanwhile, perception towards oral health measured through the GOHAI score was significantly associated with handgrip strength ($p<0.05$). According to association with dietary assessments, energy intake was significantly associated with handgrip strength ($p<0.05$) while protein intake and both energy and protein adequacy were not significantly associated with handgrip strength of the subjects ($p>0.05$). Finally, malnutrition risk assessed through MNA-SF was not significantly associated with the handgrip strength of the subjects ($p>0.05$).

Table IV: Correlation between sociodemographic factors, medical background, anthropometry assessments, biochemical markers level, perception towards oral health, dietary assessments and malnutrition risk with handgrip strength of the hospitalized elderly (N=57)

Variables	r-value[a]	p-value
Sociodemographic factors		
Age (Years)	-0.370	<0.0005
Educational level	0.471[b]	<0.0005
Medical background		
Number of comorbidities	-0.058	0.669
Number of medication drugs	-0.098	0.466
Anthropometry assessments		
Weight (kg)	0.111	0.415
Height (cm)	0.152	0.263
Body mass index (kg/m^2)	0.118	0.386
Body fat percentage (%)	0.061	0.660
Biochemical markers level		
Serum albumin (g/L)	0.199	0.166
Hemoglobin (g/dL)	0.012	0.929
Perception towards oral health		
Total GOHAI score	0.370	<0.0005
Dietary intake		
Energy (kcal)	0.367	<0.0005
Protein (g)	0.068	0.617
Dietary adequacy		
Energy (%)	0.171	0.213
Protein (%)	0.166	0.226
Malnutrition risk		
Total MNA-SF score	0.143	0.288

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

DISCUSSION

This study showed that there was a significant difference in handgrip strength value between male and female subjects where male subjects had higher mean handgrip strength than females as they have higher skeletal muscle mass than females. In terms of association, there was a significant association between age and the handgrip strength of the subjects ($p<0.05$). Similarly, a previous study had found a similar result where handgrip strength decreased with age because aging affected all organ

Table III: Handgrip strength of the hospitalized elderly (N=57)

Classification	Male	Female	Total	*t* value	*p*-value
Handgrip strength (kg/force)					
Among subjects with and without ONS	10.65 ± 8.43	6.56 ± 5.05	8.28 ± 6.92	2.284	0.026*
Among subjects with ONS	8.13 ± 6.73	3.40 ± 4.41	5.29 ± 5.75	1.656	0.122
Among subjects without ONS	11.48 ± 8.94	7.74 ± 4.83	9.34 ± 7.05	1.745	0.089
Handgrip strength categories			**N (%)**		
Poor handgrip strength (M= < 26 kg/force, F= < 18 kg/force)			54 (94.7)		
Normal handgrip strength (M= ≥ 26 kg/force, F= ≥ 18 kg/force)			3 (5.3)		

**Significant value at p<0.05*

systems in the body, including the musculoskeletal, vascular and nervous systems, resulting in a decrease in muscle mass and the ability to activate muscles too (3). Furthermore, since the musculoskeletal system was affected by aging and the medical status of the hospitalized elderly, a deterioration in hand structure and function may affect handgrip strength as well. Besides, another study had also found an association between age and handgrip 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 handgrip strength decline that resulted in their oldest participants to have a weaker grip strength compared to their younger participants where the decline rate accelerates from the age of 60 concurrent with the current study subjects' age criteria (26,27). A previous study had also found the educational level to affect the handgrip strength of the elderly as it interfered with the nutritional knowledge and the acknowledgement of the importance to maintain a good physical status where similarly, in this current study, elderly who were more educated tend to be more health-conscious and curious over their health including their food intake, medication and functional status (6). Besides, having a good awareness on their health-related issues would directly impact their food choices too which influences their physical health (28).

The number of comorbidities and medications were found to have no significant associations with handgrip strength which was contrary to a previous study that found the number of chronic diseases to be associated with handgrip strength among the elderly as there was an active interaction between different diseases that resulted in a deterioration of muscle function (29). The previous study had found the interaction between the presence of Hypertension and Diabetes Mellitus, respectively with handgrip strength. However, no significant association was found between coronary disease with handgrip strength in the similar study (29). Thus, this might indicate that the presence of the two most prominent diseases among the subjects of this study which were Diabetes Mellitus and Hypertension had affected the interaction of the number of comorbidities with handgrip strength as only a small number of subjects had other diseases such as Chronic Kidney Disease and Dyslipidemia. This could be influenced by the smaller number of subjects in this study. Besides, the different severity of the diseases and duration of diagnosis which weren't studied in the current study can also be related to the deterioration of handgrip strength. Another study carried out in China had found a similar result to this study where no significant association was found between handgrip strength and any of the diseases either by number or presence (30). Meanwhile, a study in Germany found that there was no difference in handgrip strength among those on plenty number of medication drugs which is similar to this current study where different interactions of different medicines such as anti-hypertensive drugs and ACE inhibitors might have different mechanisms affecting handgrip strength which need to be further investigated (6,31).

This study had found no significant association between anthropometry assessments and handgrip strength. Opposite to the current study, anthropometry assessments were found to be significant in previous studies with handgrip strength. It was found that low height and weight were related to lower bone mass and impaired bone structure which affects muscle strength and function including handgrip strength (3,32,33). This was related to stronger and larger muscles that increases bone size and strength in response to the growth (34). Hence, stronger and larger bones in taller and heavier people including people with higher BMI had been associated with the stronger grip strength in those studies. However, the relationship might be affected as elderly body composition changes while they aged which causes their weight to increase due to higher body fat instead of bone and muscle mass while the total weight only might be not comparable in this study without distinction between fat mass and fat-free mass in the measure (35). Meanwhile, both BMI and body fat percentage can be indicators of body fat among the elderly where fat percentage provided the definite value of body fat; however, in this study no significant associations were found either of BMI or body fat percentage with handgrip strength. Therefore, other factors such as fat distribution, the difference in fat and fat-free mass and the type of obesity that the elderly have might have affected the underlying mechanisms in the association of anthropometry assessments with handgrip strength (36,37).

Biochemical markers were found to have no significant association with handgrip strength. This was opposite to the result of some of the previous studies. Significant association of both serum albumin and hemoglobin level had been found with handgrip strength among Japanese elderly women as it was justified that both low hemoglobin level and elevated albumin level interrupted the maximal capacity of the musculoskeletal system to function resulting in decreased grip strength (37). Hemoglobin level lower than 14.2 g/dL was found associated with poor grip strength too (38). However, there were other confounding factors as well that affected the association such as their medical condition and comorbidities while weakness among the elderly affected both the inflammation status and physical status including handgrip strength which makes the association between these two factors not significant as more explanation should be derived to explain the causal relationship in the mechanism of associations (39).

The significant association between perception towards oral health and handgrip strength was similar to some previous studies. The positive relationship indicated

that better perception towards oral health affected the handgrip strength of the hospitalized elderly positively. It was justified that the mechanism behind this significant relationship was the masticatory ability and willingness among the 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 hands which resulted in reduced grip strength (40). Besides, having pain or discomfort in the 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 (41,42). 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 (6).

Meanwhile, in contrast with the current study, a study among Korean elderly women had found both energy and protein intake to have significant associations with handgrip strength whereas in this study, only energy intake was found to be significantly associated with handgrip strength (43). Similarly, a study in Korea had also found a significant association between energy intake and handgrip strength in a positive relationship which indicates higher energy intake would lead to better grip strength (13). Low energy intake which seems to be prevalent among hospitalized elderly could affect the handgrip strength as it interferes with the synthesis of muscle protein where this interruption could reduce muscle activity (44). The reduced efficiency of muscle to work caused poor grip strength initiation by the elderly. Besides, having a low energy intake also caused the body to catabolize muscles to produce energy to meet the daily need to carry out basic daily activities. Inadequacy of energy and protein intake as found in this study is common among hospitalized elderly in Malaysia (45,46). Thus, a previous study had also found that energy and protein inadequacy affected handgrip strength contradicting the current study finding (47). This is because a prolonged deficiency in energy intake could bring in confounding factors such as malnutrition due to muscle catabolism and wasting which; however, can be affected by the length of hospital stay. Meanwhile, despite some studies found a significant relationship of protein intake with handgrip strength, a study on protein supplementation found no improvement in handgrip strength results among their subjects despite protein supplementation to reach adequate protein intake where it can be concluded that despite protein intake having a positive relationship with handgrip strength, other factors such as micronutrients role and protein pattern can affect the mechanism too (48).

The current finding has been found inconsistent with some of the previous studies that found handgrip strength to be significantly associated with malnutrition risk where multiple methods were used to assess malnutrition risk including MNA and SGA form (7,49). Malnutrition causes depletion in muscle protein supply which is the major energy supply for muscle movement including grip thus, handgrip strength of the elderly decreases. Besides, weight loss and muscle mass loss which are the two common components among malnourished elderly may cause a loss in handgrip strength too (47). However, a study carried out among the Australian elderly with a larger sample size also found no significant association between malnutrition risk (MNA-SF score) with handgrip strength among the elderly (50). Thus, more investigation is needed to derive the mechanism behind the association of malnutrition with handgrip strength by studying other confounding factors such as duration of hospital stay and illnesses.

The strength of our studies was in terms of measurements of variables where validated tools were used in the methods such as MNA-SF form and GOHAI score. Meanwhile, this study also used 24-hour dietary recall for two days to get an average of dietary intake assessments which lacks in previous studies' methods. Several limitations were acknowledged in the current study. Firstly, there was a limitation in terms of the data collection where the biochemical data availability depended on the report of assessments carried out during their hospitalization by their health care specialists. Next, due to factors such as distractions or recall bias during the dietary recall, there was underreporting reported in the dietary intake among the subjects (30%). This study also did not include the reasons for admission, types and severity of underlying diseases in the inclusion criteria. In this study, physical activity and functionality through instrumental activities of daily living (IADL) could be included as potential confounding variables.

CONCLUSION

This study revealed that among hospitalized elderly in Klang Valley hospitals, 94.7 % of them had poor handgrip strength while 5.3 % had normal grip strength, indicating that most of them were having poor results in handgrip 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 handgrip 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 hemoglobin level, protein intake, dietary adequacy and malnutrition risk. Thus, as low handgrip strength was found to be common among hospitalized

elderly, handgrip strength and its associated factors should be given importance in caring for the elderly especially factors that could be controlled such as energy intake and oral health assessment and treatment in hospital. This would support the effort to reduce the 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 a significant relationship with handgrip strength as well as enlarging studies on the other factors.

ACKNOWLEDGMENT

The authors would like to thank the Malaysia Ministry of Higher Education for the grant funding (FRGS/1/2019/SK06/UPM/02/17). We also would like to express our gratitude to the directors of Hospital Sungai Buloh, Hospital Tengku Ampuan Rahimah and Hospital Kuala Lumpur, heads of the department of respective wards, hospital staff, caregivers, and all the subjects involved in this study.

REFERENCES

1. Kanasi E, Ayilavarapu S, Jones J. The aging population: demographics and the biology of aging. Periodontol 2000. 2016 Oct;72(1):13–8. doi: 10.1111/prd.12126.
2. McGrath R, Johnson N, Klawitter L, Mahoney S, Trautman K, Carlson C, et al. What are the association patterns between handgrip strength and adverse health conditions? A topical review. SAGE Open Med. 2020;8:205031212091035. doi: 10.1177/2050312120910358.
3. Ong HL, Abdin E, Chua BY, Zhang Y, Seow E, Vaingankar JA, et al. Hand-grip strength among older adults in Singapore: A comparison with international norms and associative factors. BMC Geriatr. 2017;17(1):1–12. doi: 10.1186/s12877-017-0565-6.
4. Greco EA, Pietschmann P, Migliaccio S. Osteoporosis and Sarcopenia Increase Frailty Syndrome in the Elderly. Front Endocrinol (Lausanne). 2019;10:255. doi: 10.3389/fendo.2019.00255.
5. Looker AC, Ph D, Wang C, Ph D. Sarcopenia Nih. 2015;(179):2011–2. Available from: https://www.cdc.gov/nchs/data/databriefs/db179.pdf
6. Kim CR, Jeon YJ, Jeong T. Risk factors associated with low handgrip strength in the older Korean population. PLoS One. 2019;14(3):1–14. doi: 10.1371/journal.pone.0214612
7. Riviati N, Setiati S, Laksmi PW, Abdullah M. Factors Related with Handgrip Strength in Elderly Patients. Acta Med Indones. 2017;49(3):215–9.
8. Yunus NM, Abd Manaf NH, Omar A, Juhdi N, Omar MA, Salleh M. Determinants of healthcare utilisation among the elderly in Malaysia. Institutions Econ. 2017;9(3):117–42.
9. LIN, T. S., HARITH, S., HASMAH, A & YUSUF WNW. Re-evaluation of Malnutrition Risk Screening Tool-Hospital (MRST-H) for Geriatric Patients : A Multicentre Study in Peninsular Malaysia. Sains Malaysiana 45(9)(2016): 1311–1317.
10. Shahrin FIM, Yu LZ, Omar N, Zakaria NF, Daud ZAM. Association of socio-demographic characteristics, nutritional status, risk of malnutrition and depression with quality of life among elderly haemodialysis patients. Malays J Nutr. 2019;25(1):1–12.
11. Allard JP, Keller H, Teterina A, Jeejeebhoy KN, Laporte M, Duerksen DR, et al. Lower handgrip strength at discharge from acute care hospitals is associated with 30-day readmission: A prospective cohort study. Clin Nutr [Internet]. 2016;35(6):1535–42. doi:10.1016/j.clnu.2016.04.008
12. Manoharan VS, Sundaram SG, Jason JI. Factors Affecting Hand Grip Strength and Its Evaluation: a Systemic Review. Int J Physiother Res. 2015;3(6):1288–93. doi: 10.16965/ijpr.2015.193
13. Tak YJ, Lee JG, Yi YH, Kim YJ, Lee S, Cho BM, et al. 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. Nutrients. 2018;10(9):1–13. doi: 10.3390/nu10091180.
14. Volaklis KA, Thorand B, Peters A, Halle M, Heier M, Strasser B, et al. Physical activity, muscular strength, and polypharmacy among older multimorbid persons: Results from the KORA-Age study. Scand J Med Sci Sport. 2018;28(2):604–12. doi: 10.1111/sms.12884.
15. W.H.O. OBESITY: PREVENTING AND MANAGING THE GLOBAL EPIDEMIC. Rep a WHO Consult Obes. 1998;
16. Gallagher D, Heymsfield SB, Heo M, Jebb SA, Murgatroyd PR, Sakamoto Y. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. Am J Clin Nutr. 2000 Sep;72(3):694–701. doi: 10.1093/ajcn/72.3.694.
17. Othman W-NW, Muttalib KA, Bakri R, Doss JG, Jaafar N, Salleh NC, et al. Validation of the Geriatric Oral Health Assessment Index (GOHAI) in the Malay language. J Public Health Dent. 2006;66(3):199–204. doi: 10.1111/j.1752-7325.2006.tb02580.x.
18. Azogui-Lévy S, Dray-Spira R, Attal S, Hartemann A, Anagnostou F, Azerad J. Factors associated with oral health-related quality of life in patients with diabetes. Aust Dent J. 2018;63(2):163–9. doi: 10.1111/adj.12577
19. Pfrimer K, Vilela M, Resende CM ari., Scagliusi FB aez., Marchini JS ergi., Lima NKC, et al. Under-reporting of food intake and body fatness in independent older people: a doubly labelled

water study. Age Ageing. 2015;44(1):103–8. doi: 10.1093/ageing/afu142.
20. Volkert D, Beck AM, Cederholm T, Cruz-Jentoft A, Goisser S, Hooper L, et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. Clin Nutr [Internet]. 2019;38(1):10–47. doi:10.1016/j.clnu.2018.05.024
21. Dent E, Chapman IM, Piantadosi C, Visvanathan R. Performance of nutritional screening tools in predicting poor six-month outcome in hospitalised older patients. Asia Pac J Clin Nutr. 2014;23(3):394–9. doi: 10.6133/apjcn.2014.23.3.18.
22. Suzana SJ, Siti Saifa H. Validation of nutritional screening tools against anthropometric and functional assessments among elderly people in selangor. Malays J Nutr. 2007 Mar;13(1):29–44.
23. Trampisch US, Franke J, Jedamzik N, Hinrichs T, Platen P. Optimal jamar dynamometer handle position to assess maximal isometric hand grip strength in epidemiological studies. J Hand Surg Am [Internet]. 2012;37(11):2368–73. doi:10.1016/j.jhsa.2012.08.014
24. Amaral CA, Amaral TLM, Monteiro GTR, Vasconcellos MTL, Portela MC. Hand grip strength: Reference values for adults and elderly people of Rio Branco, Acre, Brazil. PLoS One. 2019;14(1):1–13. doi: 10.1371/journal.pone.0211452.
25. Yoo J, Choi H. Mean Hand Grip Strength and Cut-off Value for Sarcopenia in Korean Adults Using KNHANES VI. J Korean Med Sci. 2017;32(5):868-872. doi: 10.3346/jkms.2017.32.5.868.
26. Alqahtani B, Alenazi A, Alshehri M, Alqahtani M, Elnaggar R. Reference values and associated factors of hand grip strength in elderly Saudi population: A cross-sectional study. BMC Geriatr. 2019;19(1):4–9. doi: 10.1186/s12877-019-1288-7.
27. Kim CR, Jeon YJ, Kim MC, Jeong T, Koo WR. Reference values for hand grip strength in the South Korean population. PLoS One. 2018;13(4):1–13. doi: 10.1371/journal.pone.0195485.
28. Shahrin FIM, Omar N, Daud ZAM, Zakaria NF. Factors associated with food choices among elderly: A scoping review. Malays J Nutr. 2019;25(2):185–98.
29. Pessini J, Barbosa AR, Trindade EBS de M. Chronic diseases, multimorbidity, and handgrip strength among older adults from Southern Brazil. Rev Nutr. 2016;29(1):43–52. doi: 10.1016/j.nut.2019.110636.
30. Cheung CL, Nguyen USDT, Au E, Tan KCB, Kung AWC. Association of handgrip strength with chronic diseases and multimorbidity: A cross-sectional study. Age (Omaha). 2013;35(3):929–41.
31. Love BL, Mitchell; Erin M, Norris LB. Association Between Reduced Handgrip Strength and Commonly Prescribed Medications. 2020;1–30. doi: 10.1101/2020.01.15.20017087
32. Mendes J, Amaral TF, Borges N, Santos A, Padrro P, Moreira P, et al. Handgrip strength values of Portuguese older adults: A population based study. BMC Geriatr. 2017;17(1):1–12. doi: 10.1186/s12877-017-0590-5.
33. Pengpid S, Peltzer K. Hand Grip Strength and Its Sociodemographic and Health Correlates among Older Adult Men and Women (50 Years and Older) in Indonesia. Curr Gerontol Geriatr Res. 2018;2018. doi: 10.1155/2018/3265041.
34. Daly RM, Saxon L, Turner CH, Robling AG, Bass SL. The relationship between muscle size and bone geometry during growth and in response to exercise. Bone. 2004 Feb;34(2):281–7. doi: 10.1016/j.bone.2003.11.009.
35. Keevil VL, Luben R, Dalzell N, Hayat S, Sayer AA, Wareham NJ, et al. Cross-sectional associations between different measures of obesity and muscle strength in men and women in a British cohort study. J Nutr Heal Aging. 2015;19(1):3–11. doi: 10.1007/s12603-014-0492-6.
36. Lad UP, Satyanarayana P, Shisode-Lad S, Siri CC, Ratna Kumari N. A study on the correlation between the Body Mass Index (BMI), the body fat percentage, the handgrip strength and the handgrip endurance in underweight, normal weight and overweight adolescents. J Clin Diagnostic Res. 2013;7(1):51–4. doi: 10.7860/JCDR/2012/5026.2668.
37. Yamada E, Takeuchi M, Kurata M, Tsuboi A, Kazumi T, Fukuo K. Low haemoglobin levels contribute to low grip strength independent of low-grade inflammation in Japanese elderly women. Asia Pac J Clin Nutr. 2015;24(3):444–51. doi: 10.6133/apjcn.2015.24.3.11.
38. Hirani V, Naganathan V, Blyth F, Le Couteur DG, Seibel MJ, Waite LM, et al. Low hemoglobin concentrations are associated with sarcopenia, physical performance, and disability in older australian men in cross-sectional and longitudinal analysis: The concord health and ageing in men project. Journals Gerontol - Ser A Biol Sci Med Sci. 2016;71(12):1667–75. doi: 10.1093/gerona/glw055.
39. Reijnierse EM, Trappenburg MC, Leter MJ, Sipil∆ S, Stenroth L, Narici M V., et al. Serum albumin and muscle measures in a cohort of healthy young and old participants. Age (Omaha). 2015;37(5). doi: 10.1007/s11357-015-9825-6.
40. Moriya S, Tei K, Murata A, Muramatsu M, Inoue N, Miura H. Relationships between Geriatric Oral Health Assessment Index scores and general physical status in community-dwelling older adults. Gerodontology. 2012;29(2):998–1004. doi: 10.1111/j.1741-2358.2011.00597.x.
41. Moriya S, Tei K, Yamazaki Y, Hata H, Shinkai S, Yoshida H, et al. Relationships between perceived chewing ability and muscle strength of the body among the elderly. J Oral Rehabil. 2011;38(9):674–9. doi: 10.1111/j.1365-2842.2011.02207.x.
42. Tôrres LHDN, Tellez M, Hilgert JB, Hugo FN, De Sousa MDLR, Ismail AI. Frailty, Frailty Components,

and Oral Health: A Systematic Review. J Am Geriatr Soc. 2015;63(12):2555–62. doi: 10.1111/jgs.13826.
43. Jang W, Ryu HK. 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. Korean J Community Nutr. 2020;25(3):226. doi: 10.5720/kjcn.2020.25.3.226
44. Doyev R, Axelrod R, Keinan-Boker L, Shimony T, Goldsmith R, Nitsan L, et al. Energy Intake Is Highly Associated with Handgrip Strength in Community-Dwelling Elderly Adults. J Nutr. 2021;151(5):1249–55. doi: 10.1093/jn/nxaa451.
45. Hambali NA, Omar N, Yusop NB. Total Cholesterol Level and Its Associated Factors among Hospitalized Elderly : A Cross-sectional Study. 2021;17(4):235–44.
46. Hashidi SN, Omar N, Adznam SNA. Determination of the prevalence of hypertension and factors associated with blood pressure among hospitalised elderly in Hospital Serdang, Selangor, Malaysia. Malays J Nutr. 2021;27(1):93–105.
47. S.Setiati and F Akbar. Correlation between hand grip strength and nutritional status in elderly patients. J Phys. 2018;(1073). doi:10.1088/1742-6596/1073/4/042032
48. Zhu K, Kerr DA, Meng X, Devine A, Solah V, Binns CW, et al. Two-Year Whey Protein Supplementation Did Not Enhance Muscle Mass and Physical Function in Well-Nourished Healthy Older Postmenopausal Women. J Nutr. 2015 Nov;145(11):2520–6. doi: 10.3945/jn.115.218297.
49. Zhang XS, Liu YH, Zhang Y, Xu Q, Yu XM, Yang XY, et al. Handgrip Strength as a Predictor of Nutritional Status in Chinese Elderly Inpatients at Hospital Admission. Biomed Environ Sci [Internet]. 2017;30(11):802–10. doi:10.3967/bes2017.108
50. Charlton K, Batterham M, Langford K, Lateo J, Brock E, Walton K, et al. Lean body mass associated with upper body strength in healthy older adults while higher body fat limits lower extremity performance and endurance. Nutrients. 2015;7(9):7126–42. doi: 10.3390/nu7095327.