ORIGINAL ARTICLE

Assessment of Body Fat Percentage and Its Associated Factors among Hospitalized Elderly

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ABSTRACT

Introduction: Elevated body fat percentage among elderly has resulted in a significant number of morbidity and mortality. Thus, this study aimed to determine the body fat percentage and its associated factors among hospitalized elderly in Klang Valley hospitals. **Methods:** A total of 57 subjects aged ≥ 60 years were recruited from the geriatric wards of three Klang Valley hospitals (Hospital Sungai Buloh, Hospital Tengku Ampuan Rahimah and Hospital Kuala Lumpur) using purposive and convenience sampling. A face-to-face interview and physical examination were conducted to obtain the data on socio-demographic characteristics, medical background, anthropometric measurements, total cholesterol levels, hand-grip strength, perception towards oral health, dietary assessment and malnutrition risk. The body fat percentage was assessed using a handheld bio-electrical impedance OMRON HBF-302 and compared with Gallagher's classification of body fat percentage. A simple descriptive statistic and correlation analysis were used to analyze the body fat percentage and its associated factors. **Results:** Majority of hospitalized elderly (49%) had elevated body fat percentages. Weight ($p \leq 0.0005$), BMI ($p \leq 0.0005$), and malnutrition risk ($p \leq 0.0005$) were significantly associated with the body fat percentage. Meanwhile, other variables were not significantly associated with body fat percentage in hospitalized elderly. **Conclusion:** Weight, BMI, and malnutrition risk were found to be significantly associated with the body fat percentage. Other variables were not significantly associated. Thus, a better understanding of factors associated with body fat percentage is necessary in managing elevated body fat percentage to reduce the risk of morbidity and mortality among hospitalized elderly.
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INTRODUCTION

Ageing population has progressed rapidly among populations in developed and developing countries. The percentage of older people is projected to rise from 9.3% in 2020 to 16.0% in 2050 worldwide whereby it is predicted that 1 in 6 people will be 65 years of age or over (1). In Malaysia, the number of elderly people increased 0.4% in a year from 10.3% in 2019 to 10.7% in 2020 (2).

The aging population is experiencing an increase in fat mass and a decline in fat-free mass as reflected in several studies, which has a profound impact on their health and function (3–5). National Health Morbidity Survey (NHMS) (2018) revealed that 2 in 10 elderly in Malaysia were obese. In fact, Malaysian elderly had twice the prevalence of obesity compared to Singaporean elderly (6). Therefore, the association of excessive body fat with high metabolic risk contributes to the needs of preventive health measurement as the baseline prevention (7). Thus, body fat percentage is considered to be one of the most important measurements for the diagnosis of obesity by which the excess body fat percentage tends to be correlated with various types of comorbidities (3,8–11). Body fat percentage is defined as the amount of body fat mass calculated as the total body weight percentage (8). It was advocated as an alternative measure of body composition, as an overall individual's body composition is poorly indicated by their BMI (12). Most of the study revealed the issue regarding higher body fat percentage among elderly whereby it is shown that becoming elderly and females contribute to higher percentage of body fat (3). In clinical settings, a study reported that elderly patients aged 60 years or older at the Geriatric Outpatient Clinic in Jakarta showed a significant increase in body fat along with an increase

in age (13). Higher body fat percentage also found among obese elderly whereby a study showed a strong correlation of body fat percentage among obese elderly females compared to young females (12). In addition, it has shown that 60% of patients above normal body fat percentage have diabetes and hypertension (8). There are some gaps from previous studies that are required for further investigation. To the best of knowledge, local studies on body fat percentage and its related factors are still limited. A considerable number of studies have addressed factors influencing body fat percentage but are limited only to those in community-dwelling populations. Hence, it might give different results for the hospital settings. Apart from that, previous studies lack in terms of assessment of the handgrip strength, perception towards oral health, dietary intake, and malnutrition risk. Therefore, this study aimed to determine the associations between socio-demographic characteristics, medical background, anthropometric measurements, total cholesterol levels, hand-grip strength, perception towards oral health, dietary assessment and malnutrition risk with the body fat percentage among hospitalized elderly in Klang Valley hospitals.

MATERIALS AND METHODS

Study Population and Design

This was a cross-sectional study conducted at government hospitals in the Klang Valley area among geriatric patients aged 60 and above. Ethical approval was obtained from the Ethics Committee for Research involving Human Subjects in UPM (JKEUPM-2020-278) and National Medical Research Register (NMRR) (NMRR-20-308-52632). Hospitals around Klang Valley that offer geriatric wards were chosen using purposive sampling. Then, based on the selection, Hospital Sungai Buloh, Hospital Tengku Ampuan Rahimah, Klang (HTAR), and Hospital Kuala Lumpur (HKL) were chosen purposively. Also, convenience sampling was used to select patients who are available during the research period, agreed to participate and meet the inclusion and exclusion criteria. The highest sample size calculated was 46, and after adjusting for a non-response rate of 20%, the number of subjects recruited for this study was 55. Inclusion criteria for this study include Malaysian citizens, patients aged 60 years and above, able to understand and speak English or Malay or both, and patients who are on an oral hospital diet or receive oral nutrition support (ONS) or both. While, the exclusion criteria were patients who are critically ill, full enteral or parenteral feeding, patients with psychiatric illness, and patients who are admitted in less than 48 hours. A total of 57 were recruited in this study (response rate of 112%). Subjects who are eligible to participate were provided with information sheets and consent form to obtain their approval. Some selected information was collected from a medical system or a bed-head ticket if available otherwise physical assessment was conducted to get the information. Data collection was conducted for 3 months from August till October 2020 which was in the Conditional Movement Control Order (CMCO) period where COVID-19 cases were still in control.

Measurements

Socio-demographic Characteristics

A self-developed questionnaire was used to obtain socio-demographic characteristics by obtaining through medical records or face-to-face interviews with the subject or caregiver. The socio-demographic characteristics included are age, gender, and educational level of the subject.

Medical Background

The medical background of the patients includes the types and number of comorbidities as well as the number of prescribed medications which was determined by access to the hospital's system or referring to the bed-head ticket. Face-to face interview was carried out if needed to complete the questionnaire. The subject was asked about the types of comorbidities, specifically diabetes mellitus, hypertension, chronic kidney disease, dyslipidemia, cardiovascular disease and cancer. The total number of comorbidities were also recorded and was classified as having multi-morbidity if the subjects had two or more chronic diseases (14). The number of medications taken was categorized as polypharmacy with definition by consuming five or more medications (15–17).

Anthropometry Measurements

Anthropometry measurements included current body weight, height, and body mass index (BMI) were obtained through physical examinations or interview sessions. For non-ambulatory subjects, knee height (KH) and mid-upper arm circumference (MUAC) were taken to determine the subject's weight and height. BMI was further classified according to the standard Body Mass Index (BMI) as stated in WHO (2016).

Total Cholesterol Level

Total cholesterol levels were obtained either from the hospital system or a bed-head ticket. Then, the value obtained was compared to the normal value based on TMCE (2017).

Hand-grip Strength

Hand-grip strength was obtained through physical examination by using the Jamar Digital Handgrip Dynamometer. Maximum hand-grip strength was taken on the basis of the highest value between the two hands or from a single hand if the subject was capable of gripping only by one hand (18). The results were then compared using the cut-off values based on Asian Working Group of Sarcopenia (AWGS).

Perception towards Oral Health

Perception of oral health was assessed using the Geriatric

Oral Health Assessment Index (GOHAI) developed by Atchison and Dolan in 1990. Score was given using Likert scale 1 to 5 and was obtained based on GOHAI score one by one through face-to-face interview with the subjects. The GOHAI score ranges from 12 to 60, with 12 being the lowest and 60 being the highest. Higher GOHAI score (≥ 57) suggests better self-reported oral health status and high perception towards oral health while a score from 12 – 56 indicates low perception towards oral health.

Dietary Assessment

Subject's dietary assessment was conducted and analysed from 2 days of 24-hour dietary recall in the hospital to determine the intake and adequacy of energy and protein. In the case of subjects on oral nutrition support (ONS), the amount of prescription and brand of the product received was obtained from the nurses, caregivers or subject's medical records. The caregiver can assist with answering the subject's dietary intake. Next, the Nutritionist Pro software was used to analyze the overall intake for the two days whereby the second day was asked on the following day. Energy and protein requirement of the subjects was estimated against formula 30 kcal/kg body weight and 1.2 g/kg body weight respectively (19). The intake was then compared with the requirement by ESPEN Guideline 2018 to determine the adequacy of the subject's dietary intake.

Malnutrition Risk

The Mini Nutritional Assessment-Short Form (MNA-SF) was used to assess the malnutrition risk of the subject through face to face interview. It comprises 7 items whereby the scales for question one, two, three and five ranged from 0 (severe) to 3 (less severe). Meanwhile the option of "YES" or ``NO" was given for question four. Next the sixth question is based on the BMI category of subjects and the score detail is from zero to three (BMI < 19 kg/m2 for 0 and the score 3 for ≥ 23 kg/m2). The last question for MNA-SF was about the calf circumference of the subject. This was an optional question when the BMI cannot be obtained. The score from the MNA tool was summed from all assessments in which 12 to 14 points indicate normal nutritional status, 8 to 11 points are at risk of malnutrition and 0 to 7 indicate malnourished.

Body Fat Percentage

Physical examination was conducted using a handheld bioelectrical impedance OMRON HBF-302 to measure the body fat percentage. In order to assure accuracy of the measurements, factors such as hydration status that may be affected by food, water, alcohol and diuretics have been taken into account. Results obtained from the hand-held BIA were then compared with the Gallagher's classification of body fat percentage for elderly (20).

Statistical Analysis

Statistical analysis of the data was performed using IBM SPSS version 25 with significance level set at $p<0.05$. The normality of the data distribution was examined before starting the analysis. All the data were normal. Descriptive statistics was presented in frequency, percentage, mean, standard deviation, minimum, and maximum value. Meanwhile, inferential statistics was used to determine the associations with the body fat percentage, whereby the associations were analyzed using the Chi-square test for all categorical variables. For the continuous variable, the correlation was tested using Pearson's Product-Moment Correlation.

RESULTS

Table I shows socio-demographic characteristics, medical background and anthropometric measurements of the subjects. The age of recruited subjects ranges between 60 to 86 years old with a total mean age of 72.27 ± 7.31 years. From a total of 57 subjects, 42.1% were male and 57.9% were female. Based on the educational level of the subjects, almost half of them (47.4%) had completed secondary education, followed by no formal education (29.8%), primary education (15.8%), and the remaining (7%) had tertiary education. Subjects had a mean number of comorbidities of 2.12 ± 1.07 in between 0 to 5 with concurrent diseases. Most of the subjects (68.4%) reported having two or more comorbidities categorized as presence of multi-morbidity while the remaining having less than two comorbidities. Five major diseases were asked about, along with any other comorbidities that the subjects had. Hypertension was the most prevalent in which it appears as the highest in number of comorbidities presented among recruited subjects. Diabetes mellitus came in second, with 54.4% of subjects suffering from the disease. Some subjects have cardiovascular disease (CVD) (35.1%), and the same percentage of subjects (21.1%) suffering chronic kidney disease (CKD) and dyslipidemia. In addition, 3.5% of subjects have diseases other than diabetes mellitus, hypertension, chronic kidney disease, dyslipidemia, and CVD. Furthermore, the mean number of medications was 4.61 ± 2.87 ranging from 0 to 13 units. This research also reveals that some subjects (40.4%) had polypharmacy, with a total of 5 units or more medications taken every day. The total mean for weight and height was 55.49 ± 14.34 kg and 155.75 ± 10.26 cm respectively. Meanwhile, the subjects' mean of BMI was 22.92 ± 6.78 kg/m2 which places them in the normal category according to BMI classification. Majority of subjects had normal (46.4%) BMI followed by underweight (23.2%), and overweight (17.9%). Following that, 8.9% classified as obese type I and 1.8% for both obese type II and obese type III respectively.

The total cholesterol levels of the subjects are shown in Table II. The mean cholesterol level for subjects was 4.78 ± 1.08 mmol/L with a minimum value of 3.35 mmol/L and a maximum value of 6.80 mmol/L. The proportion of subjects having abnormal total cholesterol

Table I: Socio-demographic characteristics, medical background and anthropometry measurements of the subjects (*n*=57)

Characteristics	*n (%)*	*Mean ± SD*
Age (Years)		72.27 ± 7.31
Gender		
Male	24 (42.1)	
Female	33 (57.9)	
Education level		
No formal education	17 (29.8)	
Primary	9 (15.8)	
Secondary	27 (47.4)	
Tertiary	4 (7.0)	
Number of comorbidities		2.12 ± 1.07
Number of medications		4.61 ± 2.87
Presence of multi-morbidity		
Yes (≥2)	39 (68.4)	
No (<2)	18 (31.6)	
Type of comorbidities		
Diabetes mellitus	31 (54.4)	
Hypertension	43 (75.4)	
Chronic Kidney Disease	12 (21.1)	
Dyslipidemia	12 (21.1)	
CVD	20 (35.1)	
Others	2 (3.5)	
Polypharmacy		
Yes (≥5 unit/day)	23 (40.4)	
No (<5 unit/day)	34 (59.6)	
Weight (kg)		55.49 ± 14.34
Height (cm)		155.75 ± 10.26
BMI (kg/m^2)		22.92 ± 6.78
BMI classification		
Underweight (<18.5 kg/m^2)	13 (23.2)	
Normal (18.5-24.9 kg/m^2)	26 (46.4)	
Overweight (25.0-29.9 kg/m^2)	10 (17.9)	
Obese I (30.0-34.9 kg/m^2)	5 (8.9)	
Obese II (35.0-39.9 kg/m^2)	1 (1.8)	
Obese III (≥40 kg/m^2)	1 (1.8)	

Table II: Total cholesterol levels of the subjects (*n*=20*)

Characteristics	*n (%)*	*Mean ± SD*
Total cholesterol level (mmol/L)		4.78 ± 1.08
Total cholesterol level classification		
Normal (<5.2 mmol/L)	12 (60.0)	
Abnormal (≥5.2 mmol/L)	8(40.0)	

*missing data (n=37) due to unavailability of data

level was 40% while the majority had a normal total cholesterol level. However, there were missing values for 37 subjects due to unavailability of the subjects' data. The hand-grip strength, perception towards oral health, dietary assessment and malnutrition risk of the subjects are presented in Table III. The total mean for hand-grip strength was 8.28 ± 6.92 with a range value of 0 to 33. Most of the subjects (94.7%) had lower hand-grip strength and only 5.3% of them were normal. For perception towards oral health, the total mean score of

Table III: Hand-grip strength, perception towards oral health, dietary assessment and malnutrition risk of the subjects (*n*=57)

Characteristics	*n (%)*		*Mean ± SD*
Hand-grip strength			8.28 ± 6.92
Hand-grip strength classification			
Lower	54 (94.7)		
Normal	3 (5.3)		
Total GOHAI score			44.21 ± 7.06
GOHAI score classification			
Low perception towards oral health (12-56 scores)	57 (100.0)		
High perception towards oral health (≥57 scores)	0 (0.0)		
Dietary Requirement			
Energy (kcal)			1664.82 ± 430.16
Protein (g)			66.59 ± 17.21
Dietary Intake			
Energy (kcal)			968.97 ± 315.82
Protein (g)			36.56 ± 15.58
Dietary Adequacy	*Ade-quate (100%)*	*Inade-quate (<100%)*	
Energy (%)	5 (9.1)	50 (90.9)	61.19 ± 24.88
Protein (%)	7 (12.7)	48 (87.3)	59.74 ± 34.26
With ONS	15 (26.3)		
Energy (kcal)			1007.84 ± 378.44
Protein (g)			42.36 ± 18.33
Without ONS	42 (73.7)		
Energy (kcal)			954.75 ± 293.69
Protein (g)			34.44 ± 14.12
MNA-SF score			9.93 ± 2.53
MNA-SF Classification			
Normal nutritional status (12-14 points)	16 (28.1)		
At risk of malnutrition (8-11 points)	33 (57.9)		
Malnourished (0-7 points)	8 (14.0)		

the subjects was 44.21 ± 7.06 with a minimum value of 27 and a maximum value of 55. As the maximum value was 55 which did not exceed the score for high perception towards oral health, thus the finding showed that all the subjects have low perception towards oral health. The mean daily energy requirement, intake and adequacy for the subjects was 1664.82 ± 430.16 kcal, 968.97 ± 315.82 kcal and 61.19 ± 24.88 % respectively. Meanwhile, the mean daily protein requirement, intake and adequacy for the subjects was 66.59 ± 17.21 g, 36.56 ± 15.58 g and 59.74 ± 34.26 % respectively. Among the subjects, 90.9% did not meet energy adequacy and 87.3% did not consume enough protein. When subjects' dietary recall was further analysed, 73.7% of them did not receive ONS. Hence, the mean intake of subjects who received ONS was much higher than those who do not receive ONS. For the malnutrition risk, the mean score of MNA-SF of the subjects was 9.93 ± 2.53 with a minimum value of 1 and a maximum value of 14. The

total score was further classified into three categories. About 28.1% of the subjects have normal nutritional status. More than half (57.9%) of the subjects are at risk of malnutrition while another small proportion (14%) are malnourished.

As shown in Table IV, the total mean for body fat percentage was 29.25 ± 9.10% while for males and females was 26.05 ± 7.36% (fall in high category of body fat %) and 31.74 ± 9.63% (fall in normal category of body fat %) respectively. Then, the subject's body fat percentage was further classified based on Gallagher's classification. Majority of the respondents had normal body fat (38.2%), followed by high body fat (27.3%), very high body fat (21.8%), and only 12.7% of them had a low body fat percentage. When summarised, this means that majority of subjects (49%) had an elevated body fat percentage which consists of high and very high body fat percentage.

Table IV: Body fat percentage of the subjects (*n*=55)

Body fat percentage (%)	*n (%)*	*Mean ± SD*
Total		29.25 ± 9.10
Males		26.05 ± 7.36
Females		31.74 ± 9.63
Classification		
Low	7 (12.7)	
Normal	21 (38.2)	
High	15 (27.3)	
Very high	12 (21.8)	

Pearson's and Spearman's correlation in Table V and Chi-square tests in Table VI showed that weight (r=0.636, p≤0.0005), BMI (r=0.802, p≤0.0005), and malnutrition risk (r=0.586, p≤0.0005) were significantly associated with the body fat percentage. Meanwhile, other variables were found not to be associated.

Table V. Pearson's and Spearman's correlation between socio-demographic characteristics, medical backgrounds, anthropometric, total cholesterol levels, handgrip strength, perception towards oral health, dietary assessment and malnutrition risk with body fat percentage among hospitalized elderly (*n*=55)

Variables	*r*	*p*[a]
Age (years)	-0.021	0.879
Number of comorbidities	0.249	0.067[b]
Number of medications	-0.206	0.132
Weight (kg)	0.636	0.000*
Height (cm)	-0.235	0.088
BMI (kg/m^2)	0.802	0.000*
Total cholesterol levels (mmol/L)	0.049	0.842
Handgrip strength	0.086	0.531[b]
GOHAI-score	0.027	0.844
Energy intake (kcal)	-0.008	0.954
Protein intake (g)	-0.193	0.162
MNA-SF score	0.586	0.000*

*p sig. at <0.05; [a]Pearson's correlation; [b]Spearman's correlation

DISCUSSION

Current study showed that there was no significant association between sociodemographic characteristics and body fat percentage which is similar to past studies (21,22). Other factors such as low food intake and absorption causing lesser calories and nutrition might affect the association (13). Inconsistently, a study indicated that a high body fat percentage was positively associated with increasing age in both males and females and this is due to a gradual increase in fat mass and decline in fat-free mass in elderly population (7,23). Besides, in older age groups, RMR and fat oxidation decreased, resulting in changes in body composition (24). On the other hand, body fat percentage has found to be increases in both genders as participants grew older whereby a greater percentage of body fat was found in women than in men (3,7,21,23). Sarcopenia which is more common among women and people in the older age group (59–69 years) would be the reason for higher body fat percentage (5). Several studies discussed similar results with the current study in which no association was found between educational level and body fat percentage (12). However, a study had found a negative association in which body fat percentage was significantly greater in those with lower education (3). This might be because individuals with a higher level of education are more likely to be aware and knowledgeable of a balanced and healthy lifestyle which can help them manage their body composition well (3).

Past studies have found that body fat percentage is significantly higher among individuals with chronic diseases, and the presence or absence of chronic diseases has been shown to affect body fat percentage (3). It has been revealed that the prevalence of diabetes and hypertension was higher (60%) in patients with higher body fat percentage and visceral fat levels (8). Additionally, in previous studies, the prevalence of hypertension in hospitalized elderly increased along with the number of overweight or obese individuals (25–27). Contrary to current study, a previous study found an association between presence of multimorbidity and body fat percentage, revealing that subjects suffering more than six comorbid conditions have a higher body fat percentage than those with the least chronic conditions (28). In terms of medication, the current finding is inconsistent with past study whereby subjects with diseases and consuming medication had a significantly higher body fat percentage (3). This may relate to the presence of multi-morbidity which increases the odds of polypharmacy (28,29). However, it should be noted that type of medication drugs may affect the fat distribution (30).

Findings from this study reported that body weight and BMI have a significant influence on the body fat percentage. Consistently, another study found that body weight has been associated with body fat percentage

Table VI: Chi-Square test between socio-demographic characteristics, medical backgrounds, anthropometric, total cholesterol levels, handgrip strength, dietary assessment and malnutrition risk with body fat percentage among hospitalized elderly (*n*=55)

Variables	*Body fat percentage N (%)*		X^2	*p*
	Abnormal	*Normal*		
Gender			0.035	0.851
Male	14 (58.3)	10 (41.7)		
Female	20 (64.5)	11 (35.5)		
Education level			1.456	0.228
No formal education	8 (47.1)	9 (52.9)		
Received formal education	26 (68.4)	12 (31.6)		
Presence of multi-morbidity			0.0001	1.000
Yes (≥2)	23 (60.5)	15 (39.5)		
No (<2)	11 (64.7)	6 (35.3)		
Comorbidities (Diabetes Mellitus)			0.001	0.980
Yes	18 (60.0)	12 (40.0)		
No	16 (64.0)	9 (36.0)		
Comorbidities (Hypertension)				0.208[d]
Yes	28 (66.7)	14 (33.3)		
No	6 (46.2)	7 (53.8)		
Comorbidities (Chronic Kidney Disease)				0.502[d]
Yes	8 (72.7)	3 (27.3)		
No	26 (59.1)	18 (40.9)		
Comorbidities (Dyslipidemia)				0.336[d]
Yes	9 (75.0)	3 (25.0)		
No	25 (58.1)	18 (41.9)		
Comorbidities (CVD)			0.021	0.886
Yes	11 (57.9)	8 (42.1)		
No	23 (63.9)	13 (36.1)		
Comorbidities (Others)				1.000[d]
Yes	1 (50.0)	1 (50.0)		
No	33 (62.3)	20 (37.7)		
Polypharmacy			1.415	0.234
Yes (≥5 units/day)	13 (54.2)	11 (45.8)		
No (<5 units/day)	21 (67.7)	10 (32.3)		
BMI classification			7.806	0.099
Underweight (<18.5 kg/m^2)	5 (41.7)	7 (58.3)		
Normal (18.5-24.9 kg/m^2)	14 (53.8)	12 (46.2)		
Overweight (25.0-29.9 kg/m^2)	8 (80.0)	2 (20.0)		
Obese I (30.0-34.9 kg/m^2)	5 (100.0)	0 (0.0)		
Obese II (35.0-39.9 kg/m^2)	1 (100.0)	0 (0.0)		
Total cholesterol level				0.377[d]
Normal (<5.2 mmol/L)	8 (72.7)	3 (27.3)		
Abnormal (≥5.2 mmol/L)	4 (50.0)	4 (50.0)		
Hand-grip strength				1.000[d]
Lower	32 (61.5)	20 (38.5)		
Normal	2 (66.7)	1 (33.3)		
Energy adequacy				1.000[d]
Adequate	13 (81.3)	3 (18.8)		
Inadequate	21 (53.8)	18 (46.2)		
Protein adequacy				0.354[d]
Adequate	13 (81.3)	3 (18.8)		
Inadequate	21 (53.8)	18 (46.2)		
MNA-SF classification				3.649
Normal nutritional status (12-14 points)	13 (81.3)	3 (18.8)		
At risk of malnutrition (8-11 points)	17 (53.1)	15 (46.9)		
Malnourished (0-7 points)	4 (57.1)	3 (42.9)		

[c]Chi-square test; [d]Fisher's Exact test

(31). This is due to true weight loss or excessive weight gain are primarily correlated with a change in the size of fat deposits thus affecting body fat percentage (32). Prior studies also ascertained the association between BMI and body fat percentage (7,8,13). However, a study in India revealed different finding which found no association between BMI and body fat percentage for underweight females as the study describe that BMI is an indicator of body fat mass rather than body fat proportion, hence increment in BMI may not result in equivalent increment in body fat (12).

In contrast, past study found a significant positive relationship of total cholesterol, with the increased body fat percentage (24). However, several studies have shown the total cholesterol value is affected by other lipid indicators as well (33,34). Besides that, a study showed that total cholesterol was significantly higher in the high group for BF% compared with the normal group (31).

The current study revealed that there was no significant association between handgrip strength with body fat percentage. In accordance with this, a study revealed that increasing body fat percentage decreased hand grip endurance, but not hand grip strength, whereby a reduction in hand grip endurance was found with increasing body fat percentage (35). However, past literatures found a negative association between handgrip strength and body fat percentage, showing that those with a lower fat percentage and a greater amount of muscle and bone mass performed better on grip strength performance (5,36). It can be concluded that the presence of excess body fat might impair activities that involve lower body strength and balance (36). In addition, hospitalized elderly is likely to exhibit decreased muscular strength when their ADL and physical inactivity levels are reduced concurrently, and less rapid reductions in muscle loading (e.g., 2 weeks of daily ambulation reduced to 1500 steps/day) have also been shown to result in decreased muscle mass and function (37,38). This may help to explain why older adults' handgrip strength is decreased during hospitalization. Besides, with increasing age, it is more common to have limitations in mobility-related tasks. It may be linked to excess body fat, which increases the risk of functional impairment, particularly in obese people who require more muscle strength to move because they are more prone to balance issues (39). Thus, hand-grip strength has been suggested as a tool to identify mobility limitation. Limited mobility is frequently the initial indicator of functional impairment, identifying those who may still benefit from preventive actions (40). A study showed that for men and women, the overall handgrip strength cutoff value for the likelihood of mobility limitations was 18.4 kg (41). Another study suggested that the optimal hand-grip cut-points for increased likelihood of mobility

limitation, according to the ROC curve, were 37 kg for males and 21 kg for women (39). They found out that as BMI increased, the cut-off points for hand-grip strength increased as well (39).

Similar to the current finding, a study reported that decayed, missing and filled teeth (DMFT) was not significantly associated with body fat percentage (38). However, past study had found that older people wearing complete dentures are vulnerable to being under-fat and affecting body fat percentages (22).This due to edentulous elderly consuming less micronutrients and hard-to-chew foods when compared to dentate elderly adults (22). The same information was reported during the interview session at the time of data collection in the current study. As age increases, elderly people begin to lose their teeth, which decreases dietary intake and thus reduces BMI and body fat mass (13). Similarly, tooth loss leads to a decrease in the efficiency of mastication, and older people may alter their dietary intake to compensate for the difficulty of eating certain foods (23).

Consistent to the current study, past study showed no significant association between body fat percentage and dietary intake (43). Furthermore, findings from diet recalls conducted in the previous study reported that no association was found between body fat percentage and macronutrients (44). They hypothesized that some issues such as underreporting of food consumed and inconsistency with the participant's environment while reporting become major contributing factors to the such findings. Based on observation and interview sessions during data collection, subjects who have marked tooth loss were less likely to consume foods with a heavy consistency or hard foods, which provide a significant source of protein, fiber, vitamins and minerals. However, it is also important to consider factors other than oral health status, such as availability of food, psychosocial factors, personal preferences, economic factors and dietary habits (45). Previous literature also identified health as the key factor influencing food choices among the elderly (46). However, several studies found a positive relationship between energy intake and body fat percentage (3). They revealed that higher proportions of energy derived from protein were reported significantly in men while women showed to have more percentage of energy extracted from fat (3). In terms of adequacy, most subjects did not meet energy and protein adequacy. The complaints were similar to previous studies in which subjects complained of no appetite, difficulty chewing and swallowing food, food was unappealing, and circumstances of their meals might have contributed to the insufficient intakes (25,47).

Malnutrition is a common problem among hospitalized elderly (34,48). Thus, the MNA-SF is a valid and reliable tool for classifying elderly people according to malnutrition classification. It is shown that there is an association between malnutrition risk and body fat percentage. Similarly, a previous study also found the association between body fat percentage and nutritional risk status (49). It is proven that poor nutritional status is likely to lower the body composition indicator including body fat percentage (50). This may relate to lower food intake due to numerous ageing factors, including anorexia of ageing, depression, increased number of comorbidities and medication taken as well as poor oral health, resulting in malnutrition (49,50). A study showed that malnourished older adults had a significantly lower body fat percentage compared to those identified as at risk of malnourished and well-nourished older adults (50). Furthermore, prolonged malnutrition led to the loss of fat stores among the subjects (35,47).

There are some limitations in this study. Firstly, the study has the potential to be biased, especially recall bias during completion of the dietary assessment, the MNA-SF form and the GOHAI score as some items are dependent on subject memory. During the interview session, the questions can either be answered by the caregiver or the subject. If the subject or caregiver did not know well or have a problem recalling the answer, misreported might happen. Besides, bias could occur between interviewer and subjects due to under-reported or over-reported of their 2 days dietary recall and current mental state for stress level. Underreporting dietary intake for 2 days of dietary recall which accounted for about 30% is one of the limitations that need to be addressed in this study. Based on current literature, lipid profile is found to be associated with body fat percentage, however due to limited data for lipid profile during data collection, thus only total cholesterol is available. However, reading of total cholesterol level was not available for certain subjects. Next, the prerequisite for body fat percentage measurements such as fasting for four hours and abstaining from physical activity for 12 hours was self-reported and relied on information given by the subjects. Thus, it could produce some bias. Nevertheless, the results were comparable to those of other studies that utilized more controlled subjects. Aside from that, BIA has also been compared with other recommended reference methods, including air displacement plethysmography, DEXA and has been found to be valid and reliable but is not considered a gold standard. However, in epidemiological studies, some accuracy must be sacrificed for ease, acceptability, and speedy collection of data, which together allow studies with large-scale screening.

CONCLUSION

In conclusion, the majority of hospitalized elderly (49%) had elevated body fat percentages. Weight, BMI, and malnutrition risk were found to be significantly associated with the body fat percentage. Body fat percentage considered to be an important measurement by which it tends to be correlated with nutritional status of the elderly. Hence, determination of body fat accurately

and a better understanding of factors associated with body fat percentage could provide clinically helpful information for healthcare professionals to assess disease risks especially in obese patients and improve preventive remedies for these patients that would reduce the risk of morbidity and mortality among hospitalized elderly. It would assist healthcare professionals such as doctors, nurses and dietitians in offering clinical guidance and interventions to address health issues particularly on obesity and multimorbidity among hospitalized elderly in Malaysia considering the ageing phenomenon occurring worldwide.

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