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Prevalence of Geriatric Malnutrition and its Associated Factors at the Hospital Universiti Sains Malaysia, Kelantan

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ABSTRACT

Introduction: Identified parameters associated with geriatric malnutrition add greatly to the knowledge of clinical nutrition and facilitate patient-centred nutritional care management. **Methods:** A six-month cross-sectional study with the aims of determinine the prevalence of malnutrition and its associated parameters was conducted among hospitalised geriatrics admitted to Hospital USM. A total of 130 (49 men, 81 women) eligible participants with a mean age of 69.7 (6.99) were recruited for this study. Anthropometric tests, biochemical tests, and subjective global assessments (SGA) were applied in this study to assess the nutritional status of the participants. Meanwhile, socio-demographics, nutritional risk factors, and clinical elements were examined to identify the associated factors of malnutrition. **Results:** The findings of this study revealed that 35.4% of the participants were malnourished based on SGA ratings of B (26.2%) and C (9.2%), with women having a significantly higher proportion (43.5%) compared to men (22.4%) with $p<0.05$. Multivariate analysis revealed that loss of appetite ($p<0.001$), low body mass index (BMI) ($p<0.001$), albumin ($p<0.05$), and surgical procedures ($p<0.05$) were significantly associated with malnutrition. **Conclusion:** The associated parameters were found to be practicable in facilitating the identification process of malnutrition, and thus enable earlier nutritional intervention to improve the overall disease progress.

Key words: Geriatrics, hospitalised, malnutrition, nutritional assessment

INTRODUCTION

Malaysia has an increasing geriatric population. The proportion of geriatrics has steadily increased from 5.7% of the population in 1990 to 6.3% in 2000, and is expected to be 9.8% by the year 2020 (Ambigga *et al.*, 2011). Although life expectancy has improved, factors such as poverty, lack of education, and social isolation can potentially influence the well-being of the elderly (Ambigga *et al.*, 2011). A report in 2004 demonstrated that coronary heart disease, mental illness, cerebrovascular disease, road traffic accidents, and cancer are the leading causes of disease burden in Malaysia, (Ministry of Health Malaysia, 2010). It was also reported that Malaysia is in the phase of epidemiological transition of non-communicable diseases which are highly prevalent among the geriatric population. This has resulted in a higher

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rate of hospitalisation, thereby increasing the expenditure on this segment of the population's healthcare.

Hospitalised geriatrics have been identified to have a high risk of malnutrition associated with the biological progress of ageing and clinical factors (Kagansky *et al.*, 2005; Volkert *et al.*, 2010). The prevalence of malnutrition in several countries among hospitalised geriatrics is reported to be in the range of between 20% to 60% regardless of the background setting and methodology applied (Kagansky *et al.*, 2005; Kuzuya *et al.*, 2005; Coelho *et al.*, 2006; Cereda, Valzolgher & Peroll., 2008; Vanderwee *et al.*, 2010; Volkert *et al.*, 2010; Holyday *et al.*, 2012). Nevertheless, Malaysian studies conducted in the central region have demonstrated a prevalence of malnutrition in hospitalised geriatrics ranging from 10.5% to 55% (Suzana *et al.*, 2002, Sakinah *et al.*, 2010; 2012). These findings illustrate that malnutrition is a perennial problem in the clinical setting.

Despite the well-reported occurrence of nutritional deterioration observed in a clinical setting, the recognition of this critical element is frequently inadequate (Volkert *et al.*, 2010; Holyday *et al.*, 2012). As a result, a higher number of malnourished patients are left untreated. Patients who have been enduring malnutrition exhibit poor clinical outcomes such as longer hospitalisation (Vanderwee *et al.*, 2010), complications (Norman *et al.*, 2008), and frequent re-admission (Koren-Hakim *et al.*, 2011). These situations indirectly mean higher healthcare expenditure and resource intensity associated with malnutrition as proposed by Lim *et al.* (2012).

For the aforementioned reasons, it is crucial to understand the prevalence of this preventable condition at the beginning of hospitalisation. The magnitude of the occurrence found would facilitate institutions to take into account the healthcare service provided. Indeed, nutritional screening and assessment are the essential elements that need to be performed for early identification of those who will benefit from nutritional intervention. Moreover, in conjunction with the transformation phase of the Accelerated Program for Excellence (APEX), Hospital Universiti Sains Malaysia (USM) is striving for excellence in the quality of teaching and contribution to the development of the health care industry. Thus, to support the needs of this transformation phase, assessment of nutritional information is a valuable part of the clinical management processes

The aims of this study were to determine the prevalence and associated parameters of malnutrition among hospitalised geriatrics admitted to Hospital USM.

METHOD

Setting and sample

This cross-sectional study was conducted from September 2012 to March 2013 at Hospital USM, Kubang Kerian, Kelantan. The subject area included ten wards of various clinical disciplines, namely, medical, surgical, oncology, ophthalmology, and orthopaedics. Geriatric patients aged 60 years and above were recruited based on a purposive sampling technique. Other inclusion criteria in this study were, having the ability to communicate verbally or with the assistance of a caregiver, being admitted for no more than 72 hours, not having physical deformation, being mentally competent, not having a critically ill condition, and being able to participate consensually. In this study, patients who were unconscious, ventilated, on intensive monitoring, and/or listed has having death risk by the physician in charge, were considered to be in a critical condition and were excluded.

Ethical consideration

This study was approved by the Human Research Ethics Committee, USM [ref:USMKK/PPP/JEPeM249.4.(4.9)].

Official permission was obtained from Hospital USM, [ref: HUSM/11/020/Jld.]. The purpose and procedures of this study were explained to the eligible participants prior to obtaining their consent.

Instruments

Subjective Global Assessment (SGA)

A multidimensional nutritional assessment tool known as Subjective Global Assessment (SGA) was used in this study to delineate the normal and malnourished subjects. A guideline suggested by Detsky *et al.* (1987) was applied. The SGA used consisted of five features covering patient history and physical examinations. The variables measured by the SGA were: changes in weight, appetite, gastrointestinal symptoms that last for more than two weeks (including nausea, vomiting, diarrhoea and anorexia), functional capacity and clinical diagnosis and its relation to metabolic demands.

The physical examination component of SGA consisted of five items, namely, the loss of subcutaneous fat in the triceps and mid-axillary line at the lower rib region, muscle wasting in quadriceps and deltoid region, and finally the presence of edemas in the ankle, sacral region, and ascites. Based on the SGA assessment of patient history and physical examination, an individual's nutritional status was then classified into one of three categories, namely, A (well nourished), B (moderately malnourished) and C (severely malnourished).

Anthropometry

Anthropometry measurements including weight, height, body mass index (BMI), mid-upper arm circumference (MUAC), and calf circumference (CC) were measured. The standard weight was measured in kilograms using an electronic weighing scale (Seca model 881). Standing height measurement among geriatrics is not possible due to kyphosis which causes a forward curvature and they are frequently observed to be unable to stand straight. Hence, an alternative method of height calculation was applied in this study. Individual heights were standardised using a formula given by Ngoh *et al.* (2012). Body weight and height were used to obtain the BMI (kgm^{-2}). Those below the universal BMI cut-off points of $18.5kgm^{-2}$ were classified as having undernutrition or chronic energy deficiency (CED)(WHO, 2006).

The MUAC measurement was taken on the right side if it was possible. Nevertheless, under certain circumstances such as the presence of medical devices or weakness on the right side, the left arm was measured. The measuring tape was placed around the arm without compressing the soft tissue, kept perpendicular to the long axis of the arm, and the measurement was taken at the level of mid-point marked. The procedure was repeated for a second reading. The measurements were recorded to the nearest 0.1(cm). The participants were classified as having muscle wasting if the MUAC recorded was <23.0 cm and < 22.0 cm for men and women, respectively (Sakinah *et al.*, 2010). Meanwhile, the CC measurements were taken in the supine position with the knee bent at 90° if the participant was unable to sit up straight. Individual participants were asked to sit on the bed with their left leg hanging loosely. The measuring tape was wrapped around the calf at the widest part and was pulled without compressing the tissue area. The procedure was repeated for the second measurement and the readings were recorded to the nearest 0.1 cm. The participants were classified as having muscle wastage if the CC recorded was <30.1 cm and <27.3 cm for men and women, respectively (Sakinah *et al.*, 2010).

Biochemical

Biochemical results for albumin and haemoglobin were obtained from the individuals' medical records from any blood analysis taken within 72 h of admission as ordered by the physician

in charge. This study did not purposely trigger any additional blood analysis if the required biochemical test was not ordered. Low levels of albumin (<35g/L) and haemoglobin (men <13g/L; women <12g/L) (Sakinah *et al.*, 2010) indicate malnutrition.

Data collection procedures

Two trained researchers were assigned to the data collection process. A structured questionnaire was used to record socio-demographic data, clinical and nutritional risk factors, and nutritional assessment. In addition, if the subjects had difficulty in answering the questions verbally, a family member or a caregiver was consulted.

Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20. Descriptive data were presented in frequencies and percentages (%) for categorical data. Meanwhile, means and standard deviations (SD) were used to present continuous data. Independent sample *t*-test and Pearson chi-square test were used to examine the differences of continuous and categorical data, respectively. To identify the associated factors of malnutrition, nutritional status, as an dependent variable, was dichotomised into well-nourished (SGA A) and malnourished (SGA B and C) groups. A simple logistic regression (SLR) analysis was firstly performed, and then followed by a multiple logistic regression (MLR) analysis. Variables with *p*-values less than 0.25 ($p<0.25$) found in the SLR and clinically important were considered significant to be included in further ML analysis. The concept of forward selection, which automatically enters an important independent variable into the model was applied. Multi-collinearity and interaction effects were tested with no significant interaction between the variables found. The assumptions of model fitness using the classification table, Hosmer-Lemeshow test, and the area under the receiver operator curve (ROC) were examined. The results were presented in regression coefficient (b), crude odds ratio at 95% confident interval, Wald statistics, and *p*-value. The level of significance was set $p<0.05$ for all statistical analyses.

RESULTS

Socio-demographic data

During the period of study, 217 eligible participants were identified. However, only 136 participants consented to participate. Another six participants were unable to complete the study procedure because they could not be approached within the time limit during the course of the study. Consent was not given by some eligible participants because some refused to participate, had communication problems, were too weak to participate, or were unable to complete the study procedures. Of the 130 participants, 37.7% and 62.3% were men and women, respectively. Ethnically, 91.5% were Malays and 8.5% were Chinese. The mean (SD) age of men and women participants were 69.6 (6.76) and 69.7 (7.15) years respectively. Participants' age ranged from 60 to 89 years. Baseline socio-demographic data illustrated that more women were currently single or widowed, unemployed, and depended on others for financial support compared to men ($p<0.05$). The socio-demographic characteristics of the participants are shown in Table 1.

Primary diagnosis was obtained from medical records according to the standard International Classification of Diseases (ICD-10). The three most common categories of primary diagnosis among the subjects were found to be circulatory system diseases (35.4%), followed by respiratory and genitor-urinary system diseases (11.5% respectively), and eye and and adnexa diseases (7.7%). Both men and women in this study had a high percentage of circulatory system diseases, with 38.8% and 33.3%, respectively.

Table 1. Socio-demographic characteristics of participants according to gender

	Men (n=49)	*Women (n=81)*	*Total (N=130)*
		Frequencies (%)	
Age (year) mean (SD)	69.6 (6.76)	69.7 (7.15)	69.7 (66.99)
Ethnicity			
Malay	48 (98.0)	71 (87.7)	119 (91.5)
Chinese	1 (2.0)	10 (12.3)	11 (8.5)
Marital Status*			
Single or widowed	5 (10.2)	45 (55.6)	50 (38.5)
Married	44 (89.8)	36 (44.4)	80 (61.5)
Literacy			
Literate	38 (77.6)	40 (49.4)	78 (36.9)
Illiterate	11 (22.4)	41 (60.6)	52 (63.1)
Living Arrangements			
Alone	2 (4.1)	8 (9.9)	10 (7.7)
With children or relatives	47 (95.9)	73 (90.1)	120 (92.3)
Employment Status*			
Unemployed	26 (53.1)	74 (91.4)	100 (76.9)
Employed or pensioner	23 (46.9)	7 (8.6)	30 (23.1)
Financial Economy /Dependency*			
Yes	28 (57.1)	66 (81.5)	94 (72.3)
No	21 (42.9)	15 (18.5)	36 (27.7)
Anxiety			
Yes	7 (14.3)	11 (13.6)	18 (13.8)
No	42 (85.7)	70 (86.4)	112 (86.2)
Smoking Status			
Active smoker	8 (16.3)	3 (3.7)	11 (8.5)
Ex-smoker	19 (38.8)	3 (13.6)	22 (16.9)
Non smoker	22 (44.9)	75 (82.7)	97 (74.6)
Alcohol consumption			
Yes	0 (0.0)	0 (0.0)	0 (0.0)
No	49 (100)	81 (100)	130 (100.0)

* (p<0.05) Pearson chi-square test was significantly different between genders

Prevalence of malnutrition

The details of malnutrition prevalence according to the anthropometrics measurements, biochemical, and SGA assessments among participants are shown in Figure 1. Almost 17% were classified as having CED (BMI < 18.5kgm^{-2}). Meanwhile, the SGA assessment revealed that 35.4% of the participants were malnourished with SGA B of 26.2% and SGA C of 9.2%. Both SGA and BMI assessments indicated that women (SGA: 43.2% and BMI: 22.2%) had a higher prevalence of malnutrition compared to men (SGA: 22.4% and BMI: 8.2%), significant at a p-value of less than 0.05 (p<0.05).

The assessment of MUAC and CC measurements demonstrated that 15.4% to 25.4% of participants had muscle wasting with no significant differences between geriatric men and women. Meanwhile, the nutritional status represented by biochemical assessment revealed that 42.3% and 62.5% of the subjects were classified as being hypo-albuminemia and anaemia, respectively.

Associated parameters for malnutrition

The SLR analysis performed (Table 2) revealed that for women, financial dependency, loss of appetite, albumin, haemoglobin, polypharmacy, the number

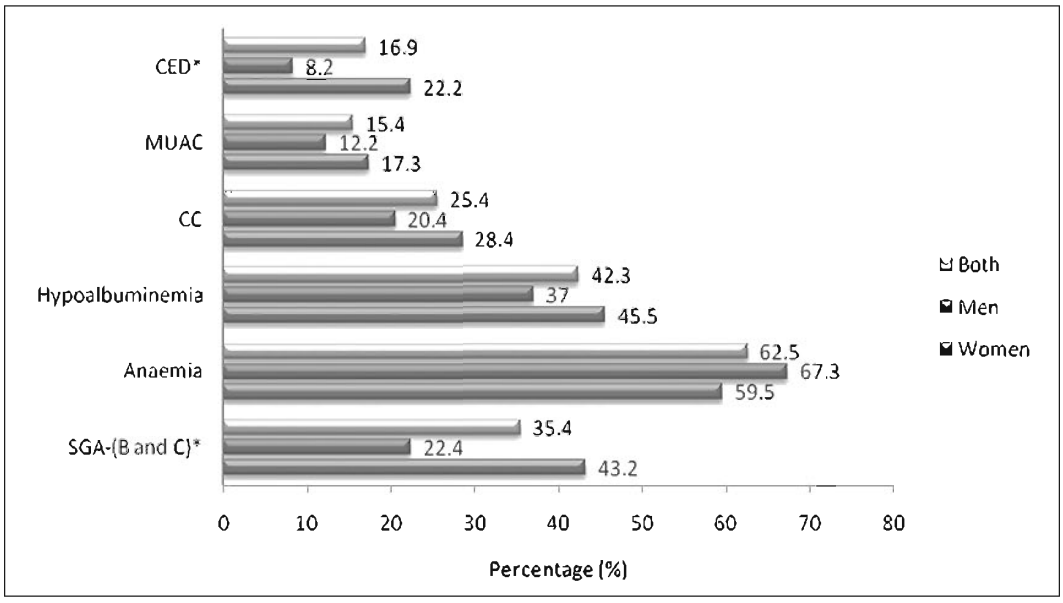

Figure 1. Prevalence of malnutrition according to anthropometry, biochemical and SGA assessments

Note: CED (BMI <18.5kgm^{-2}), MUAC (men <23.0 cm; women <22cm), CC (men:<30.1cm; women:<27.3cm), Hypoalbuminaemia (Albumin <35g/L), Anaemia (men <13 g/L; women <12g/L) *significant difference between gender at (p<0.05), Pearson Chi-squared test

Table 2. Simple logistic regression analysis of malnutrition (SGA B and C) as dependent variable and nutritional risk factors as independent variables

Variables	*Regression coefficient (b)*	*Crude Oodds Rratio (95% CI)*	*Wald statistic*	*p-value*
Gender				
Men	0	1	-	-
Women	0.923	2.52 (1.12, 5.67)	4.945	0.025[a]
Literacy				
Literate	0	1	-	-
Illiterate	0.446	1.56 (0.74, 3.30)	1.374	0.241
Economy dependency				
Yes	1.292	3.64 (1.37, 9.66)	6.37	0.009[a]
No	0	1	-	-
Ability to buy food				
Yes	0	1	-	-
No	1.194	3.30 (1.05, 10.42)	2.659	0.103
Chewing difficulties				
Yes	0.102	1.11 (0.45, 2.70)	0.050	0.823
No	0	1	-	-
Swallowing difficulties				
Yes	0.297	1.35 (0.44, 4.16)	0.266	0.606
No	0	1	-	-
Dry mouth				
Yes	0.905	2.47 (0.97, 6.31)	3.589	0.058
No	0	1	-	-

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Mouth sores				
Yes	0.625	1.87 (0.61, 5.72)	1.198	0.274
No	0	1	-	-
Nausea				
Yes	0.815	2.26 (0.95, 5.38)	3.385	0.066
No				
Vomiting				
Yes	0.916	2.50 (0.91, 6.89)	3.134	0.077
No	0	1	-	-
Loss of appetite				
Yes	1.889	6.61 (2.84, 15.37)	19.261	0.000[a]
No	0	1	-	-
Bloating or stomach discomfort				
Yes	0.435	1.55 (0.72, 3.32)	1.246	0.264
No	0	1	-	-
Diarhoea				
Yes	0.354	1.42 (0.36, 5.60)	0.256	0.613
No	0	1	-	-
Constipation				
Yes	-0.148	0.86 (0.41, 1.82)	0.151	0.698
No	0	1	-	-
Feeding difficulties				
Yes	0.892	2.44 (0.52, 11.43)	1.280	0.258
No	0	1	-	-
Frequently eating alone				
Yes	-0.560	0.57 (0.27, 1.20)	2.172	0.141
No	0	1	-	-
Dentition				
Good	0	1	-	-
Poor	0.354	1.43 (0.68, 2.99)	0.872	0.350
Vision problem				
Yes	0.231	1.26 (0.59, 2.69)	0.356	0.551
No	0	1	-	-
Hearing problem				
Yes	0.011	1.01 (0.28, 3.66)	0	0.987
No	0	1	-	-
Cardiovascular disease				
Yes	-0.560	0.57 (0.27, 1.20)	2.172	0.141
No	0	1	-	-
Diabetes mellitus				
Yes	-0.383	0.68 (0.32, 1.47)	0.962	0.327
No	0	1	-	-
Chronic kidney disease				
Yes	-0.627	0.53 (0.21, 1.39)	1.663	0.197
No	0	1	-	-
Disease of respiratory system				
Yes	0.705	2.02 (0.91, 4.51)	2.980	0.084
No	0	1	-	-
Cancer				
Yes	-0.043	0.94 (0.30, 3.06)	0.005	0.943
No	0	1	-	-

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Disease of gastrointestinal system				
Yes	0.223	1.25 (0.49, 3.21)	0.215	0.643
No	0	1	-	-
Anemia				
Yes	0.785	2.19 (0.74, 6.52)	1.996	0.158
No	0	1	-	-
Principle procedure				
Surgical	0.640	1.89 (0.81, 4.42)	2.201	0.138
Medical	0	1	-	-
Age	0.018	1.02 (0.97, 1.07)	0.443	0.506
Albumin	-0.202	0.82 (0.75, 0.90)	18.870	0.000[a]
Haemoglobin	-0.390	0.68 (0.54, 0.84)	12.24	0.000[a]
Polypharmacy	0.080	1.08 (0.95, 1.24)	18.870	0.000[a]
Number of comorbidities	-2.850	0.75 (0.57, 0.99)	4.173	0.041[b]
BMI	-0.350	0.71 (0.62, 0.81)	26.707	0.000[a]
MUAC	-0.389	0.68 (0.59, 0.78)	27.637	0.000[a]
CC	-0.387	0.68 (0.59, 0.78)	27.727	0.000[a]

Significant at [a](p<0.001), [b](p<0.05) by Simple logistic regression analysis

Table 3. Associated factors of malnutrition by multiple logistic regression analysis

Variables	*Regression coefficient (b)*	*Adjusted Odds Ratio[a] (95% CI)*	*Wald statistic*	*p-value*
BMI	-0.351	0.70 (0.59, 0.84)	14.956	<0.001
Albumin	-0.187	0.83 (0.73, 0.94)	8.113	0.004
Loss of appetite				
Yes	2.085	16.54 (3.91, 69.93)	14.540	<0.001
No	0	1	-	-
Principle procedure				
Surgical	2.031	7.48 (1.61, 34.83)	6.583	0.010
Medical	0	1	-	-

[a]Forward conditional multiple logistic regression model was applied
Multicollinearity and interaction terms were checked and not found
Hosmer-Lemeshow test (p=0.320),
Classification table (overall correctly classified percentage= 85.4%)
Area under the ROC curve (92.0%) was applied to check the model fitness

of comorbidities, BMI, MUAC, and CC were significantly associated with malnutrition (p<0.05). In order to confirm the association found, an MLR analysis was conducted. The final results demonstrated that four significant factors associated with malnutrition were retained (Table 3). Geriatric patients with loss of appetite were almost sixteen times as malnourished as those with good appetite. Moreover, patients principally treated surgically, either emergency or elective surgery, had approximately 7.5 times the chances of being malnourished compared to patients who were treated with medical procedures alone. Meanwhile, low BMI and albumin levels slightly affected the chances of geriatrics being malnourished.

DISCUSSION

The prevalence of malnutrition found in this study was 35.4% based on the standard

SGA assessment. This finding was within the range of 10.5% to 55.2% reported by others (Suzana *et al.*, 2002; Sakinah *et al.*, 2010; 2012). However, it is noted that direct comparisons might be difficult to conduct as previous studies used different nutritional assessments for malnutrition. For instance, Sakinah *et al.*(2010) used a generated multi-parameter assessment known as a global indicator of malnutrition (GIM) which consists of BMI, SGA, albumin analysis, total lymphocytes count, and haemoglobin analysis. On a broader scale, the prevalence of malnutrition among hospitalised geriatrics in this study was higher compared to other Asian countries such as Hong Kong and Japan in which the prevalence reported was less than 35% (Shum *et al.*, 2005; Kuzuya *et al.*, 2007). Factors such as different lifestyles, population growth rates, hospitalisation rates, and definitions and methodologies applied might have a great influence on the discrepancies observed. Additionally, this study demonstrated that elderly women significantly exhibited a higher prevalence of malnutrition when assessed by SGA (rating B and C) and BMI. This gender disparity indicates that elderly women are more vulnerable to malnutrition compared to men, as supported by a previous study (Sakinah *et al.*, 2010). In addition to the differences in biological attributes, geriatric women were also found to have poor appetite compared to men as observed in a local study conducted by Hanisah, Shahar & Lee (2012). Low education leading to a lack of access to nutritional knowledge may also have a great influence on the prevalence of malnourished geriatric women (Ngoh *et al.*, 2012). Anthropometric measures by BMI indicated that 16.9% of participants had CED (BMI <18.5 kg/m^2). This figure is consistent with the previous reports by Suzana *et al.* (2002) and Sakinah *et al.* (2010) where 12% to 18% of hospitalised geriatrics had CED. The presence of inflammatory factors during acute or chronic illness aggressively impairs the overall normal nutritional metabolism. Hence, the loss of body weight will affect the BMI status. The normal ageing process also contributes to unintentional weight loss which may hamper the BMI measurement in the later years of life (Shum *et al.*, 2005; Ngoh et al., 2011. However, despite the controversy of the practicality of accurate cut-off points for the elderly, studies have proven that BMI is a useful indicator to delineate well-nourished and malnourished geriatrics (Cereda, Valzolgher & Pedrolli, 2008; Vanderwee *et al.*, 2010).

Muscle wasting is another significant nutritional indicator which enables health care professionals to identify those malnourished. MUAC and CC reflect an individual's muscle wasting and fat loss (Sakinah *et al.*, 2012; Tsai, Lai & Chang, 2012). Limitation in mobility during illness greatly influences muscle condition (Tsai *et al.*, 2012). In this study, 15.4% to 25.4% of the participants had muscle wasting according to the MUAC and CC assessment, respectively. The prevalence found was similar with a previous study conducted by Sakinah *et al.* (2010). In that particular study 16% to 26% of geriatrics were found to have muscle wasting. Hence, it was deduced that muscle wasting commonly occurs among hospitalised geriatrics as a result of their disease conditions.

The other nutritional indicators that have been commonly applied in various nutritional studies are albumin and haemoglobin. These can reflect nutritional deterioration earlier compared to anthropometric and physical changes. In this study, 42.3% of the subjects were hypo-albuminemic and 62.5% were anaemic. Similarly, hypo-albuminemia prevalence is commonly observed among hospitalised geriatrics (Sakinah *et al.*, 2010). A low albumin level indicates that geriatrics who have been enduring diseases are susceptible to protein depletion and may have inadequate protein intake (Saka *et al.*, 2010; Shum *et al.*, 2005). Indeed, Kagansky *et al.* (2005) found that a low albumin

level is a significant predictor of mortality among hospitalised geriatrics. Meanwhile, Feldblum *et al.* (2007) found that this indicator may also be useful in the later stages of malnutrition. Further clarification of this issue may give a deeper explanation on the applicability of this indicator for use in malnutrition diagnosis.

This study showed a higher number of anaemic geriatrics compared to the previous studies where the proportion of anaemic was 40% (Suzana *et al.*, 2002; Sakinah *et al.*, 2012). The differences in disease severity might have greatly influenced the prevalence of anaemia. Furthermore, the alteration of normal nutritional metabolism during illness was found to also greatly influence haemoglobin status (Kagansky *et al.*,2005; Tsai *et al.*,2012). However, factors such as the ageing process (Shum *et al.*, 2005), disease severity, blood loss, and medication regime (Rolfes, Pinna & Whitney, 2006) may also influence haemoglobin status rather than nutritional *per se*.

The high prevalence of malnutrition observed in this study postulates that nutritional deterioration is a common occurrence in a clinical setting among geriatric patients. Despite the disease conditions, the presence of other factors related to ageing increases the risk of geriatrics developing malnutrition. Additionally, this vulnerable population has higher hospitalisation rates due to multiple morbidities which have been proven attributable to malnutrition among geriatrics (Mudge *et al.*, 2011). Hence, this preventable condition should receive adequate attention from healthcare providers so that it is recognised earlier and necessary intervention can be initiated immediately. Additionally, the cost involved in managing complications associated with malnutrition can be reduced through continuous assessment and monitoring of malnutrition.

Associated factors for malnutrition

The multivariate analysis performed demonstrated that four independent factors were significantly associated with malnutrition among the participants of this study. Loss of appetite was the first and the strongest independent factor of malnutrition found. Others have also found this factor to be associated with malnutrition (Mudge *et al.*, 2011).

In this study, loss of appetite increased the odds of malnutrition by about sixteen times (odds ratio [OR] (95% CI) 16.54 (3.91, 69.93), $p<0.001$). This factor indirectly explains that a decrease in food consumption is commonly observed during illness. Hence, it results in increased body catabolism and impairment of overall basic physiological and physical functions (Ahmed & Haboubi, 2010). Consequently, nutritional depletion leads to a poor response from normal physiological systems to battle against diseases during clinically administered treatment.

Ultimately, a longer convalescence period (Kagansky *et al.*, 2005 and impaired clinical outcomes (Sullivan *et al.*, 2002) are commonly observed. It therefore cannot be denied that loss of appetite becomes one of the major factors associated with malnutrition in a clinical setting.

Additionally, this study discovered that BMI had a linear association with malnutrition among hospitalised geriatrics (OR (95% CI); 0.70 (0.59, 0.84), $p<0.001$). Individuals with decreased BMI had less ability to cope with the physiological changes due to illness. This finding is also supported by previous studies which demonstrated that malnourished geriatrics had significantly lower BMI across two different nutritional states, namely, at risk of being malnutrition and being well-nourished (Cereda *et al.*, 2008; Vanderwee *et al.*, 2010). Moreover, it was found to be significantly associated with other nutritional indicators such as albumin level (Kuzuya *et al.*, 2005), muscle wasting

assessed by CC, and functional capacity (Coelho *et al.*, 2006). Logically, impaired nutritional appetite increases the risk of weight loss among the malnourished due to the decrease in food consumption and higher nutritional needs. Although malnutrition is measurable through CC, the presence of edema or ascites might influence the accuracy of weight measured, and thus, caution is needed when applying this indicator to a susceptible individual.

Other than that, this study also found that albumin can be a significant predictor of malnutrition (OR (95% CI); 0.83 (0.73, 0.94), $p<0.05$). The data seemed to confirm the findings revealed by Kagansky *et al.*(2005) and Saka *et al.* (2010). Albumin is a useful and practical indicator to delineate malnourished or well-nourished states in a clinical setting since it is one of the common tests performed during hospitalisation. It is noted that under the acute disease phase, a decrease in albumin synthesis is common due to the presence of inflammatory conditions. However, this indicator frequently coexists with other clinical conditions among hospitalised geriatrics which makes it less accurate in assessing nutritional status (Kagansky *et al.*, 2005). Furthermore, non-nutritional factors such as drugs used and laboratory procedures applied may affect the result of the biochemical testing. Hence, a multi-parameter assessment which considers the albumin level might improve the validity of albumin as a malnutrition indicator.

Besides the aforementioned factors, this study identified that geriatrics treated surgically (both elective and emergency procedures) are 7.48 times more likely to be malnourished compared to those treated medically (95% CI, (1.61, 34.83), $p<0.05$). Sonwalkar & Wilson (2005) suggest that surgical patients commonly have uncontrolled morbidity at the pre-operative stage such as cardiovascular, respiratory, and metabolic derangements. These conditions have been constantly found to be associated with malnutrition among geriatrics (Saka *et al.*, 2010; Mudge *et al.*, 2011). Meanwhile, in the post-operative phase, higher energy demand is commonly observed due to higher oxygen consumption and physiological response to post-operative inflammatory reaction (Sonwalker & Wilson, 2005). This acute inflammatory phase induces a rapid catabolic effect on lean body mass and ultimately impairs nutritional status. Thus, disease severity indirectly explains the higher prevalence of malnutrition in surgical patients.

All the identified factors possess valuable information to identify malnourished geriatrics in a clinical setting. Consequently, early recognition and intervention can aid the prevention of negative implications due to nutritional depletion. However, due to the limitation of each indicator, a comprehensive approach that consists of multi-parameter assessments is suggested for nutritional assessments.

This study has some limitations. The exclusion of critically ill patients and eligibility criteria may limit the assessment of malnutrition prevalence among geriatric patients admitted to Hospital USM. It is plausible that excluded patients may suffer from malnutrition. Moreover, this is a cross-sectional study, and thus the effect of examined items could not be identified. A longitudinal study is recommended to gain a deeper understanding on this issue and further investigation on the predictors of malnutrition among hospitalised geriatrics is needed.

CONCLUSION

The prevalence of malnutrition was found to be apparently high among hospitalised geriatrics. The findings of this study elucidated that anthropometric, biochemical, and multidimensional nutritional assessments tools are practicable to assess nutritional status among geriatrics during hospitalisation. Moreover, these measurements can be conducted at the

bedside and are convenient for both healthcare professionals and patients. Routine screening and assessment of nutritional status are critically important to assess and monitor the efficient management of the nutritional health status of the geriatrics.

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