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Development of a Local Malnutrition Risk Screening Tool-Hospital (MRST-H) for Hospitalised Elderly Patients

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ABSTRACT

Introduction: Hospitalised elderly patients are at high risk of malnutrition due to the presence of chronic diseases and inadequate food intake. It was on this premise that a Malnutrition Risk Screening Tool–Hospital (MRST-H) was developed for identifying the risk of malnutrition among Malaysian elderly patients. **Methods**: A total of 181 respondents aged 65 years and above who had been admitted to the Geriatric Ward of the University Malaya Medical Centre were recruited. The respondents' nutritional assessment was assessed using the Global Indicator of Malnutrition (GIM), a reference gold standard of malnutrition consisting of anthropometric measurements, biochemical indicators and the Subjective Global Assessment (SGA). Important predictive factors of malnutrition were determined by logistic regression analysis. **Results**: Five out of 18 predictive factors were significantly associated with malnutrition ($p<0.05$) in the final multivariate logistic regression model. These five factors were used to develop the MRST-H. Its validity was tested among 100 elderly inpatients in the Kuala Lumpur Hospital. The MRST-H was found to have 66.7% sensitivity, 96.2% specificity and 82.4% positive predictive value to GIM. The MRST-H was tested for reliability among 40 patients involving three raters (a dietitian and two nurses). The Kappa index of agreement was excellent between the dietitian with nurse A (81.3%, Kappa=0.84) and nurse B (87.5%, Kappa=0.89) respectively. **Conclusion**: The MRST-H developed showed high validity and reliability as a screening tool for identifying hospitalised elderly patients with high risk of malnutrition.

Keywords: Hospital malnutrition, MRST-H, screening tool, validation, reliability

INTRODUCTION

Economic development has provided several advances in medical care which have led to a longer life span and an increase in the elderly population. According to World Health Organization (WHO), there are an estimated 605 million elderly people

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(60 years and above) in the world today. By 2025, the proportion of the population aged 60 years and above is expected to reach 11% in South and Central Asia (WHO, 2002). In Malaysia, based on the 2010 census, the percentage of the elderly (65 years and above) has increased to 5.1% compared to 3.9% in 2000 (Department of Statistics Malaysia, 2011).

Malnutrition is a condition when there is an imbalance between an individual's food intake and the recommended nutritional needs to maintain optimum health (WHO, 1995). Many researchers have shown that the elderly are at high risk of malnutrition (Jensen, Friedman & Coeman, 2001; Suzana, Wong & Wan Chak, 2002). Guigoz, Vellas & Garry (1996) and Constants (2003) estimated that about 10-85% institutionalised elderly, 22-59% hospitalised elderly and 2-7% of elderly in the community are malnourished.

A number of nutritional screening and assessment tools have been developed to detect malnutrition. However, there is still a lack of a reference gold standard for the optimal definition and diagnosis of malnutrition (Meijers *et al*., 2010). Thus, there is a need to combine several methods into a standard test battery to accurately identify malnutrition.

Nutritional screening is the initial process to identify those who are malnourished or at risk for malnutrition, hence, early referral can be made to the appropriate professional to conduct an in-depth nutritional assessment and begin nutritional support in time (Ferguson *et al*., 1999; Green & Watson, 2005). A nutritional screening tool is meant to be simple and rapid to administer (Visvanathan, Penhall & Chapman, 2004). On the other hand, nutritional assessment is more complex, comprehensive and involves the use of several measures such as anthropometry, dietary, and biochemical measurements, clinical history, physical and other parameters (WHO, 1973).

The usefulness of a screening tool depends on its reliability, validity, sensitivity, and specificity (Green & Watson, 2005). Several nutritional screening tools are available for hospitalised patients including for elderly patients such as short-form Mini Nutritional Assessment (MNA-SF), Malnutrition Universal Screening Tool (MUST), Nutritional Risk Screening 2002 (NRS 2002), and Geriatric Nutritional Risk Index (GNRI). In Malaysia, a local Malnutrition Risk Screening Tool-Community (MRST-C) has been developed and validated to rapidly identify elderly individuals at high risk of malnutrition in the community (Suzana, Dixon & Earland, 1999; Suzana *et al*., 2007). However, MRST-C was not valid for hospitalised elderly patients (Sakinah *et al*., 2004). The aim of this research was therefore to develop a simple, reliable, and valid local Malnutrition Risk Screening Tool-Hospital (MRST-H) that could be used to identify elderly patients at risk of malnutrition upon admission to hospitals. The validity and reliability of MRST-H was also evaluated.

METHODS

The development of the MRST-H was based on the results of the nutritional status and characteristics of 181 patients (Population A). The validity of the MRST-H was tested in a different population of 100 patients (Population B); the reliability of the MRST-H was tested on 40 patients (Population C). Informed consent was obtained from all who agreed to participate in the study.

Development of the MRST-H (Population A)

All patients admitted to the Geriatric Ward University Malaya Medical Centre (UMMC) in Kuala Lumpur, Malaysia, during a four-month study period (April to August 2003) were eligible for inclusion in the study; the exclusions were as follows: patients under the age of 65 years, patients with physical

deformities or impairments that would affect anthropometric assessment, psychiatric patients, critically ill patients (patients who need intensive care including those ventilated / sedated) and patients with communication difficulties. This study was approved by the Medical Ethical Committee of the UMMC (Ref: MEC: 290.12).

Nutritional assessment

The nutritional status of the respondents was assessed using a combination of methods that included the anthropometric measurements: body mass index (BMI); biochemical indicators of albumin, haemoglobin, and total lymphocyte count (TLC) and Subjective Global Assessment (SGA) as shown in the Global Indicator of Malnutrition (GIM) (Table 1). Literature indicates that these nutritional assessment measures are commonly accepted standards. Thus they were used together as the reference gold standard of malnutrition for the purpose of this study. The respondents were considered malnourished if two or more of the indicators in GIM were presented: a BMI of less than 16.0kg / m^2; SGA rating of rank C; low biochemical parameters [two or more conditions presented – hypoalbuminemia (albumin < 3.3g / dL); anemia (hemoglobin < 13.0g / L for men and < 11.5g / L for women); low TLC (TLC < 1200 x 10^6 / L)].

The body weight (kilograms) and height (meters) of the respondents were measured upon admission. BMI was calculated from weight (kilograms) divided by height (meters) squared. Measurement of standing height was not possible for some respondents who were unable to stand straight. In such cases, arm span was used to estimate height using a derivation equation for the Malaysian elderly (Suzana & Ng, 2003).

Fasting blood samples (at least 12 hours of fasting) were collected from respondents by a trained medical officer for the analysis of serum albumin, haemoglobin and TLC. The SGA was performed as described by Detsky *et al.* (1987). SGA is a valid and reliable tool capable of assessing nutritional status based on the features of the medical history (weight change, dietary intake change, gastrointestinal symptoms that have persisted for more than two weeks, and changes in functional capacity) and physical examination (loss of subcutaneous fat, muscle wasting, ankle / sacral edema, and ascites). Features were combined subjectively into an overall or global assessment, where subjects were rated as being well nourished (SGA A); moderately, or suspected of being malnourished (SGA B); or severely malnourished (SGA C).

The mid-upper arm circumference (MUAC) and calf circumference (CC) were measured in addition to the GIM. MUAC was taken from the less dominant arm using a flexible measuring tape. The criterion in

Table 1. Global Indicators of Malnutrition (GIM)

No.	*Items*	*References*
1.	Body Mass Index < 16.0 kg / m^2 **OR**	James *et al.* (1988)
2.	Subjective global assessment – SGA C (severely malnourished) **OR**	Detsky *et al.* (1987)
3.	≥2 following parameters (albumin, hemoglobin, total lymphocyte count)	Hurwitz (1993)
	OR	
	- Hypoalbuminemia – Albumin < 3.3g / dL	
	- Anemia – Hemoglobin (men) < 13.0g / L (men); < 11.5g / L (women)	
	- Low total lymphocyte count – Total lymphocyte count <1200x10^6 / L)	Kamel *et al.* (2000)
	Malnutrition → presented ≥2 of the indicators above	

using MUAC to assess muscle wasting / malnutrition was based on the classification proposed by Ferro-Luzzi & James (1996). The cut-off points for men and women at risk of muscle wasting / malnutrition were 23.0cm and 22.0cm respectively. The CC was measured when respondents were either standing, sitting or lying down. This was dependent upon a respondent's health condition. The CC was measured using a flexible measuring tape which was wrapped around the right calf. The criterion in using CC to assess muscle wasting / malnutrition was based on the local classification developed by Sakinah *et al.* (2004) for Malaysian elderly. The cut-off points for men and women at risk of muscle wasting / malnutrition were 30.1cm and 27.3cm respectively.

Selection/development of nutrition screening questions

The criteria for developing the MRST-H were : (1) applicable for use in elderly patients; (2) convenient to use, simple, quick and easily completed by health care professionals; (3) non-invasive and inexpensive; and (4) valid and reproducible (Elmore *et al.*, 1994). Based on the literature review, 18 questions (independent variables) which were the predictive factors for malnutrition were selected and / or developed for nutrition screening. These 18 questions covered socio-economic status, anthropometric measurements, health and clinical experiences (Table 2).

Multiple logistic regression analysis was used to assess these 18 predictive factors of malnutrition. The variables with $p < 0.20$ in the univariable analysis (Pearson Chi-square test) along with the variables of known clinical importance were all entered into the multivariate analysis stepwise regression model (forward selection followed by backward elimination) for variables selection. To derive a nutritional tool comprising of a small number of variables, *p*-value of 0.05 was used as a selection criteria. A final model of the important predictive factors (significant variables, $\rho<0.05$) of malnutrition was obtained at this step. A combination of the variables in the final model was called Nutritional Risk Index (NRI). The regression coefficients (BC) of these variables were then rounded into simplified coefficients (SC) to form a Simplified Nutritional Risk Index (SNRI) for easier administration. The logistic regression equation of SNRI was formed with the SC and computed for the probability of malnutrition and SNRI score. The sensitivity and specificity were calculated for all possible cut-off points in a receiver operating characteristic (ROC) analysis of the participants with the GIM as the reference standard for the determination of the optimal cut-off point of SNRI. The area under the curve (AUC) represents a summary measure of the ability of SNRI to discriminate between patient at risk of malnutrition and not at risk of malnutrition.

Validity of the MRST-H (Population B)

This study took place between July and August 2004 on 100 patients admitted to the acute medical and oncology wards in Hospital Kuala Lumpur (Population B). The dietitian conducted a full nutritional assessment and completed the MRST-H on all patients within 72 hours of admission. The MRST-H was validated against GIM. The MRST-H scores were dichotomised as not at risk of malnutrition or at risk of malnutrition ($\geq$5 points) for use in statistical analyses.

Reliability of the MRST-H (Population C)

This reliability study was approved by the UMMC Ethics Committee (Ref: MEC: 290.12). The respondents were a new group of 40 patients admitted to the Geriatric Ward of the UMMC throughout January 2005. Respondents were selected using the inclusion criteria previously outlined. MRST-H for this group was completed by a dietitian and two nurses on the same day.

Table 2. Association between malnutrition and the nutrition screening questions (predictive variables) among elderly respondents (Population A)

Q	*Nutrition screening questions/ Predictive variables*	*Level*	*Patients at risk/total (n)*	*Frequency (%)*	*P value*
Q1	Had muscle wasting as assessed by MUAC in cm?	Yes	21/29	72.4	<0.001
		No	29/102	28.4	
Q2	Had muscle wasting as assessed by CC in cm?	Yes	25/36	69.4	<0.001
		No	25/95	26.3	
Q3	Did you lose weight unintentionally during the last month or six months ?	Yes	48/70	68.6	<0.001
		No	2/61	3.3	
Q4	Do you experience decreased appetite?	Yes	46/77	59.7	<0.001
		No	4/54	7.4	
Q5	Do you depend on someone for your source of income?	Yes	42/80	52.5	0.024
		No	8/51	15.7	
Q6	Are you unable to feed or eat by your self?	Yes	7/15	46.7	0.085
		No	43/116	37.1	
Q7	Do you have diarrhoea?	Yes	8/18	44.4	0.093
		No	42/113	37.2	
Q8	Do you have dry mouth?	Yes	17/46	37.0	0.101
		No	33/85	38.8	
Q9	Do you have mouth sores?	Yes	4/8	50.0	0.148
		No	46/123	37.4	
Q10	Do you experience nausea?	Yes	12/32	37.5	0.168
		No	38/99	38.4	
Q11	Do you experience difficulty chewing?	Yes	3/6	50.0	0.213
		No	47/125	37.6	
Q12	Do you eat less than 3 main meals?	Yes	17/51	33.3	0.282
		No	33/80	41.3	
Q13	Do you experience difficulty sleeping?	Yes	12/36	33.3	0.392
		No	38/95	41.1	
Q14	Do you often eat alone?	Yes	8/24	33.3	0.502
		No	42/107	39.3	
Q15	Do you experience difficulty passing urine?	Yes	8/25	32.0	0.598
		No	42/106	39.6	
Q16	Do you have false teeth/wear dentures?	Yes	5/15	33.3	0.606
		No	45/116	38.8	
Q17	Do you experience swallowing?	Yes	5/17	29.4	0.863
		No	45/114	39.5	
Q18	Do you vomit?	Yes	7/25	28.0	0.964
		No	43/106	40.6	

Abbreviations: CC - calf circumference; MUAC- mid upper arm circumference

[a] Chi-Square test or Fisher's Exact test; α was set at 0.20.

Ten (10) variables – Q1 to Q10 with $p<0.20$ were entered into the logistic regression model.

Five (5) variables – Q1 to Q3, Q5 to Q6 were significantly associated with the malnutrition in the final model ($p<0.05$).

The κ index of agreement was used to determine inter-rater reliability. The practice and feedback of nutritional screening by 31 nurses in the ward were observed in the meantime.

RESULTS

A total of 181 respondents (Population A) fulfilled the inclusion criteria and agreed to participate in the study with written consent. Of these respondents, 83 (45.9%) were men and 98 (54.1%) were women. The average age was 73.4 ± 6.2 years (range: 65 – 90 years). Almost half of our respondents (48.1%) were diagnosed with circulatory diseases, followed by 16.6% with respiratory diseases, and 10.5% with endocrine and metabolic diseases. The prevalence of malnutrition among the elderly patients in the Geriatric Ward UMMC was 10.5% according to GIM. Table 2 shows the association between malnutrition and the 18 screening questions (predictive variables). Ten variables with $p<0.20$ in these univariable analyses were entered into the logistic regression model. Five variables were significantly associated with malnutrition among the elderly patients ($p<0.05$) in the final model: Q1 – 'Had muscle wasting as assessed by MUAC'; Q2 – 'Had muscle wasting as assessed by CC'; Q3 – 'Lost weight unintentionally during the last month or six months '; Q5 – 'Depends on someone for source of income'; and Q6 – 'Unable to feed or eat by him / herself'. A combination of these five variables produced the NRI with 42.0% sensitivity, 94.7% specificity, and 74.1% PPV. The BC of these 5 NRI and the rounded SC are shown in Table 3. The logistic regression equation of SNRI was drawn up with these SC and computed for the probability of malnutrition as below: probability of malnutrition = e^S / $(1 + e^S)$, where S = 2 (Q1) + 1 (Q2) + 3 (Q3) + 1 (Q4) + 1 (Q5). The SNRI score of our respondents were between 0 and 8. The optimal cut-off point of SNRI score with risk of malnutrition was identified at 5. SNRI score more or equal to 5 (≥5) had 40.0% sensitivity, 94.7% specificity, and 74.1% PPV (Table 4). These values were almost the same with the NRI obtained from the logistic regression analysis model and thus was acceptable. The area under the ROC curve was 0.97, indicating the SNRI model had good discriminatory power. Finally, a local nutritional screening tool (MRST-H) for hospitalised elderly patients was developed with the SNRI established (Figure 1).

Validity of the MRST-H

A total of 100 respondents (37% men and 63% women) participated in the validation study in Hospital Kuala Lumpur (Population B). The age range was 65 – 95 years and the mean (SD) was 73.11 ± 6.03

Table 3. Summary of analysis logistic regression in predicting malnutrition (in the form of regression coefficient and simplified coefficient)

No.	*Predictive factors in the final model*	*Malnutrition*	
		BC	*SC*
Q1	Had muscle wasting as assessed by MUAC in cm	1.538	2
Q2	Had muscle wasting as assessed by CC in cm	1.048	1
Q3	Did you lose weight unintentionally during last month or six months ago?	2.280	3
Q5	Do you depend on someone for your source of income?	0.531	1
Q6	Are you unable to feed or eat by your self?	1.050	1

Abbreviations: BC - regression coefficient; CC- calf circumference; MUAC- mid-upper arm circumference; SC- simplified coefficient

Table 4. Diagnostic statistics to identify cut-off point for SNRI score of malnutrition

SNRI score	*Probability*	*Sensitivity[a] (%) [True positive value, n=50]*	*Specificity[b] (%) [True negative value, n=130]*	*PPV (%)*	*NPV (%)*
≥0	0.028	100.0	19.1	32.1	100.0
≥1	0.028	98.0	42.7	39.5	98.2
≥2	0.070	100.0	44.3	40.7	100.0
≥3	0.249	94.0	51.1	42.3	95.7
≥4	0.249	60.0	85.5	61.2	84.8
≥5	**0.467**	**40.0**	**94.7**	**74.1**	**80.5**
≥6	0.608	28.0	96.9	77.8	77.9
≥7	0.804	2.0	100.0	100.0	72.8
≥8	0.804	0	100.0	0	72.4

Abbreviations: NPV, negative predictive value; PPV, positive predictive value; SNRI, Simplified Nutritional Risk Index

[a] Percentage of malnutrition that accurately identified with the SNRI score for each of the cut-off point.

[b] Percentage of normal nutrition that accurately identified with the SNRI score for each of the cut-off point.

years. Of the respondents, 36.0% were diagnosed with circulatory diseases, 16.0% with respiratory diseases, 12.0% with neoplasm, 12.0% with digestive diseases, and 10.0% with endocrine and metabolic diseases. The prevalence of malnutrition among the elderly patients in Hospital Kuala Lumpur was 21.0% according to the reference gold standard of malnutrition (GIM). The MRST-H identified 17.0% of our respondents as having nutritional risk. The MRST-H had 66.7% sensitivity, 96.2% specificity and 82.4% PPV while validated using GIM.

Reliability of the MRST-H

A total of 40 respondents (25.0% men and 75.0% women) participated in the reliability study in the Geriatric Ward, UMMC (Population C). The age range was 66 – 92 years; mean (SD) 74.83 ± 6.81 years. The κ of the MRST-H, an indicator for the nurse-nurse inter-rater reliability of the 40 patients, was 0.74 with 72.2% agreement. The κ of the MRST-H on the 40 patients by nurse A and a dietitian and nurse B and a dietitian were 0.84 (81.3%) and 0.89 (87.5%) respectively. Kappa index values were higher for the dietitian and nurse B compared with nurse A. The Kappa index values were above the cut-off point of good reliability ($\kappa > 0.80$).

For the practice and feedback of nurses regarding nutritional screening, 83.9% of the nurses practised the nutritional screening as a routine component of their responsibility at ward; and only 16.1% did the screening upon request by the medical officer. Most of the nurses (74.2%) understood the necessity of nutritional screening – to identify patients with risk of malnutrition. The reasons for skipping nutritional screening was lack of time (38.7%), no standard protocol set by the hospital (19.4%), insufficient staff (9.7%), increased workload (9.7%), and no training / less skilled (9.7%). Most of the nurses were aware of the importance of nutritional screening (96.8%), and agreed to practise the nutritional screening procedure if a standard protocol was available (90.3%), and if courses and training were provided (93.5%).

DISCUSSION

Considerable efforts have been made to develop sensitive, specific, cheap, simple and rapid nutritional screening tools (Jones, 2004). A number of nutritional screening

Malnutrition Risk Screening Tool - Hospital (MRST-H)

Note:
There are 5 questions in this malnutrition risk screening tool. Its purpose is to screen the elderly when they are first admitted into the ward (within 72 hours) in order to identify those who at risk of developing malnutrition.

Step 1 – Circle the correct answer for each question (Yes or No)
Step 2 – Total up the score for all questions

No	Questions	Malnutrition	
		Yes	No
1	Do you depend on someone for your source of income?	1	0
2	Are you able to feed or eat by your self?	1	0
3	Did you have any unintentional weight loss in the last one month or six months? ($\geq$5% 1 month or $\geq$10% 6 months)? Original weight =.....kg Current weight =.....kg % weight loss = {original weight – current weight } x 100 / original weight	3	0
4	Mid-Upper Arm Circumference (MUAC) in cm 0 = MUAC $\geq$ 23.0 (male), 22.0 (female) 2 = MUAC < 23.0 (male), 22.0 (female)	2	0
5	Calf Circumference (CC) in cm 0 = CC $\geq$ 30.1 (male), 27.3 (female) 1 = CC < 30.1 (male), 27.3 (female)	1	0
	Total score =		

Interpretation:
- Total score $\geq$ 5 = an individual is at high risk of malnutrition

Completed by: .....
Signature: .....
Date: .....

Please refer to dietitian for nutritional assessment and intervention within 24 hours if patient is at high risk of malnutrition.

Figure 1. Malnutrition Risk Screening Tool-Hospital (MRST-H)

tools are well-established and available to detect malnutrition in the hospitalised elderly. Examples are MNA-SF (Rubestein *et al*., 2001), MUST (Elia, 2003) and NRS 2002 (Kondrup *et al*., 2003). In Malaysia, early efforts to develop a nutritional screening tool for the elderly was undertaken by Suzana *et al*. (2007) based on local studies (Suzana, Dixon & Earland, 1999). This Malnutrition Risk Screening Tool for Community (MRST-C) was developed specifically for the community elderly and has been validated at several places in Malaysia. However, its validity in detecting malnutrition in a hospital setting was shown to be quite low (low sensitivity – 0 to 37.9%; high specificity – 57.9 to 100%; and low PPV – 10.0 to 21.0%) (Sakinah *et al*., 2004). The development of MRST-H provides a solution to this drawback as it was locally developed to assist in identifying hospitalised elderly patients who are at risk of malnutrition.

The MRST-H developed based on the five important risk factors of malnutrition (anthropometric, clinical, functional and socio-economic status), is a holistic nutritional screening tool. It had 66.7% sensitivity, 96.2% specificity and 82.4% PPV while validated using GIM. A good screening tool should have sensitivity and specificity values of at least 80% to prove its usefulness (Nahid *et al.*, 1999). High sensitivity (identifies all those at risk) is important for a screening tool as the screening test is the first step to identify those who need further assessment. A high specificity (identifies all those without risk) is important as well as it can reduces the probability of giving unnecessary and in depth assessment and treatment to those who do not require it (Suzana, Dixon & Earland, 1999). Our MRST-H had high specificity (96.2%) but moderate sensitivity (66.7%). Altman (1995) reported that the PPV can be used to support the validity of a screening tool even with a low sensitivity value and a high specificity value. The PPV is influenced by the prevalence of the disease or exposure that is being measured in the population studied. In our study, the PPV, that is, the percentage of patients with positive (i.e. at risk of malnutrition) test results were actually malnourished. The high PPV (82.4%) of MRST-H enables accurate screening of the elderly at risk of malnutrition in the ward although the sensitivity value is moderate.

Two of the important anthropometric risk factors of malnutrition in our MRST-H are MUAC and CC measurements. Both the cut-off points used are suitable as they were either developed using data generated from Asia countries (Ferro-Luzzi & James, 1996) or established using data generated from the Malaysian elderly population (Sakinah *et al.*, 2004). The use of population based specific cut-off points or reference values can ensure and increase the sensitivity and specificity of our MRST-H in evaluating nutritional risk among the elderly.

The respondents (Populations A, B & C) in this current study are a reflection of the nutritionally relevant population of a general hospital. This is largely due to the fact that Hospital Kuala Lumpur is a central hospital in Malaysia and receives referrals from other state hospitals. To understand the true validity of a screening tool, its impact on clinical outcomes has to be proved. Thus, the length of hospital stay, care complexity, and weight changes during hospital stay were recorded to determine whether the use of the MRST-H and its subsequent treatment plan were beneficial and cost-effective.

The inter-rater reliability of the MRST-H was also good using the cut-off κ Index (Cohen, 1960) with the level of agreement between raters ranging between 72.2% and 87.5%. Awareness programmes among the nursing staff on the impact of malnutrition on hospital patients, the need for nutritional screening, and also training on the implementation of MRST-H could result in even better nurse-nurse reliability.

It is recommended that MRST-H be performed within 72 hours of hospital admission. Patients who are at risk of malnutrition (MRST-H score ≥ 5) should undergo a more detailed nutrition assessment (such as SGA) to identify if they are severely malnourished and to determine the most appropriate form of nutrition support. By implication, MRST-H would result in a more effective use of a dietitian's time and resources by decreasing inappropriate referrals.

In conclusion, the MRST-H has been proven to be a valid and reliable instrument in detecting malnourished elderly patients during the early stage of hospitalisation. It is quick and easy to use, does not result in large numbers of patients being referred inappropriately and only few false negative results occur. Early detection of the elderly at high risk of malnutrition using MRST-H may result in improvement in the quality of patient care and possibly reduce the length of stay due to early nutritional interventions.

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