Original Article

Validity of the Malnutrition Universal Screening Tool (MUST) in Australian hospitalized acutely unwell elderly patients

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Background and Objectives: This study validated the Malnutrition Universal Screening Tool (MUST) for nutritional screening in acutely unwell elderly patients against a reference assessment tool – Patient-Generated Subjective Global Assessment (PG-SGA). **Methods and Study Design:** One hundred and thirty two acutely admitted general medical patients contributed data for this study. In addition to performance of MUST and PG-SGA the following nutritional parameters were measured: weight loss >5% in previous 3-6 months, handgrip strength, triceps skinfold thickness, Mid-arm circumference, Mid-arm muscle circumference (MAMC). Quality of life (QoL) was determined using the EuroQoL Questionnaire (EQ-5D 5 level). Sensitivity, specificity, predictive values and concordance were calculated to validate MUST against PG-SGA. **Results:** MUST when compared to PG-SGA gave a sensitivity of 69.7%, specificity of 75.8%, positive predictive value of 75.4%, negative predictive value of 70.1% and kappa statistics showed 72.7% agreement (k=0.49) for detecting malnutrition. The MUST score had significant inverse correlation with body mass index, Triceps skinfold thickness and Mid-arm muscle circumference but not with Handgrip strength. Malnourished patients (PG-SGA class B/C) were found to have a significantly worse QoL. **Conclusions:** This study demonstrates that MUST can be confidently administered with respect to validity in acutely unwell general medical elderly patients to detect malnutrition. In this study, significant recent weight loss also seems to have validity, almost comparable to MUST, for predicting the risk of malnutrition. Further research is needed to verify this finding, as a single item may be more feasible to complete than an instrument consisting of two or more items.

Key Words: PG-SGA, EQ-5D, hospital length of stay, weight loss, anthropometric measures

INTRODUCTION

Malnutrition is common in the elderly population and its prevalence depends upon the setting, ranging from 10-30% in the community, to as high as 70% in the acute care setting.[1] Diagnosis of malnutrition is often missed in hospitalized patients due to a number of factors, including lack of awareness among medical and nursing staff, low priority given other medical conditions, a lack of understanding of available screening tools and also time-poor clinicians in busy acute care settings.[2] Further to this, factors such as cognitive impairment, the number of co-morbidities and altered taste sensation make elderly patients an even more vulnerable group.[3,4]

It is well established that malnutrition is associated with adverse clinical outcomes, including increased length of hospital stay, increased complications during hospitalization, increased risk of infections, accidental falls and high morbidity and mortality.[5-8] Given the high prevalence of malnutrition in hospitalized patients, experts have recommended screening all patients for malnutrition by using a valid nutrition screening tool. If the patient is found to be at risk of malnutrition, practitioners must confirm with a more extensive nutritional assessment tool such as the Patient Generated Subjective Global Assessment tool (PG-SGA), and then initiate an individualized nutrition care plan.[9] The PG-SGA is a version of Subjective Global Assessment (SGA) designed for the nutritional assessment of oncology patients and is dependent on infor-

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mation received from the patient. Nutrition screening aims to identify patients who are malnourished or at significant risk of malnutrition, and patients identified at risk are further referred for an in-depth nutritional assessment.[10] In the last couple of decades, a number of screening tools have become available and the Malnutrition Universal Screening Tool (MUST), developed by the British Association for Parenteral and Enteral Nutrition (BAPEN), is a rapid screening tool which has been found to have content validity (comprehensiveness of the tool), face validity(issues which are relevant to the purpose of the test) and internal consistency.[11,12] The MUST was primarily developed for use in the community and includes a body mass index (BMI) score, a weight loss score, and an acute disease score. A total MUST score of 0 indicates low risk, 1 indicates medium risk and ≥2 indicates high risk of malnutrition.[13] MUST is designed to identify need for nutritional treatment, as well as establishing nutritional risk on the basis of knowledge about the association between impaired nutritional status and impaired function.[14,15] It has been documented to have a high degree of reliability (low inter-observer variation) with a k=0.88-1.00.[2] This tool has recently been extended to other health care settings, including hospitals, where again it has been found to have excellent inter-rater reliability with other tools (k ≥0.783), and predictive validity (length of stay, mortality in elderly wards, and discharge destination in orthopaedic patients).[2]

The SGA is a method of nutritional assessment based on a medical history and physical examination, whereby each patient is classified as either well nourished (SGA A) or suspected of being malnourished (SGA B), or severely malnourished (SGA C).[16] It has been validated against objective parameters, measures of morbidity and quality of life and has a high degree of inter-rater reliability.[11,17,18] A further development of SGA is PG-SGA, which incorporates a score in addition to global assessment. Typical scores range from 0 to 35, with a higher score reflecting a greater risk of malnutrition. It has been demonstrated to be a valid method of nutrition assessment in a number of patient groups.[19] The PG-SGA score correlates with objective nutrition parameters (% weight loss, BMI), quality of life, morbidity (survival, length of stay), and has a high degree of inter-rater reproducibility and demonstrates a high sensitivity and specificity when compared with other validated nutrition assessment tools.[2,5,15,16] It is thus considered to be one of the most appropriate nutrition assessment tools and is often used in the absence of a 'gold standard' for diagnosing malnutrition. An advantage of PG-SGA over SGA is that a PG-SGA score can be used as an objective measure to demonstrate the outcome in nutrition intervention trials.[20]

In the absence of a 'gold standard' for diagnosing malnutrition, it is difficult to establish the validity of nutrition screening tools.[11] There have been very few studies confirming the validity of MUST with PG-SGA in acutely unwell patients, and only a few studies are available among elderly general medical patients with multiple clinical problems.[21] This study was carried out to verify the validity of the MUST with PG-SGA in detecting malnutrition in acutely unwell general medical patients admitted via an acute medical unit of a large Australian tertiary care hospital.

MATERIALS AND METHODS

A total of 132 hospitalized patients were recruited from November 2014 to August 2015. These patients are participants in a randomized control trial (RCT) (registration number ACTRN1261400083362) investigating the cost effectiveness of an extended ambulatory nutritional intervention in patients who are discharged from acute care. Patients admitted to General Medicine wards of Flinders Medical Centre were conveniently sampled and screened for eligibility for study participation, based on certain inclusion and exclusion criteria. Inclusion criteria were age ≥60 years admitted under General Medicine ward and exclusion criteria were palliative patients, Indigenous, non-English speaking patients or those residing outside metropolitan Adelaide and also patients who were unable to give valid consent. Ethics approval for the study was obtained from Southern Adelaide Human Research Ethics Committee on 21st July 2014 (No. 273.14-HREC/14/SAC/282).

Procedure

Potential participants who were admitted to the Acute Medical Unit and General Medicine wards of Flinders Medical Centre were identified and an information package about the study was provided and explained to the participants. Written informed consent was obtained from all participants or legal guardians (if participants had dementia/cognitive impairment).

Data collection and measures

Baseline data on demographics, health and medical history was obtained from medical records and case notes. The following demographic characteristics of patients were recorded: age, sex, pre-hospital residential status, and mobility at the time of admission. Clinical characteristics recorded were: principal presenting diagnosis, number of co-morbidities, Charlson co-morbidity index, number of medications and vitamin and calcium supplementation. The MUST score was obtained from the case notes, where available. In Flinders Medical Centre, it is expected that all patients who are admitted under General Medicine have the MUST completed electronically, as a part of initial nursing assessment, and a hard copy is inserted in the case notes. Where MUST was not found in the case notes, it was noted and a member of the research team either asked the assessment nurse to perform MUST or completed the MUST themselves. All consenting patients were then referred to a research dietitian who was blinded to the MUST nutritional risk score and performed PG-SGA, as well as anthropometric measurements, including hand grip strength with a hand held dynamometer in patients' dominant hand, Mid-upper-arm circumference (MUAC) measured at the midpoint between acromion process and olecranon using a steel measuring tape, TSF (Triceps skin fold thickness) using calibrated Harpenden skinfold caliper on the right side and MAMC (Mid-arm muscle circumference) was determined using the formula MAMC = MUAC -(0.3142 × TSF(mm) = in cm. The PG-SGA was scored consistent with the literature.[22]

The EuroQoL EQ-5D 5 level (EQ-5D 5L) questionnaire was also completed by all participants, to assess the impact of nutritional status on quality of life. The EQ-5D 5L is a modification of the EuroQoL EQ-5D 3 level (EQ-5D 3L), which was developed jointly by a group of European-based researchers with the intent of constructing a simple, self-administered instrument that provides a composite index score representing the preference for a given health state.[23] The descriptive system records self-reported problems on each of the following five dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression) on five different levels: no problem, some problem, moderate problem, extreme problem or unable to perform. The resultant EQ-5D-5L health description can then be converted into a valuation ranging from -0.208 to 1using the UK-specific algorithm.[24]

Data analysis

Data analysis was performed using STATA (version 13.1). Descriptive analysis was conducted for all the demographic variables. Sensitivity, specificity and positive and negative predictive values were calculated to determine whether the MUST is a valid nutritional screening tool among hospitalized elderly general medical patients. Sensitivity is defined as the percentage of malnourished patients correctly identified by the MUST and specificity is the percentage of well-nourished patients correctly identified by MUST. Predictive values are the likelihood that the MUST correctly predicts the presence or absence of malnutrition, compared to PG-SGA. A receiver operating characteristic curve[25] interpreted relative areas under the curves, and kappa statistics were used to determine the proportion of agreement between the MUST and PG-SGA. The value of kappa varies from 0 to 1, with a value of <0.20 = poor, 0.20 to 0.40 = fair, 0.41 to 0.60 = moderate, 0.60 to 0.80 = substantial, and >0.81 = perfect agreement.[26] Statistical significance was reported at the p value <0.05 (two tailed). For comparison, all patients with a MUST score of 0 were classified as nourished and those with a score of ≥1 were classified as malnourished. Similarly, patients who were PG-SGA class A were classified as well-nourished and PG-SGA class B and C as malnourished.

RESULTS

The mean age of participants was 79.5 years (range 60-97, SD 9), with the majority being female (n=83, 62.9%) and living at home (n=118, 90.1%) (Table 1). The mean number of co-morbidities was 6.2 (range 0-15, SD 2.94) and mean Charlson index was 2.3 (range 0-9, SD 1.9). More than half of the participants (n=64, 50.8%) needed some kind of support (a stick or walking frame) for mobilization and 2 (1.6%) were bed bound, while 60 (47.6%) participants were independent in mobility (Table 1). The mean number of medications was 8.7 (range 0-23, SD 4.4) and 51 (38.6%) of participants were on vitamin D and calcium supplementation. The majority of participants presented with a principal diagnosis of respiratory illness (n=47, 35.6%), with 19 (14.3%) presenting with accidental falls and another 46 (34.8%) had miscellaneous diagnoses, including sepsis (Table 1). Only 67 (51.2%) patients were found to have had an initial MUST screening performed at the time of admission. Table 2 describes that according to PG-SGA, 66 patients (51.6%) were malnourished and 62 (48.4%) were well nourished, while MUST found 65 (49.2%) patients as malnourished and 67 (50.8%) well nourished. The median length of hospital stay (LOS) of participants was 5.5 days, and malnourished patients stayed 4.5 days longer than nourished patients with p<0.001 (Table 2). EQ-5D 5L utility scores were significantly lower in malnourished patients compared with well-nourished patients, with median EQ5D index of 0.697 (IQR 0.501-0.838) in malnourished and 0.804 (IQR 0.656-0.899) in well-nourished patients (p=0.004) (Table 2).

Table 3 describes that MUST results, when compared with PG-SGA, showed that 46 patients (69.6%) were correctly classified as malnourished (true positive) and 47 patients (70.1%) were correctly classified as well nourished (true negative). In contrast, 15 (22.3%) were wrongly classified as malnourished (false positive) and 20 patients (33.3%) were wrongly classified as well nourished, despite being identified as malnourished by PG-SGA. When compared with PG-SGA, MUST had a sensitivity of 69.7% and specificity of 75.8% with a positive predictive value of 75.4% and a negative predictive value of 70.1% and an ROC area of 0.73, indicating good agreement (Figure 1). Kappa statistics showed 72.7% agreement with k=0.45, p<0.001 indicating good agreement between the MUST and PG-SGA.

Eighty-one patients lost less than 5% weight in the preceding three to six months and 49 had more than 5% weight loss. Significantly more patients 38 (58.5%), who were classified as malnourished by PG-SGA, lost more than 5% weight compared with 27 (41.5%), who lost less than 5% weight (p<.001). Kappa statistics showed 70.8% agreement with k=0.42, p<0.001, indicating good agreement between percent weight loss and nutritional status and ROC area of 0.71 (Figure 1).

DISCUSSION

The current study demonstrated the validity of MUST compared with a reference nutrition assessment using PG-SGA in elderly acutely unwell patients in medical units of a large tertiary hospital. The MUST tool was shown to be reasonably effective in identifying patients at risk of malnutrition, when compared with PG-SGA with a sensitivity of 69.7%, a specificity of 75.8%, a positive predictive value of 75.4% and a negative predictive value of 70.1%. Additionally, kappa statistics demonstrated good agreement: kappa=0.45, p<0.001.

There are few studies comparing MUST with PG-SGA in acutely unwell hospitalized patients with multiple co-morbid illnesses. Boleo-Tome et al,[21] in their study on cancer patients undergoing radiotherapy, compared MUST with PG-SGA and found significant agreement with a k=0.86 and higher sensitivity (80%) and specificity (89%), indicating high performance and strong capacity to effectively detect patients at nutrition risk, however they included only cancer patients with a wide age range, 18-95 years. Stratton et al in their study in hospitalized general medical patients found excellent agreement (k

Table 1. Participant demographic, health and physical characteristics (n=132)

	Mean (range) (SD)
Demographic characteristics	
Age, years	79.5 (60 to 97) (8.6)
Sex (women), n (%)	83 (62.9)
Residential status, n (%)	
Home	118 (90.1)
Nursing home	12 (9.2)
Others	1 (0.8)
Mobility, n (%)	
Independent	60 (47.6)
Stick	11 (8.7)
Walking frame	53 (42.1)
Bed bound	2 (1.6)
Health characteristics	
Admission diagnosis, n (%)	
Respiratory disease	47 (35.6)
Cardiac problem	11 (8.3)
Falls	19 (14.4)
CNS disease	9 (6.8)
Other	46 (34.9)
No of co-morbidities	6.2 (0-15) (2.9)
Charlson index	2.4 (0-9) (1.9)
No of Medications	8.7 (0-23) (4.4)
Patients on vitamin D/calcium, n (%)	51 (38.6)
MUST tool completion at admission, n (%)	67 (51.2)
Physical assessments according to gender	
Weight, kg	
Men	73.3 (42.1-130) (19.4)
Women	60.6 (35-117.5) (15.9)
BMI, kg/m^2	
Men	24.2 (14.6-42.3) (6.1)
Women	23.9 (14.3-44.5) (5.7)
Handgrip strength, kg	
Men	25.3 (11.5-44.5) (8.1)
Women	14.6 (2-27.5) (5.4)
Triceps skinfold thickness, mm	
Men	12.4 (3.7-33.2) (6.6)
Women	17.9 (3.4-46.7) (10.2)
Mid arm circumference, cm	
Men	28.1 (20.4-40.4) (5.5)
Women	26.4 (17.9-37.8) (4.6)
Mid arm muscle circumference, cm	
Men	24.2 (18.1-35.6) (4.1)
Women	21.0 (14.9-28.7) (3.0)
EQ-5D index	
Men	0.704 (0.185-1) (0.211)
Women	0.700 (0.030-1) (0.220)

SD: standard deviation; CNS: central nervous system; MUST: Malnutrition Universal Screening Tool; BMI: body mass index; EQ-5D: European Quality of Life Questionnaire.

Table 2. Characteristics of nourished and malnourished patients

	Nourished	Malnourished	*p* value
PG-SGA, n (%)	62 (48.4)	66 (51.6)	
MUST, n (%)	65 (49.2)	67 (50.8)	
Length of Hospital stay (in days), median (IQR)	3.5 (2.5-11)	8 (4-14)	<0.001
EQ-5D index, median (IQR)	0.697 (0.501-0.838)	0.804 (0.656-0.899	0.004

PG-SGA: Patient Generated Subjective Global Assessment; MUST: Malnutrition Universal Screening Tool; IQR: inter quartile range; EQ-5D: European Quality of Life.

0.783) between the MUST and SGA (two category) in newly admitted patients, although the investigator did not categorize any patients into the malnourished group when using SGA,[11] however we cannot apply these validity results to PG-SGA as this study used SGA for comparison.

Undernutrition is often overlooked in hospitalized patients, despite adoption of strict guidelines to screen all patients for malnutrition. In our study, MUST was expected to be completed on all patients, but the actual completion rate was only 51.2%, highlighting that malnutrition screening is still suboptimal. Missed diagnosis of

Table 3. Nutrition risk (MUST) compared with Nutrition status (PG-SGA)

PG-SGA	MUST		
	Positive (at risk)	Negative (not at risk)	Total
Malnourished	46 (true positive)	20 (false negative)	66
Well Nourished	15 (false positive)	47 (true negative)	62
Total	61	67	128

MUST: Malnutrition Universal Screening Tool; PG-SGA: Patient Generated Subjective Global Assessment.

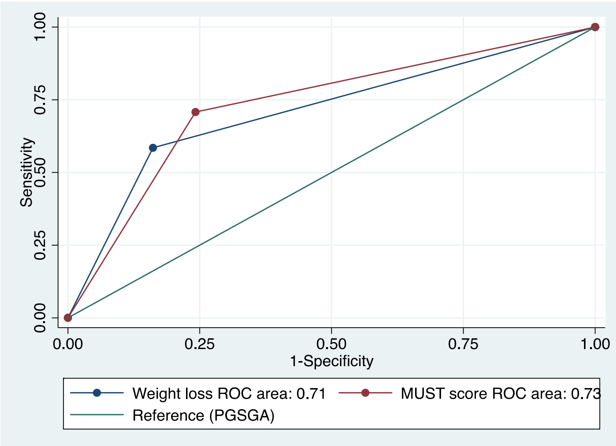

Figure 1. Receiver Operating Characteristic Curve Agreement between MUST and PG-SGA. ROC: Receiver Operating Characteristic; MUST: Malnutrition Universal Screening Tool; PG-SGA: Patient-Generated Subjective Global Assessment.

malnutrition is not only detrimental for patient care, but is also costly for hospitals as malnutrition is considered as a comorbidity or complication under the Australian refined diagnosis-related group (AR-DRG) classification system for case mix-based funding.[27] Gout et al in their study on Australian hospitalized patients, found poor recognition and documentation of malnutrition with only15% of malnourished patients correctly diagnosed with a consequent substantial shortfall of AUD $1,850,540 in reimbursements in one financial year.[28]

Our study confirms that malnourished patients have significantly increased LOS and MUST screening, may be useful to predict hospital length of stay, as malnourished patients stayed 4.5 days longer than well-nourished patients. Kyle et al, in their study in hospitalized patients, also found significant association between increased LOS and a high risk MUST score.[29] Similarly, Correia and Waitzberg, in their study on hospitalized patients found significantly longer LOS in malnourished patients (mean 16.7 days vs 10.1 days) with significant increase in hospital costs for care of malnourished patients.[30]

The MUST does not need time-consuming calculations, incorporates objective and subjective clinical parameters reflecting changes in nutritional status and unlike PG-SGA, can be used by any trained professional without nutritional expertise.[11,12] Our study found statistically significant inverse correlations between the MUST score and anthropometric measures like BMI, triceps skinfold thickness and mid-arm muscle circumference, indicating that MUST score predicts fat and lean body mass. Both lean body mass and fat mass are measures of nutritional status, with lean body mass a reliable indicator of muscle mass, whereas fat mass reflects energy storage.[31] Noori et al, in their study on maintenance haemodialysis patients, found that higher fat mass in both males and females and higher lean body mass in females were associated with greater survival.[31] Anthropometric measurement may offer an alternative method of assessing nutritional status in those elderly patients, where height and weight are difficult to assess and have been shown to be significant predictors of mortality in older people.[32,33]

We also found that a history of significant weight loss (≥5% weight loss) in the preceding three to six months had good correlation with nutritional status, with a ROC area of 0.71 against PG-SGA, which almost matches the MUST tool. Boleo-tome et al, in their study on cancer patients, also found that percent weight loss is a valid and reliable nutrition parameter when compared to PG-SGA, with a high sensitivity, specificity, and positive and negative predictive values to detect undernourished patients.[21] The use of weight loss has, however, been questioned in the past given the influence of many non-nutritional factors and because many patients may not remember their weight in the recent past.[34] Further research is needed to confirm this finding, as a history of significant weight loss may be a useful marker of malnutrition and may solely be used to classify patients as malnourished, especially in busy acute care settings, where there is reluctance to perform screening tool tests.

Our study found overall low QoL in hospitalized elderly patients with a mean EQ-5D 5L score of 0.70, compared to 0.80 (mean EQ-5D 3L) in the general population.[35] Furthermore, malnourished patients had statistically significantly worse QoL compared to well-nourished patients (median EQ-5D 5L scores: 0.697 versus 0.804). Our results are similar to Rasheed and Woods, who in their study on elderly hospitalized patients, also found in general low QoL in hospitalized patients, with malnourished patients experiencing a significantly lower QoL compared to well-nourished patients in both physical and mental dimensions of EQ-5D 3L.[36] Food and eating are essential for health and an inability to eat as a result of loss of appetite, digestive problems or swallowing difficulties affect QoL and these problems may be a significant contributor to a low QoL in unwell hospitalized elderly patients.[37]

A major strength of our study was that the research dietitian who conducted PG-SGA was blinded to the nutritional status of the participants based on their MUST score and this may have removed bias to score patients based on a subjective component of PG-SGA. In addition, our study was one of the first comparing MUST and PG-SGA among elderly hospitalized patients with multiple co-morbid illnesses, as there have not been many studies among this nutritionally vulnerable group. A major limitation of our study is that we were not able to recruit a significant number of patients who were cognitively impaired or had dementia, mainly due to difficulty in obtaining consent and also as our study included elderly general medical patients with multiple clinical problems, our findings cannot be generalized to younger patients or those admitted to sub-specialties with single organ involvement. Further studies are needed to verify our findings in this group of patients. We also acknowledge that this is a single centre study limited to acutely unwell elderly patients, which represent only a subset of hospitalized patients, and our results are not applicable to relatively stable medical or surgical patients.

Conclusion

Our study indicates that MUST is a reasonably good screening tool as compared with PG-SGA among elderly acutely unwell general medical patients, and malnutrition screening is still suboptimal in hospitalized patients, leading to a significant number of patients being discharged with a missed diagnosis of malnutrition. Our research suggests that despite establishment of hospital policies, MUST screening is still sub-optimal and this deficiency needs to be addressed as this could pay dividends in terms of improved quality of care. We suggest further studies to confirm our findings and further efforts should be made to screen all patients for malnutrition.

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AUTHOR DISCLOSURES

All authors have no conflict of interest to declare.

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