Malnutrition screening tools

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TITLE: Malnutrition screening tools: comparison against two validated nutrition assessment methods in older medical inpatients

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Abstract

Objective: While several validated nutrition screening tools have been developed to “triage” inpatients for malnutrition diagnosis and intervention, there continues to be debate in the literature as to which tool/s clinicians should use in practice. This study compares the accuracy of seven validated screening tools in older medical inpatients against two validated nutrition assessment methods.

Research methods and procedures: Prospective cohort study of medical inpatients aged ≥65 years. Malnutrition screening was conducted using seven tools recommended in evidence-based guidelines. Nutritional status was assessed by Accredited Practicing Dietitian using Subjective Global Assessment (SGA) and Mini-Nutritional Assessment (MNA). Energy intake was observed on a single day during first week of hospitalisation.

Results: In this sample of 134 participants (80±8 years, 50% female), there was fair agreement between SGA and MNA (κ=0.53), with MNA identifying more “at risk” patients and SGA better identifying existing malnutrition. Most tools were accurate in identifying patients with malnutrition determined by SGA, particularly Malnutrition Screening Tool and Nutritional Risk Screening 2002. MNA Short Form was most accurate at identifying nutrition risk according to MNA. No tool accurately predicted patients with inadequate energy intake in hospital.

Conclusion: As all tools generally performed well, clinicians should consider choosing a screening tool which best aligns with their chosen nutrition assessment and is easiest to implement in practice. This study confirms the importance of re-screening and monitoring food intake to allow early identification and prevention of nutritional decline in patients with poor intake during hospitalisation.

Keywords: undernutrition, diagnosis, triage, hospitalization; aged

INTRODUCTION

Despite the high prevalence and negative health consequences, protein-energy malnutrition in elderly hospital patients continues to be under-recognised and under-treated [1-2]. Malnutrition screening is recommended as the first step in nutrition care to allow early identification and treatment malnutrition [2-4]. A screening tool needs to be quick, simple and accurately identify patients with possible malnutrition to allow efficient targeting of resources for nutrition assessment [5,**6**]. Ideally, such a tool would identify all malnourished patients for assessment (high sensitivity), with a positive screen identifying no well nourished patients (high positive predictive value) [7].

A range of validated screening tools have been recommended for use in elderly and/or hospital populations (Table 1). Malnutrition Screening Tool (MST [8]) is the most common screening tool used in Australian hospitals [9], while Nutrition Risk Screening (NRS 2002 [10]) tool has been successfully implemented throughout Europe [11]. Mini-Nutritional Assessment Short Form (MNA-SF [12]) is recommended for screening elderly people across settings [4]. Simplified Nutritional Appetite Questionnaire (SNAQ [13]) and Rapid Screen [14] were developed in community-dwelling populations, but have not yet been validated in the hospital setting. There are distinct similarities between tools with most including recent change in weight and food intake, with some accounting for body mass index (BMI) and acute disease (Table 1).

A major limitation in validating malnutrition screening tools is the absence of a single objective measure or "gold standard" for diagnosing malnutrition [27]. Subjective Global Assessment (SGA [25]) and Mini-Nutritional Assessment (MNA [26]) are both widely-used validated nutrition assessments which use a range of parameters to make a nutritional diagnosis and initiate treatment, have been recommended as outcomes in clinical trials [28] and predict health outcomes in elderly hospital patients [29-30]. There is a key difference between nutrition assessment and nutrition screening [31]: SGA and MNA are comprehensive nutrition *assessments* used by trained professionals (e.g. dietitians, physicians, trained nurses or research assistants) to diagnose malnutrition and initiate nutrition intervention. In contrast, nutrition *screening* tools (such as those in Table 1) are intended as a quick and easy method for identifying possible malnutrition and to "triage" patients for comprehensive nutrition assessment and intervention. While SGA and MNA are both recommended for use in diagnosing malnutrition in the elderly [2], there are substantial differences between the parameters of these assessments, meaning that different "at risk" groups may be identified [21,32]. While previous research has compared existing nutrition screening tools, no study has concurrently investigated the validity of these tools against both SGA and MNA.

Studies have shown that nutritional status declines during hospitalisation [33] and that nutritional intake is suboptimal [1,34-35]. In elderly hospital patients, it has become clear that malnutrition on admission does not necessarily predict poor nutritional intake during hospitalisation [1]. In fact, many well-nourished inpatients eat poorly, presenting a second group of patients who should be identified early in their hospital admission to prevent malnutrition. This highlights the importance of screening and re-screening elderly patients to not only pick up existing malnutrition, but also those at risk of poor intake during hospitalisation. While malnutrition screening tools are now commonly used to identify existing malnutrition [9,11], there are no screening tools to proactively identify patients at risk of poor nutritional intake during hospitalisation.

This study aims to a) compare the assessment of malnutrition using SGA and MNA in elderly medical inpatients, b) compare the accuracy of seven nutrition screening tools in identifying patients with malnutrition as assessed by SGA and MNA and c) compare the predictive accuracy of screening tools to identify patients with poor energy intake during the first week of hospitalisation.

MATERIALS AND METHODS

This was a prospective cohort study conducted in medical wards of the Royal Brisbane and Women's Hospital, a large metropolitan public teaching hospital in Brisbane, Australia, and was part of a larger observational study of nutritional intake in older medical patients [1]. The study was approved by the hospital human research ethics committee.

Consecutive patients aged 65 years or older with a hospital stay of more than two days were recruited between November 2007 and March 2008. Between day 3 and day 7 of admission, a single trained dietitian (AY) screened each patient with MST, MNA-SF, Malnutrition Universal Screening Tool (MUST), NRS 2002, Short Nutritional Assessment Questionnaire (SNAQ©), Simplified Nutritional Appetite Questionnaire (SNAQ) and Rapid Screen (presented in Table 1). We draw the reader's attention to the differences between the two "SNAQ" tools in Table 1. These screening tools were selected as they are recommended for use in evidence-based practice guidelines [2,3]. Each tool was performed separately and as per authors' instructions. The same dietitian assessed each participant using SGA [25] and MNA [26]. Nutrition screening and assessment data was available for all participants, with the exception of SNAQ (missing data for 2 participants).

Dietary intake was measured at breakfast, lunch and dinner on the same day of nutrition screening and assessment. Plate waste of each meal component (e.g. soup, meat, vegetables) was visually estimated, which correlates closely to weighed methods [36]. Mid-meal intake, including snacks and/or nutrition supplements (ordered for 20% of participants as per existing nutrition support protocol) was estimated by observation and/or patient recall. It has previously been shown that food intake on a single day during hospitalisation closely correlates with intake over two or three days [1,37]. Energy intake was determined using known food composition data of each meal component and analysis of standardised recipes in FoodWorks Professional software (version 3.02, Xyris, Brisbane Australia 2004). Resting energy expenditure (REE) was calculated as 18.4 kcal/kg bodyweight/day for patients with BMI >21kg/m^2 and 21.4 kcal/kg/day for those with BMI≤21 kg/m^2 [38].

Nutrition assessments were categorised as “well nourished” (SGA A; MNA score ≥24) or “malnourished or at risk of malnutrition” (SGA B or C; MNA score <24). Scores for each screening tool were also categorised into “no/ low risk” or “at risk” of malnutrition, using recommended cut-points (Table 1). Inadequate energy intake was defined as measured energy intake less than REE.

Participant characteristics were summarised using mean and standard deviation (SD) for continuous variables, or categorised according to validated cut-offs and clinical meaning. To compare the performance of the two nutrition assessments (SGA and MNA), kappa statistics were calculated and interpreted using criteria by Shrout [39]. To compare the accuracy of each screening tool to detect malnutrition as diagnosed using each nutrition assessment, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated. Sensitivity is defined as the proportion of malnourished correctly identified as such, whereas specificity is the proportion of well-nourished who are correctly identified as well-nourished. PPV is the proportion of patients with a positive screen who are malnourished. Conversely, NPV is the proportion of patients with a negative screen who are well-nourished. These were calculated for the three outcomes of interest: (1) malnutrition assessed using SGA; (2) malnutrition assessed using MNA; and (3) inadequate energy intake. In further analysis, raw scores for each tool (except Rapid Screen which produces dichotomous data) were used to construct receiver operating characteristic (ROC) curves where the sensitivity was plotted against the false positive rate (1 – specificity) for each outcome of interest.

Area under the curve (AUC) values for each ROC curve were interpreted as follows: acceptable (0.70–0.80), excellent (0.80–0.90), outstanding (>0.90) [40]. ROC analysis was also used to explore instrument cut-points.

RESULTS

Participants and nutrition assessments

Over the 16 week study period, 134 patients (mean age 80 years (SD 8), 50% female, mean weight 70 kg (SD 17), mean BMI 26 kg/m^2 (SD 6).and median length of stay 8 days (IQR 8)) consented to participate in the study (38% consent rate). One participant was excluded due to incomplete data. Participant characteristics are shown in Table 2. Non-participants had similar demographic characteristics and length of stay, but were more likely to be discharged to residential aged care (24% vs 13%).

There was fair agreement between SGA and MNA (κ=0.53, 95% CI 0.40-0.66; Table 3). More participants were assessed as "at risk" or "malnourished" using MNA (68%) than with SGA (47% malnutrition).

Malnutrition as determined by Subjective Global Assessment

The performance of each screening tool to identify malnutrition determined by SGA (rating of B or C) is summarised in Table 4. MST, NRS 2002, MUST and SNAQ© all had high sensitivity and PPV, with MST and NRS-2002 achieving slightly better NPV. While MNA-SF and SNAQ were highly sensitive, they had a lower specificity and PPV, meaning more well-nourished patients would be identified for assessment. Conversely, Rapid Screen was highly specific but had a very low sensitivity (29%), indicating that many malnourished patients may be missed using this tool.

All tools (excluding Rapid Screen) showed excellent to outstanding discrimination between those who were and those who were not malnourished using AUC analysis. The cut-off point for MNA-SF with the highest accuracy in this sample was ≤8 (compared with the published cut-off of ≤11), with sensitivity and specificity of 89%.

Malnutrition risk as determined by Mini-Nutritional Assessment

When malnutrition was determined using MNA (score of <24), MNA-SF was most sensitive, with a good PPV (Table 5). All other tools tested were highly specific but were less sensitive. In particular, Rapid Screen had very low sensitivity in this sample (20%).

Using AUC analysis, MNA-SF was outstanding at discriminating between those who were and those who were not at risk of malnutrition with MNA. All other tools showed excellent discrimination, with ROC curves demonstrating that using lower cut-points for MST, NRS-2002 and SNAQ© and higher cut-point for SNAQ may increase the sensitivity of these tools to identify malnutrition risk determined by MNA.

Inadequate energy intake

The majority of participants (59%) had inadequate energy intake to meet estimated REE. All screening tools had low sensitivity and specificity for predicting patients with inadequate energy intake on a single day during their first week of hospitalisation (see Table 6). AUC analysis shows that no screening tool adequately discriminated between those who had adequate versus inadequate energy intake. SNAQ obtained the highest level of discrimination (0.66), but did not reach an acceptable level.

DISCUSSION

This study compares the accuracy of validated malnutrition screening tools against two commonly used nutrition assessments (SGA and MNA) in a sample of elderly medical inpatients. Only fair agreement was found between SGA and MNA (κ=0.53), indicating that these nutrition assessments identify different "at risk" groups. Velasco [19] reported similar agreement between SGA and MNA (κ=0.49) in their study of 400 hospital patients, as did Persson [32] and Martins [21] who proposed that, due to its "holistic" approach, the MNA, identifies those "at risk" , as well as those with existing malnutrition. In contrast, SGA identifies existing malnutrition only. Choice of nutritional assessment tool should be guided by the goal of therapy; that is, whether the goal is prevention or treatment-focused [21,32,41]. This suggests that MNA may be better suited where a service aims to prevent malnutrition or where there is a well-resourced dietetic workforce, while SGA may be more useful in the acute setting for identifying existing malnutrition to be prioritised for treatment during the short time-frame of hospitalisation.

The primary objective of this study was to compare the performance of seven screening tools to identify patients with malnutrition. When nutritional status was assessed using SGA, most tools performed with high sensitivity and specificity with MST and NRS 2002 having the highest accuracy. In the current study, the increased complexity of NRS 2002 (which includes medical condition and BMI) did not improve accuracy compared to the simpler MST. Similar accuracy between simple screening tools (MST and SNAQ©) and more comprehensive tools (MUST and NRS-2002) has been reported previously [42]. As it is important that nutritional screening is quick, easy and can be completed by anyone (e.g. nursing, medical staff, allied health assistants or patients themselves) [3], MST is recommended as a highly accurate and user-friendly malnutrition screening tool [6,42]. Other review papers have found NRS-2002 and MUST to also have high accuracy [19-20]. As outlined in Table 1, the screening tools compared in this study include similar parameters, so it is not unexpected that they have similar performance.

As reported previously, MNA-SF had high sensitivity and specificity when used with MNA [16-17]; however poor specificity and PPV was observed when compared with SGA. MNA-SF was designed to identify patients requiring further assessment with MNA, and the poor performance against SGA is likely to be due to the different focus of MNA and SGA as discussed above. A recent study of 275 hospital patients also reported low specificity of MNA-SF in identifying existing malnutrition [42]. To improve specificity of MNA-SF, clinicians could consider reducing the cut-off of the MNA-SF score, as suggested by the original authors [12]. While the revised MNA-SF (where BMI is substituted for calf circumference) was not tested in this study, this tool could be expected to perform similarly to the original MNA-SF as shown previously [17]. Rapid Screen had very poor sensitivity against both SGA and MNA, suggesting it may only identify the most severely malnourished. Further validation studies are recommended before this tool is used with elderly hospital patients.

In summary, with the exception of Rapid Screen, all tools (including simple tools such as MST) were accurate in identifying malnutrition using SGA and can therefore be recommended for use in elderly hospital patients. While the MNA-SF was accurate, it identifies a larger number of "at risk" patients**, also reported Raslan et al. [43],** and, therefore, should be chosen only where health services have sufficient resources to provide nutritional assessment and intervention to all "at risk" patients. When choosing which screening tools to use in practice, clinicians should consider which tool is simple to implement, as well as resources available to provide nutritional care to all "at risk" patients.

In this study, the majority of participants had inadequate energy intakes. However, no screening tool accurately discriminated between those with adequate and inadequate intake. While all screening tools, with the exception of Rapid Screen, include a brief assessment of recent dietary intake, this study has found that they do not adequately identify those with poor intake during hospitalisation. This finding may reflect the other important predictors of poor nutritional intake, such as delirium and feeding dependency [2], which are not all adequately covered in these screening tools. Barriers to nutritional intake may also be related to the hospital environment and culture, for example quality of hospital food, interruptions during mealtimes and lack of mealtime assistance [44]. This study demonstrates an absence of existing screening tools to proactively identify patients at risk of poor nutritional intake, and supports the concept of two discrete nutritionally "at risk" groups for which different nutrition care processes are required: malnutrition screening to identify existing malnutrition and close monitoring of food intake to identify inadequate nutritional intake.

This is the first study to compare a range of screening tools against two recommended nutrition assessments in elderly hospital patients. It is also the first study to consider the accuracy of these tools to identify poor nutritional intake in hospital, which is common in this patient group. We do recognise some study weaknesses. While the assessment tools (SGA and MNA) are widely used by health professionals and the research community to diagnose malnutrition, there is no single objective measure of malnutrition to validate screening tools against. An important part of assessing the performance of a screening tool is to consider the reliability of the tool. As one dietitian performed all screening and assessments in this study, the reliability of measurements is enhanced. However, we are unable to comment more generally on the reliability of the tools or the performance of the tools when used by non-dietetic staff. However, the high inter-rater reliability of the tools has been reported previously [8,22,24]. Dietary intake was measured only on a single day, but we have shown close correlation between intake on day 3 and 7 of hospitalisation [1]. A further limitation of assessment of dietary intake was the estimation of energy requirements of individual participants, rather than measurement using indirect calorimetry. The low consent rate may have resulted in underrepresentation of the frailest group of patients, as fewer participants were discharged to residential aged care compared with the general elderly medical population. However, this is not likely to have affected the comparison of the screening tools.

CONCLUSION

With the exception of Rapid Screen, all screening tools were accurate in identifying malnutrition (as assessed by common clinical assessment tools) and therefore can be recommended for use in elderly hospital patients. No tool predicted poor nutritional intake during hospitalisation, highlighting importance of re-screening and monitoring intake to allow early identification and prevention of nutritional decline.

CONFLICT OF INTEREST STATEMENT

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