Review

Nutritional screening in community-dwelling older adults: a systematic literature review

Megan B Phillips BNutrDiet(Hons), Amanda L Foley PhD, Robert Barnard MEd, Elisabeth A Isenring PhD, Michelle D Miller PhD

Flinders University, Adelaide, South Australia

Nutrition screening is a process used to quickly identify those who may be at risk of malnutrition so that a full nutrition assessment and appropriate nutrition intervention can be provided. While many nutrition screening tools have been developed, few have been evaluated for use in older adults in the community setting. The aim of this paper is to determine the most appropriate nutrition screening tool/s, in terms of validity and reliability, for identifying malnutrition risk in older adults living in the community. Electronic databases MEDLINE, PUBMED, CINAHL and the Cochrane Library were searched for nutrition screening tools to identify malnutrition or under-nutrition for adults greater than 65 years living in the community. Ten screening tools were found for use in community-dwelling older adults and subjected to validity and/or reliability testing: Mini Nutritional Assessment-Short Form (MNA-SF), Malnutrition Universal Screening Tool (MUST), Nutrition Screening Initiative (NSI), which includes the DETERMINE Checklist and Level I and II Screen, Australian Nutritional Screening Initiative (ANSI), Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN I and SCREEN II), Short Nutritional Assessment Questionnaire (SNAQ©), Simplified Nutritional Appetite Questionnaire (SNAQ), and two unnamed tools. MNA-SF appears to be the most appropriate nutrition screening tool for use in community-dwelling older adults although MUST and SCREEN II also have evidence to support their use. Further research into the acceptability of screening tools focusing on the outcomes of nutrition screening and appropriate nutrition intervention are required.

Key Words: malnutrition, under-nutrition, screening tools, validity, reliability

INTRODUCTION

Nutritional well-being is a fundamental component of the health, independence and quality of life in older individuals.[1,2] Malnutrition, which in this review refers solely to protein-energy under-nutrition, can lead to undesirable health risks, including loss of independence,[3,4] longer length of hospital stay, poorer function and quality of life, readmission to hospital and discharge to higher level care,[5] increased risk of fragility fractures and mortality,[6] as well as delayed wound healing and slower recovery from surgery.[7,8] Even when older adults are living independently, changes in appetite, limited mobility, social isolation and economic constraints, often combined with the presence of chronic diseases and use of many medications, can all adversely affect nutritional status.[9,10] Hence the need to identify those at risk of malnutrition is critical in providing optimal care and promoting good nutritional status in community-dwelling older adults.[11]

Malnutrition is a major international and Australian health problem (prevalence of 25-50% in the acute setting) which continues to be unrecognised and untreated.[12] However, there are limited data on the prevalence of malnutrition and malnutrition risk in Australian community-dwelling older adults.[13] The prevalence of malnutrition from overseas studies has been reported as 2-10%, using the Mini Nutritional Assessment (MNA).[14] A recent Australian study by Visvanathan et al[15] in 250 older adults receiving domiciliary care services found a malnutrition prevalence of 4.8%, with approximately 40% at nutritional risk according to the MNA. Malnutrition prevalence in the community has been reported to vary from 10-30%.[12] This highlights the significance of malnutrition, although more extensive research in Australia, particularly in the community-dwelling population, needs to be carried out to further appreciate the extent of the problem.

As a process of identifying characteristics known to be associated with nutritional problems, nutritional screening tools have been developed to recognise individuals who are malnourished or at nutritional risk.[2] For a nutritional screening tool to be effective the tool must be easy to interpret, quick and easy to administer, be acceptable to the client, and cost-effective.[16] A nutrition screening tool should be reliable and therefore consistent in its measurement of nutritional risk.[17] Any screening tool should

Corresponding Author: Dr Michelle Miller, Flinders University Nutrition and Dietetics, Room 7E 107.1, Level 7 Flinders Medical Centre, Flinders Drive, Bedford Park, South Australia 5042.

Tel: 61 8 82045328; Fax: 61 8 82046406

Email: michelle.miller@flinders.edu.au

Manuscript received 11 February 2010. Initial review completed 22 March 2010. Revision accepted 20 April 2010.

also be tested for validity, or the extent to which a tool measures what it is intended to measure. Criterion validity refers to the nutritional screening tool performing well when compared with some other measure of nutritional status.[18] The nutritional screening tool should be valid with respect to age, gender and ethnicity, as well as particular settings, due to differences in nutritional concerns and status.[19]

To determine the validity, it is important to consider the sensitivity and specificity of nutritional screening tools to identify the accuracy of the classification of the results of the screening.[17] Sensitivity can be defined as the ability of the tool to identify those who are malnourished or at risk of malnutrition and therefore is a true positive, and specificity as its ability to detect patients who are not malnourished or at risk of malnutrition and therefore is a true negative finding.[16]

A wide range of nutritional screening tools have been developed in various settings, however the validity and effectiveness of these tools, and the methods by which they were developed are not always reported or evaluated. Green, Watson[20] conducted a literature review on nutritional screening and assessment tools from the period of 1985 to 2002 and found 21 tools for use in older adults, although many were not tested for validity and/or reliability. However additional screening tools have been developed and used since this review was conducted. Likewise, Watterson *et al.*[12] conducted a review of screening tools and identified five valid screening tools for use in the community setting. However this review only included screening tools based on recommendations from Jones[18] and any tool with level III-2 evidence or higher published after the year 2000 to support its use. Hence this may not be an extensive summary of all valid and reliable tools for use in the community setting. Therefore the aim of this review is to identify appropriate nutrition screening tool/s in terms of validity and reliability for use in older community-dwelling adults.

MATERIALS AND METHODS

The criteria for selecting articles were:

- Screening tools for identifying malnutrition risk is described.
- The development and validation of the nutritional screening tool is described.
- Nutritional screening tools that use more than one item for assessing nutritional risk. Single indicators alone (e.g., BMI) have demonstrated validity in some contexts however guidelines recommend use of tools with two or more indicators as generally they have evidence of better sensitivity and specificity.
- Nutritional screening tools that screen for protein-energy malnutrition (e.g., energy or protein deficiency, or under-nutrition).
- The following criteria were applied at the final stage of the process when all relevant articles had been obtained using the search strategy:
- The tool was developed for, or used in, the community-dwelling population.
- The search was limited to older adults (>65 years), which yielded some articles that included participants <65 years but with a mean age of >65 years.

Exclusion criteria were as follows:

- Non-English language
- Children/Paediatrics
- Specific clinical conditions (e.g., cancer, multiple sclerosis, Alzheimer's)
- Clinical settings (e.g., surgery, hospitalised patients) or populations (e.g., cancer, Alzheimer's), except when the original development of the tool was developed in this setting then adapted to the community-dwelling.
- Small sample size (<100)

Search for relevant studies

The studies in this review were obtained through electronic databases and by manual searching of relevant articles listed in the reference list of key publications. The electronic databases MEDLINE, PUBMED, CINAHL and the Cochrane Library were searched using the following keywords: protein-energy malnutrition, undernutrition, risk adj2 malnutrition, screen* tool*, malnutrition screening tool, *mass screening or *multiphasic screening, Mini Nutritional Assessment-Short Form, Malnutrition Universal Screening Tool, SCREEN II, Short Nutrition* Assessment Screening Tool, reliability, validity, specificity, and sensitivity. The Evidence Based Practice Guidelines for Nutritional Management of Malnutrition in Adult Patients across the Continuum of Care[12] highlighted nutritional screening tools that were valid in the community-dwelling; hence these tools were also included as individual search terms. The databases were searched for the period up until July 2009. Title and abstracts were examined and, if the abstracts met the inclusion criteria, the full text of the article was retrieved.

Critical appraisal, data extraction and analysis

The relevance of each article retrieved was assessed initially via abstracts, and then the full article was obtained. At this stage, the final inclusion criteria were applied resulting in publications involving the development and validation of nutritional screening tools for older adults in community-dwelling, or an alternative setting if the tool was subsequently adapted to the community setting. The strength of evidence was assessed using the level of evidence rating system recommended by the National Health and Medical Research Council (NHMRC),[21] using the diagnosis criteria. The following data for each article was extracted and summarised in summary tables which are available on request to the corresponding author: NHMRC Level of evidence, population/setting, sample size, methodology, test and reference methods/instruments, results and key findings. Further analysis and comparisons of the findings are reported below. These summary tables are presented in categories according to the different screening tools.

RESULTS

The original database search yielded 281 records. With the final inclusion criteria of community-dwelling population and older adults (age >65 years) applied, 27 records were identified, of which 18 met the full inclusion criteria, were of sufficient methodological quality, and could be analysed. A further 12 were identified through manual

searches of reference lists of key publications, resulting in a total of 30 articles to analyse.

Ten screening tools were found for use in the community-dwelling older population and subjected to validity and/or reliability testing: Mini Nutritional Assessment-Short Form (MNA-SF), Malnutrition Universal Screening Tool (MUST), Nutrition Screening Initiative (NSI), which includes the DETERMINE Checklist and Level I and II Screen, Australian Nutritional Screening Initiative (ANSI), Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN I and SCREEN II), Short Nutritional Assessment Questionnaire (SNAQ©), Simplified Nutritional Appetite Questionnaire (SNAQ), and two unnamed tools. The following sections provide a critical analysis of each tool and publication.

Risk factors used

Table 1 summarises each of the screening tools. Both the number and type of risk factors used in the screening tools varied. Anthropometric measurements were a primary feature of many of the tools. In many cases, these measures were directly measured using standardised techniques to reduce measurement error, however self-reported data, particularly for changes in weight, introduce error and therefore may not be accurate.[22] The use of BMI as a predictor of risk of morbidity and mortality in the very old has been recently questioned.[23-25] Limitations of BMI include error in measurement of height and weight, and the effects of posture such as kyphosis, which are important to consider in the older population.[25] However Miller *et al*.[6] has since provided evidence for the use of BMI as a simple and rapid indicator of nutritional status, highlighting its predictive ability in the area of fragility fracture and all-cause mortality. Many of the other risk factors, specifically dietary intake, factors affecting food intake, access to food and social factors, all involve subjective measures which rely on self-reporting from participants, which may limit the accuracy of results.[26] Also, these parameters, in particular food intake, are often variable and may not reflect true patterns or habits.[26] Hence although there is clear evidence to suggest these nutritional risk factors are associated with undernutrition, it is important to consider the limitations of these measures.

Evidence of reliability, validity (sensitivity, specificity) and acceptability

There was a variety of approaches used to test reliability, validity, and acceptability of the screening tools. Some tools had a limited number of these parameters tested, whilst others were extensively tested.

Reliability

In some cases, reliability testing did not extend beyond measuring internal consistency, which is a measure of correlation between indicators for a concept.[27] Keller *et al.*[28] and Keller *et al.*[29] assessed test-retest reliability on SCREEN I (r=0.68), and SCREEN II (ICC=0.83) respectively. Internal consistency through measuring alpha coefficients was also determined for the MNA-SF[30] and SNAQ,[31] reporting alpha coefficients of 0.83 and 0.51 respectively. Values of 0.60, 0.70 and 0.80 are considered acceptable, adequate and good for confirmatory purposes.[27] Inter-rater reliability was measured by Keller *et al*.[29] (SCREEN II) and Kruizenga *et al*.[32] (SNAQ©), with both tools having high correlations (ICC=0.83 and 0.69-0.90 respectively). The MUST is also reported to have high inter-rater agreement, with kappa values ranging from 0.80-1.00, indicating excellent agreement beyond chance.[26] Internal-comparison reliability for the South African tool was also assessed and considered adequate (r=0.737).[33] Intra-class correlation is the preferred method of estimating levels of agreement because it allows different models to be tested.[34] Keller *et al*.[29] (SCREEN II) was the sole publication to include this measure and found an intra-class correlation (r) of 0.75, which is considered adequate but not good for confirmatory purposes.[27] It therefore appears that the SCREEN II and MNA-SF have the highest level of internal consistency.

Terminology

In terms of validity testing, some of the studies were vague on the nature of the testing which took place. Both Keller *et a.l*[28] and Keller *et al.*[29] stated that construct validity, or the extent to which the tool performs in accordance with theoretical expectations,[17] was tested. Construct validity is the ultimate goal of validation,[17] and in these studies it was tested by using extreme cases rated by a dietitian and correlation with other measures of nutritional status. Hence discriminate validity, which tests whether two constructs differ[27] and convergent validity, which measures the internal consistency within one construct,[27] were also tested without being specified. Hence it is important to consider the full extent to which each tool has been validated.

Sensitivity and specificity

Many of the other studies also looked at construct validity but without stating it.[35-38] Sensitivity and specificity testing, which is a way to assess the construct validity of a tool, featured in many of the studies. The sensitivities of the screening tools ranged from 14% for the NSI[35] to 98% for the MNA-SF,[30] and the specificities of the tools ranged from 11% for the NSI[39] to 98% for the SNAQ.[40] However, only seven of these studies used Receiver Operating Characteristic (ROC) curves as a combined measure of sensitivity and specificity.[28-32,40,41] ROC curves are necessary to provide an understanding of the overall efficiency of a tool, and the area under the curve (AUC) can be used to determine if the tool has utility in clinical practice where a definite diagnosis of a condition (in this case malnutrition), is available.[27] All of the studies that used ROC curves reported the area under the curve, with the exception of Kuzuya *et al*.,[41] which left the reader to visually judge the efficiency of the tool. The AUC values ranged from 78% for the SCREEN[28] to 96% for the MNA-SF.[30] Based on the considerations above and with a reported sensitivity of 98% and specificity of 94%, the MNA-SF appears to have the highest construct validity.

Predictive validity

In addition, Keller & Østbye,[42] Brunt *et al*.,[43] Sahyoun *et al*.[37] and Yap *et al*.[44] all tested for predictive validity, which

Table 1. Summary of nutritional screening tools

Screening tool	No. of items	Items		Scoring	Treatment plan	Sensitivity/Specificity
ANSI[38]	12	Anthropometric measures	Weight change	Range 0-29 0-3 Low risk 3-5 Moderate risk ≥6 High risk	None specifically stated	0.32-0.47/0.74-0.79[35]
		Dietary intake	Frequency of intake			
			Specific component intake			
		Factors affecting food intake	Fluid intake			
			Oral problems (chewing, swallowing)			
		Access to food	Ability to shop for food			
		Clinical condition	Presence or absence of disease			
			Use of medications			
		Social factors	Social isolation			
			Alcohol intake			
Malaysian tool[48]	11	Anthropometric	Weight change	4 or more – individual at high risk of under-nutrition	None specifically stated	0.58/0.80[48]
		Dietary intake	Frequency of eating			
			Specific component intake			
		Factors affecting food intake	Appetite			
			Oral problems (chewing, swallowing)			
		Access to food	Financial dependence, transport			
		Clinical condition	Presence or absence of disease			
		Social factors	Cigarette smoking			
MNA-SF[30]	6	Factors affecting food intake	Appetite	Maximum score 14 12-14: well nourished ≤11/14: nutritional risk	Continue with full assessment	0.978/0.943[30] 1.00/0.946[39] 0.89/0.82[49]
			Neuropsychological problems			
		Anthropometry	Weight change			
			BMI †			
		Access to food	Mobility			
		Clinical condition	Presence of illness/disease			
MUST[26]	3	Anthropometry	BMI †	0 – low risk: 1 – medium risk 2 – high risk	0 – routine clinical care 1 – observe 2 – treat	Not specified[26]
			Weight change			
		Clinical condition	Presence of illness/disease			
NSI[2]	10	Anthropometric measures	Weight change	0-2 – good: 3-5 – moderate nutritional risk 6 or more – high nutritional risk	0-2 – recheck score in 6 months 3-5 – see what can be done to improve your eating habits and lifestyle 6 or more – talk to GP, dietitian or other health worker	0.609/0.627[2] 0.25-0.75/0.51-0.54[50] 0.29-1.0/0.74-0.79[35]
		Dietary intake	Frequency of intake			
			Specific component intake			
		Factors affecting food intake	Oral problems (chewing, swallowing)			
		Access to food	Ability to shop for food			
		Clinical condition	Presence or absence of disease			
			Use of medications			
		Social factors	Social isolation			
			Alcohol intake			

† Body mass index; ‡ Mid upper arm circumference
Screening tools are listed in chronological order

Table 1. Summary of nutritional screening tools (con.)

Screening tool	No. of items	Items		Scoring	Treatment plan	Sensitivity/specificity
SCREEN I[47]	15	Anthropometry	Weight change	None specifically stated	None specifically stated	0.81-0.94/0.32-0.55[28]
		Dietary intake	Frequency of eating			
			Specific component intake			
			Food avoidances			
		Factors affecting food intake	Use of meal replacements			
			Appetite			
			Oral problems (chewing, swallowing)			
		Access to food	Access to groceries and meal preparation			
		Social factors	Social isolation			
SCREEN II[29]	14	Anthropometry	Weight change	None specifically stated	None specifically stated	0.84/0.62[29]
		Dietary intake	Frequency of eating			
			Specific component intake			
			Food avoidances			
			Fluid intake			
		Factors affecting food intake	Use of meal replacements			
			Appetite			
			Oral problems (chewing, swallowing)			
		Access to food	Access to groceries and meal preparation			
		Social factors	Social isolation			
SNAQ© [32]	3	Anthropometry	Weight change	1 – well nourished 2 – moderately malnourished 3 – severely malnourished	1 – no intervention 2 – nutritional intervention 3 – nutritional intervention and treatment dietitian	0.76-0.88/0.83-0.91[32] 0.45-0.53/0.95-0.97[40] 0.63-0.67/0.98-0.99[40]
		Factors affecting food intake	Appetite			
		Dietary intake	Use of supplements/tube feeding			
SNAQ[31]	4	Factors affecting food intake	Appetite	Score ≤14 indicates significant risk of at least 5% weight loss within 6 months.	None specifically stated	0.792-0.909/ 0.764-0.873[31]
			Feeling of fullness			
			Taste			
		Dietary intake	Frequency of eating			
South African tool[33]	10	Anthropometry	MUAC ‡	Well nourished: >14.5 m, >16.0 f At risk: 9.5-14.5 m 9.5-16.0 f Malnourished: <9.5 m, <9.5 f	None specifically stated	0.821/0.723[33]
		Dietary intake	Frequency of eating			
		Factors affecting food intake	Specific component intake			
		Access to food	Cognitive function			
		Clinical condition	Motor disability			
			Food security			
			Presence of disease/illness			

† Body mass index; ‡ Mid upper arm circumference
Screening tools are listed in chronological order

measures the extent to which the tool will predict a future outcome. These outcomes included the association of nutritional risk and all-cause mortality, continued community-dwelling, hospitalisation and being functionally dependent. Whilst this is an important measure to consider and significant results were reported in many of these studies, it is only useful when using a tool that has demonstrated high construct validity, to deem the findings noteworthy.

Cross-validation

Cross-validation, or the ability of the tool to predict nutritional risk in a population different to that from which it was developed, was assessed by Rubenstein *et al.*[30] and Neelemaat *et al.*[40] for the MNA-SF (n=330) and SNAQ© (n=705) screening tools respectively. The results found high sensitivity and specificity for the MNA-SF (97.9% and 100% respectively), compared to 53-67% and 97-98% for the SNAQ©. This indicates that the MNA-SF is a well validated tool and can be effectively implemented across different populations.

Acceptability

The MUST was the only tool that had been specifically explored for the acceptability, or ease of use of the tool. Whilst Stratton *et al.*[45] reported the tool as 'easy' to use, Elia[26] found that the ease of use ranged from 'very easy' to 'difficult'. Many studies included discussion on the ease of use of administering a tool without specifically measuring it, but this is an area that should be looked at in future research.

Treatment/action plan

Outlines of an action plan according to the score obtained included further nutritional assessment (MNA-SF), nutritional intervention and treatment by a dietitian (SNAQ©), and encouraging individuals to seek professional help or medical assistance (NSI and ANSI). Most of the screening tools (SCREEN I, SCREEN II, SNAQ, MUST, Malaysian and South African tools) did not specifically outline a plan of action. Whilst it is critical that an action plan is described by the tool to ensure appropriate intervention is administered, the plan must also be realistic and feasible. Further nutritional assessment is a reasonable action plan as it allows nutritional status to be assessed in more detail. It is important to consider that with the implementation of nutritional screening, there is likely to be an increase in clients requiring treatment by a dietitian. Whilst it is critical that those at risk of malnutrition are treated in a timely and appropriate manner, with currently limited resources this workload for dietitians is unlikely to be manageable, hence more support and resources are also crucial.

Overall rating of screening tools

Table 2 provides a summary and ranking of each of the tools included in this review. The tools with the most extensive validity and reliability testing are the MNA-SF, SCREEN II and DETERMINE Checklist. Whilst tools such as the SCREEN and DETERMINE have been subjected to more extensive testing, there is no conclusive evidence that these are valid and reliable tools for use in the community dwelling population. On the other hand, some tools such as the SNAQ© appear to be valid and reliable tools, but have not been extensively tested. Acceptability was determined by the number and type of elements included in the screening tool, and the reported ease of use in the literature. Hence based on both the extensiveness and values of validity, reliability, sensitivity and specificity testing, the MNA-SF appears to be the most appropriate tool to use to assess nutritional risk in the community-dwelling older population. It has also been used across different study populations; however there is currently no data on inter-rater or test-retest reliability in the community-dwelling older adults, and the process of validity testing needs to be ongoing to cover a broad range of populations.[17]

DISCUSSION

It has been recognised that screening for malnutrition in older people can prove to be a difficult process.[46] Whilst it has been widely accepted that nutritional screening in tertiary and secondary care is useful, the importance of screening in the community setting as part of preventative

Table 2. Overall evaluation of nutrition screening tools for use in community-dwelling older adults

	Validity		Reliability			
	Evidence of testing	Validity of tool	Evidence of testing	Reliability of tool	Acceptability	Overall rating
MNA-SF [30]	+++	+++	++	++	+++	Good
SCREEN II[29]	+++	++	++	++	++	Good
MUST[26]	+++	++	++	++	++	Good
SCREEN I[47]	+++	+	++	++	+	Fair
NSI/DETERMINE [2]	+++	+	++	+	+	Fair
SNAQ© [32]	++	++	++	++	++	Fair
SNAQ [31]	+	++	+	++	++	Fair
Malaysian tool [48]	+	++	+	++	++	Fair
ANSI [38]	+	+	-	-	+	Poor
South African tool [33]	+	+	-	-	+	Poor

High: +++ Moderate: ++ Some: + None: –

Overall rating:

Good – moderate to high levels of validity and reliability testing, and good validity and reliability of the tool.

Fair – some levels of validity and reliability testing, and moderate validity and reliability of the tool.

Poor – little or no evidence of validity and reliability testing, and poor validity and reliability of the tool.

health care is also important.[28] The term 'older adults' covers a very diverse group ranging from 65 years of age to over 100 years of age, which will obviously influence measures of nutritional status; however there is limited standard values defining older age, and particularly very old people.[20]

There are a large number of risk factors for nutritional status, which is reflected in the variety of items included in each of the identified screening tools. One of the major limitations in comparing these tools is that there is no gold standard for measuring nutritional status, making it difficult to assess the validity of the tools. Jones[17] also suggests that the validity of the tool must be assessed according to the use and setting it is intended for. Whilst most of the tools were either developed or adapted for use in the community setting, some of the studies tested the validity of the tool in the same sample of which it was developed, influencing the validation process. In saying this, cross-validation of the screening tool, for example the MNA-SF in different countries, increases the validity of the tool.[27] As all tools were constructed by people with expertise in the nutritional care of older adults, they can be said to have face and content validity. However few tools have undergone rigorous reliability and validity testing. When a tool is chosen for use in clinical practice, it is important to carefully consider validity and reliability.[17] Likewise, sensitivity, specificity and acceptability should also have been considered in the development of the tool.[17] There are also issues regarding the lack of description of the type of validity test carried out, hence standardisation of terminology is required in order to assess the precise extent to which the instrument has been tested.[16] Community-health care teams should have a policy and set of specific protocols for identifying those at nutritional risk, leading to appropriate nutrition care plans.[19] Whilst screening tools can be completed by community-nurses, General Practitioners and other health-care workers, those at risk should be referred to an accredited practising or registered dietitian for a detailed assessment and individualised nutrition care plan, in order to improve the health outcomes of the individual.[19] Thus it is important not only to screen for nutrition risk, but to respond to the results of the screening to ensure optimal health care.

Methodological limitations were present in the majority of the studies. The use of convenience sampling, small sample sizes, low consent rates and highly specific populations were commonly present, limiting the reliability and validity of findings. On the other hand, strengths of some of the studies included blinding of screen results when conducting complete nutritional assessments, using standardised measurement techniques and using well validated tools to obtain information.

Limitations of the review

Whilst this review attempted to include all tools for use in the community-dwelling settings, there are some limitations to consider. The inclusion of publications was based mainly on electronic journal articles, hence any other form of publications were inadvertently missed. There are great variations in terms of the development and testing of each of the nutritional screening tools, which makes the summary and analysis difficult in terms of assessing factors such as validity and reliability. Also, whilst one of the search limits was average age of 65y and over, some of the studies reported data on participants younger than this, which may not be truly representative of 'older' adults.

CONCLUSION

Malnutrition in the elderly is a significant concern in terms of poor health outcomes; hence the ability to identify individuals at risk is critical.[26] Malnutrition prevalence has been reported as 10-30% in the community.[12] Nutritional screening tools have been developed for use specifically in the community setting, which can act as a preventative health measure.[28] Whilst several tools have been developed, most have not undergone extensive testing to demonstrate its ability to identify nutritional risk, making it difficult to select an appropriate tool to use in practice. The reliability, validity, sensitivity, specificity and acceptability of a screening tool must be considered prior to implementation of the tool, and tests used to examine these parameters should be clearly stated.[17] Of the tools assessed for use with older adults in the community setting, the MNA-SF appears to be the most appropriate, although further reliability testing and continued validation through sound methodological studies needs to be conducted. Further research in the acceptability of screening tools, as well as a focus on the outcomes of nutritional screening is required. Whilst it is important that screening tools are valid and reliable, the most important factor is the action taken as a result of the screening, to improve the nutritional status of individuals.

ACKNOWLEDGEMENTS

The authors acknowledge the assistance of the Flinders University Medical Library Liaison Librarians, Jess Tyndall and Jan Badcock for their assistance with developing the search strategy and sourcing relevant articles.

AUTHOR DISCLOSURES

The authors declare there are no conflicts of interest. No funding was obtained for this review.

REFERENCES

1. Macintosh C, Morley J, Chapman I. The anorexia of aging. Nutrition. 2000;16:983-5.
2. Posner B, Jette A, Smith K, Miller D. Nutrition and Health Risks in the Elderly: The Nutrition Screening Initiative. Am J Public Health. 1993;83:972-8.
3. Visvanathan R, Newbury J, Chapman I. Malnutrition in older people: screening and management strategies. Aust Fam Physician. 2004;33:799-805.
4. Visvanathan R, Penhall R, Chapman I. Nutritional screening of older people in a sub-acute care facility in Australia and its relation to discharge outcomes. Age Ageing. 2004;33: 260-5.
5. Neumann S, Miller M, Daniels L, Crotty M. Nutritional status and clinical outcomes of older patients in rehabilitation. J Hum Nutr Diet. 2005;18:129-36.
6. Miller M, Thomas J, Cameron I, Chen J, Sambrook P, March L, Cumming R, Lord S. Body mass index: a simple, rapid and clinically meaningful index of under-nutrition in the oldest-old? Brit J Nutr. 2008;101:1300-5.

7. Sharkey J, Branch L, Zohoori N, Giuliani C, Busby-Whitehead J, Haines P. Inadequate nutrient intakes among homebound elderly and their correlation. Am J Clin Nutr. 2002;76:1435-45.
8. Corish C, Kennedy N. Protein-energy malnutrition in hospital patients. Brit J Nutr. 2000;83:575-91.
9. Drewnowski A, Warren-Mears V. Does aging change nutrition requirements? J Nutr Health Aging. 2001;5:70-4.
10. Brownie S. Why are elderly individuals at risk of nutritional deficiency? Int J Nurs Pract. 2006;12:110-8.
11. Kushner R, Ayello E, Beyer P, Skipper A, Van Way C, Young E., Balogun L. National Coordinating Committee: clinical indicators of nutrition care. J Am Diet Assoc. 1994; 94:1168-77.
12. Watterson C, Fraser A, Banks M, Isenring E, Miller M, Silvester K, Hoevenaars R, Bauer J, Vivanti A, Ferguson M. Evidence based guidelines for nutritional management of malnutrition in adult patients across the continuum of care. Nutr Diet. 2009;66(Suppl 3):S1-34.
13. Leggo M, Banks M, Isenring E, Stewart L, Tweeddale M. A quality improvement nutrition screening and intervention program available to Home and Community Care eligible clients. Nutr Diet. 2008;65:162-7.
14. Guizog Y, Vellas B, Garry P. Assessing the nutritional status of the elderly: the mini nutrition assessment as part of the geriatric evaluation. Nutr Rev. 1996;54:59-65.
15. Visvanathan R, Macintosh C, Callary M, Pernhall R, Horowitz M, Chapman I. The nutritional status of 250 older Australian recipients of domiciliary care services and its association with outcomes at 12 months. J Am Geriatr Soc. 2003;51:1007-11.
16. Arrowsmith H. A critical evaluation of the use of nutrition screening tools by nurses. Brit J Nurs. 1999;8:1483-1490.
17. Jones J. Validity of nutritional screening tools and assessment. Nutrition. 2004;20:312-7.
18. Jones J. Nutritional screening and assessment tools. New York: Nova Science Publishers Inc; 2006.
19. Kondrup J, Allison S, Elia M, Vellas B, Plauth M. ESPEN Guidelines for Nutrition Screening 2002. Clin Nutr. 2003;22: 415-21.
20. Green S, Watson R. Nutritional screening and assessment tools for older adults: literature review. J Adv Nurs. 2006;54: 477-90.
21. National Health and Medical Research Council. N.H.M.R.C. additional levels of evidence and grades of recommendations for developers of guidelines-Pilot Program. 2005 [cited 2009/7/10]; Available from: www.nhmrc.gov.au/ consult/add_levels_grades_dev_guidelines2.htm
22. Rowland M. Self-reported height and weight. Am J Clin Nutr. 1990;52:1125-33.
23. British Dietetic Association. Effective Practice Bulletin Issue 32: Challenging the use of Body Mass Index (BMI) to assess under-nutrition in older people. Diet Today. 2003;38: 15-9.
24. Luchsinger J, Lee W, Carrasquillo O, Rabinowitz D, Shea S. Body mass index and hospitalisation in the elderly. J Am Geriatr Soc. 2003;51:1615-20.
25. Cook Z, Kirk S, Lawrenson S, Sandford S. Use of BMI in the assessment of undernutrition in older subjects: reflecting on practice. P Nutr Soc. 2005;64:313-7.
26. Elia M. The MUST report – Nutritional screening of adults: a multidisciplinary responsibility, development and use of the Malnutrition Universal Screening Tool (MUST) for adults. Malnutrition Advisory Group (MAG), BAPEN; 2003.
27. Garson G. Validity. Statnotes: Topics in Multivariate Analysis. 2009 [cited 2009/9/2]; Available from: http://faculty.chass.ncsu.edu/garson/pa765/statnote.htm
28. Keller H, McKenzie J, Goy R. Construct validation and test-retest reliability of the Seniors in the Community: Risk Evaluation for Eating and Nutrition Questionnaire. J Gerontol. 2001;56A:M552-M558.
29. Keller H, Goy R, Kane S. Validity and reliability of SCREEN II (Seniors in the Community: Risk evaluation for eating and nutrition, Version II). Eur J Clin Nutr. 2005;59: 1149-57.
30. Rubenstien L, Harker J, Salva A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form Mini Nutritional Assessment (MNA-SF). J Gerontol. 2001;56A:M366-M372.
31. Wilson M, Thomas D, Rubenstein L, Chibnall J, Anderson S, Baxi A, Diebold M, Morley J. Appetite assessment: simple appetite questionnaire predicts weight loss in community-dwelling adults and nursing home residents. Am J Clin Nutr. 2005;82:1074-81.
32. Kruizenga H, Seidell J, de Vet H, Wierdsma N, van Bokhorst-de van der Schueren M. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ©). Clin Nutr. 2005; 24:75-82.
33. Charlton K, Kolbe-Alexander T, Nel J. Development of a novel nutrition screening tool for use in elderly South Africans. Public Health Nutr. 2005;8:468-79.
34. Yaffee R. Enhancement of Reliability Analysis: Application of Intraclass Correlations with SPSS/Windows. 1998 [cited 2009/9/5]; Available from: http://www.nyu.edu/acf/socsci/ Docs/inracls.html
35. Patterson A, Young A, Powers J, Brown W, Byles J. Relationships between nutrition screening checklists and the health and well-being of older Australian women. Public Health Nutr. 2002;5:65-71.
36. Bourdel-Marchasson I, Rolland C, Jutand M, Egea C, Baratchart B, Barberger-Gateau P. Undernutrition in geriatric institutions in South-West France: Policies and risk factors. Nutrition. 2009;25155-64.
37. Sayhoun N, Jacques P, Dallal G, Russell R. Nutrition Screening Initiative checklist may be a better awareness/ education tool than a screening one. J Am Diet Assoc. 1997;97:760-4.
38. Cobiac L, Syrette J. What is the nutritional status of older Australians? Proc Nutr Soc Aust. 1995;19:139-45.
39. Charlton K, Kolbe-Alexander T, Nel J. The MNA, but not the DETERMINE, screening tool is a valid indicator of nutritional status in elderly Africans. Nutrition. 2007;23:533-42.
40. Neelemaat F, Kruizenga H, de Vet H, Seidell J, Butterman M, van Bokhorst-de, van der Schueren M. Screening malnutrition in hospital outpatients. Can the SNAQ malnutrition screening tool also be applied to this population? Clin Nutr. 2008;27:439-46.
41. Kuzuya M, Kanda S, Koike T, Suzuki Y, Satake S, Iguchi A. Evaluation of Mini-Nutritional Assessment for Japanese frail elderly. Nutrition. 2005;21:498-503.
42. Keller H, Østbye T. Nutritional risk and time to death; predictive validity of SCREEN© (Seniors in the Community Risk Evaluation for Eating and Nutrition). J Nutr Health Aging. 2003;7:274-9.
43. Brunt A, Schafer E, Oakland M. The ability of the DETERMINE Checklist to predict dietary intake of white, rural, elderly, community-dwelling women. J Nutr Elder. 1999;18: 1-19.
44. Yap K, Niti M, Ng T. Nutrition screening among community-dwelling older adults in Singapore. Singap Med J. 2007; 48:911-6.

45. Stratton R, Hackston A, Longmore D, Dixon R, Price S, Stroud M, King C, Elia M. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the 'malnutrition universal screening tool' (MUST) for adults. Br J Nutr. 2004;92:799-808.
46. Omran M, Morley J. Assessment of protein energy malnutrition in older persons, Part I: history, examination, body composition, and screening tool. Nutrition. 2000;16:50-63.
47. Keller H, Hedley M, Brownlee S. The development of Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN). Can J Diet Pract Res. 2000;61:67-72.
48. Shahar S, Dixon R, Earland J. Development of a screening tool for detecting undernutrition and dietary inadequacy among rural elderly in Malaysia: simple indices to identify individuals at high risk. Int J Food Sci Nutr. 1999;50:435-44.
49. Wikby K, Ek A, Christensson L. The two-step Mini Nutritional Assessment procedure in community resident homes. J Clin Nurs. 2008;17:1211-8.
50. de Groot L, Beck A, Schroll M, Staveren W. Evaluating the DETERMINE Your Nutritional Health Checklist and the Mini Nutritional Assessment as tools to identify nutritional problems in elderly Europeans. Eur J Clin Nutr. 1998;52: 877-83.
51. MacLellan D, Van Til L. Screening for nutritional risk among community-dwelling elderly on Prince Edward Island. Can J Public Health. 1998;89:342-6.
52. Mitchell D, Smiciklas-Wright H, Friedmann J, Jensen,G. Dietary intake assessed by the Nutrition Screening Initiative Level II Screen is a sensitive but not a specific indicator of nutrition risk in older adults. J Am Diet Assoc. 2002;102: 842-4.
53. Brownie S, Myers S, Stevens J. The value of the Australian Nutritional Screening Initiative for older adults – results from a national survey. J Nutr Health Aging. 2007;11:20-5.
54. Keller H. The SCREEN I (Seniors in the Community: Risk Evaluation for Eating and Nutrition) index adequately represents nutritional risk. J Clin Epidemiol. 2006;59:836-41.

Review

Nutritional screening in community-dwelling older adults: a systematic literature review

Megan B Phillips BNutrDiet(Hons), Amanda L Foley PhD, Robert Barnard MEd, Elisabeth A Isenring PhD, Michelle D Miller PhD

Flinders University, Adelaide, South Australia

社區老人之營養篩檢：一個系統性文獻回顧

營養篩檢是用來快速確認那些可能有營養不良風險的個體的一個步驟，進而提供完整的營養評估及適當的營養介入。雖然很多營養篩檢工具已經被發展出來，於社區老人的使用卻很少被評估。這篇文章的目的，是由信效度的角度來決定最適當的營養篩檢工具，以確認社區老人的營養不良風險。從電子資料庫 MEDLINE、PUBMED、CINAHL 及 Cochrane Library 搜尋，曾使用在 65 歲以上的社區老人，以確認營養不良或營養不足的營養篩檢工具。有 10 種篩檢工具被應用在社區老人，並有信效度測試，包括：簡易的營養評估-短版(MNA-SF)、營養不良通用篩檢工具(MUST)、營養篩檢方案(NSI)，包含評估清單及第一、二級篩檢、澳洲營養篩檢方案(ANSI)、社區老人：飲食及營養危險性評估(SCREEN I 和 SCREEN II)、短版營養評估問卷(SNAQ©)、簡化營養食慾問卷(SNAQ)及兩種未命名的工具。MNA-SF 顯示為最適合使用在社區老人的營養篩檢工具，另外也有證據支持 MUST 和 SCREEN II 的使用適合性。更進一步的研究必須探究篩檢工具在營養篩檢結果及適合的營養介入的可接受性。

關鍵字：營養不良、營養不足、篩檢工具、效度、信度