STUDY PROTOCOL

Diagnostic accuracy of the Mini Nutritional Assessment – Short Form to identify malnutrition among older adults: protocol for a systematic review and meta-analysis [version 1; peer review: awaiting peer review]

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Abstract

Malnutrition has many associated physiological and psychological consequences for older adults that can result in reduced quality of life, poor disease outcomes and more frequent and longer hospital stays. Early recognition of malnutrition allows for timely intervention and treatment. There are several screening tools for nutrition risk. The most common one for malnutrition developed and validated for older adults is the short-form of the Mini Nutritional Assessment (MNA-SF). It can be completed in just a few minutes and applied in all health care settings. This systematic review and meta-analysis serves to synthesise the totality of evidence regarding the diagnostic accuracy of the MNA-SF tool compared with the full-form of the Mini Nutritional Assessment (MNA-FF) in older adults for the diagnosis of malnutrition in healthcare settings. Systematic searches of five bibliographical databases will be performed and will include the Pubmed, EMBASE, Cochrane Library, CINAHL and Web of Science to identify all studies that validate the MNA-SF for malnutrition among older adults in healthcare settings. Risk of bias will be assessed with the Quality Assessment of Diagnostic Accuracy Studies-2 tool. Pre-specified MNA-SF scores will be used to identify patients’ risk of malnutrition. Using data from 2x2 tables, studies will be pooled to generate summary estimates of sensitivity and specificity using a bivariate random effects model. The findings of this systematic review of diagnostic accuracy will provide evidence for healthcare professionals to make informed decisions regarding the optimum use of the MNA-SF as a nutrition risk screening tool to identify malnutrition among older people.

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Keywords
malnutrition, mini nutritional assessment short form, older person, healthcare, screening tool, validation.

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Introduction
Malnutrition can be described as a condition resulting from a deficit in the uptake or intake of nutrition due to starvation, disease or ageing. As a consequence, decreased fat free mass, altered body composition and body cell mass result in weakened physical and mental function and impair the health, function and quality of life clinical outcomes of disease. There is a close relationship between malnutrition and frailty, sarcopenia and poor outcomes among older adults. It is often referred to as both “a cause and consequence of adverse outcomes”, and an increase in mortality is reported. The therapeutic aim of clinical nutrition in older adults is to provide adequate food and hydration to maintain or improve individual independence, quality of life, clinical outcomes, capacity for rehabilitation and thereby reduce the risk of morbidity and mortality.

It is estimated that 145,000 community and hospital patients in Ireland are malnourished or at risk of becoming malnourished (4% of the total population) at any given time. Malnutrition among older people varies in prevalence according to settings ranging from 3% among community dwelling older people, to 6% among those attending outpatients and 8.7% among those receiving home care services, with considerable heterogeneity between studies. In particular, malnutrition is highly prevalent in hospitals among older adults with reports that 39% are at risk of malnutrition. In a recent study, over one third of patients (n=209) admitted to an Irish Emergency Department were identified as at risk of malnutrition. This study also found that those diagnosed as malnourished were more likely to report hospital or nursing home readmission, reduced quality of life and functional decline at 30-days follow up compared to older adults who had normal nutrition status.

Screening for malnutrition in older adults is an important step in the early detection of risk or diagnosis of malnutrition. Despite the observed prevalence, malnutrition screening frequently is not performed due to perceived barriers of application in hospital settings including nursing time, competence with the tool, and resources. Effective malnutrition screening can enable a nutrition care pathway and prevent further complications to the older adult’s nutritional status. Malnutrition can be identified by combining multiple measures including weight, height, body mass index (BMI), weight change, disease stage, changes in food intake and/or functional capacity. A nutrition screening tool incorporates data from these measures to generate a score and classify an individual’s nutrition status as normal, at risk of malnutrition, or malnourished. A total of 48 malnutrition screening tools have been identified and rated according to a scoring system to recommend the best tools across healthcare settings.

To assess the validity of a tool, a comparison needs to be made with a gold standard nutrition screening tool. There is no agreed gold standard for the assessment of malnutrition and, therefore, various reference standards are used in validation studies of screening tools. The Mini Nutritional Assessment (MNA®) is an accepted reference standard for validation studies of nutrition screening tools in many different settings, such as community, home care, nursing homes and hospitals. It was originally developed as a 18-item Mini Nutritional Assessment - full form (MNA-FF) instrument to screen and assess malnutrition as part of the geriatric assessment. In 2001, the Mini Nutritional Assessment - short form (MNA-SF) was developed and validated, including a combination of six items from the MNA- FF. This includes two items that account for a pre-existing risk of malnutrition: mobility and neuropsychological problems that regularly contribute to the development of malnutrition. The short form malnutrition screening tool was further revised and validated in 2009 to include a three-category scoring system that included a classification of “malnourished” that the original tool lacked. This revision allows the MNA-SF to provide a nutritional assessment for the older adult. Further, the use of either BMI or calf circumference measurements enables its use with immobile individuals or in those circumstances where weight and height cannot be measured. It is recommended for use by the European Society for Clinical Nutrition and Metabolism (ESPEN) guideline (2018) on clinical nutrition and hydration in geriatrics. The MNA-SF is the most common screening tool developed for older adults with the criterion validity tested in all healthcare settings, and thus would have applicability to healthcare professionals to identify malnutrition in the field of integrated care programmes for older people. However, the MNA-SF may overestimate the nutritional risk in hospitalised older adults based on a poor validity (low specificity) of the tool. To date, there has not been a systematic review of diagnostic accuracy to assess the totality of evidence from validation studies.

This systematic review and meta-analysis will synthesise the totality of evidence regarding the diagnostic accuracy of the MNA-SF in older adults when compared to the full form Mini Nutritional Assessment to identify malnutrition.

Protocol
Study design
This protocol describes a systematic review and meta-analysis that will be conducted using the principles in the Cochrane Handbook for Systematic Reviews of Diagnostic Test Accuracy and will be reported using the Preferred Reporting Items for Systematic reviews and Meta-Analysis for Diagnostic Test Accuracy (PRISMA-DTA). In accordance with the guideline, this protocol was registered on 31/05/2019 with the International Prospective Register of Systematic Reviews (PROSPERO), number CRD42019131847.

Eligibility criteria
Types of study. Cross-sectional or prospective or retrospective cohort studies will be included in this review. Studies published in all languages will be included in the search.

Participants. This review will consider studies with older adults aged greater than or equal to 65 years of age at the time of nutrition screening with the MNA-SF. Settings
include and are limited to acute-care hospitals, long-term care facilities, such as nursing homes, and urgent-care and emergency medical services.

Experimental test

**Interventions.** The diagnostic accuracy of the revised MNA-SF\textsuperscript{17} screening tool for malnutrition will be explored. This will include studies where the MNA-SF is administered by a health professional (e.g., Dietitian, Registered Nurse or others) trained in administering the screening tool to identify older adults who are nourished, at risk of malnutrition or malnourished. It will not include studies where the MNA-SF is self-administered by the patient or carer as it has been shown that the resulting scores differ substantially from those assessed by healthcare professionals\textsuperscript{22}.

**Reference standard.** The MNA-FF is a validated screening tool that identifies older adults who are at risk of malnutrition or are malnourished to a maximum score of 30. Threshold value ranges are: scores less than 17 points indicate malnutrition, scores between 17 and 23 are risk for malnutrition and scores > 23 have, in general, an adequate nutritional status\textsuperscript{43,42}.

**Outcomes**

The primary outcome is the diagnostic accuracy of the MNA-SF to identify malnutrition among older adults in healthcare settings. Anticipated secondary outcomes that are clinically relevant may include the predictive accuracy of the MNA-SF including mortality, functional decline, length of stay, readmission, performance status, activities of daily living (ADLs), quality of life measures and falls.

**Exclusion criteria**

Studies published prior to January 2009 will be excluded in order to limit the search to studies that relate to the latest revision and validation of the MNA – SF (as the latest revision includes calf circumference and a revised three category scoring classification)\textsuperscript{17}. Poster session, commentary, letter to editor, “grey” literature: technical reports from government agencies or scientific research groups, working papers from research groups or committees, white papers, position papers, abstracts, conference reports or preprints will be excluded. Finally, where multiple publications from the same study exist, all will be included to extract data from the full set of data.

**Search**

To identify all studies that validate the revised MNA-SF for malnutrition among older adults the following databases will be searched: Pubmed, EMBASE, Cochrane Library, CINAHL and Web of Science. Search terms will include controlled terms from MeSH in Medline, EMtree in EMBASE.com, CINAHL. Headings in CINAHL, keywords in Cochrane, and topic searches as well as free text terms in titles and abstracts. The search strategy was developed in consultation with an academic librarian (LD, University of Limerick). A logic grid that uses Boolean operators will structure searches. The search terms relate to the population of interest “older adults”, the intervention “MNA-SF” and the primary outcome of interest “malnutrition”; full search strategy is available in the extended data\textsuperscript{24}. References of included articles will be hand searched for MNA-SF validation studies. The MNA® website will also be consulted for potential validation studies.

**Data selection**

All articles identified by database searches and those from additional sources will be downloaded into EndnoteX8 reference management software and duplicates removed. Titles and abstracts of retrieved studies will be screened independently by authors SMcG and CM to identify those that potentially meet the inclusion/exclusion criteria described above. If the selection criteria cannot be verified based on the title and/or abstract, full text screening will be applied using the same criteria. Any disagreement over eligibility will be resolved through discussion with AG as third reviewer. A PRISMA flowchart will detail the search and study selection process.

**Data extraction**

A standardised Excel (Microsoft Office Professional Plus 2016) database will be used to extract data from the included studies for assessment of the study quality and for evidence synthesis. Extracted study information will include: patient demographics; study setting, design and sample size; patient type (medical, surgical, etc.); administrator of the MNA-SF (dietitian, clinician, registered nurse, etc.); reported clinical findings of weight loss, BMI or reduced muscle mass; number categorised as normal nutritional status, at risk of malnourishment, or malnourished; additional outcome(s) measured and times of measurement; and main conclusion. Where participants are not classified dichotomously as malnourished or well nourished, or diagnostic accuracy tests were not performed, raw data extracted from the results will be used to determine diagnostic accuracy where possible. Missing data will be requested from the study authors by AG. Eligible studies that are missing some critical data will be excluded from meta-analysis where all attempts to contact the authors fail. RG will independently extract data from approximately 25% of the included studies as a quality assurance mechanism.

**Risk of bias**

The methodological quality of the studies will be assessed by two independent authors (SMcG and CM) using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool\textsuperscript{25}. Assessment will be carried out at the study level. The QUADAS-2 tool will be tailored and refined to this systematic review by considering each signaling question’s application to the domains of patient selection, index test, reference standard and flow of participants through the study and the timing of the MNA-SF and MNA-FF. Each domain is assessed in terms of the risk of bias using signalling questions and the first three domains are also assessed in terms of concerns regarding applicability\textsuperscript{25}. Once tool content has been agreed, a review-specific rating guide will be developed. CM and SM will independently pilot the tool on 10% of the included data.
primary studies and identify any further refinement required of the rating tool to judge the risk of bias. Risk of bias is judged as “low”, “high”, or “unclear”. If all signalling questions for a domain are answered “yes” then risk of bias can be judged “low”. If any signalling question is answered “no” this flags the potential for bias. In the event of disagreement, the reviewers will discuss using the review-specific rating guide before consulting a third reviewer, AG. A figure will be created summarising the results of the QUADAS-2 assessment for all included studies.

Strategy for data synthesis

An individual participant meta-analysis will be carried out by constructing a series of 2x2 tables and by extracting data on the number of true positives, false positives, true negatives and false negatives from each study. Summary estimates of sensitivity, specificity, positive predictive value and negative predictive value, with 95% confidence intervals (95% CIs), will be calculated using a bivariate random effects model. Cut-off values will be interpreted as good (sensitivity and specificity >80%, kappa >0.6), fair (sensitivity or specificity >80% but both >50%, kappa 0.4-0.6), or poor (sensitivity or specificity <50%, kappa <0.4). Sensitivity refers to the proportion of older adults who experience malnutrition (MNA-SF score 0–7) or risk of malnutrition (MNA-SF score 8–11) and who are correctly classified as such whereas specificity refers to those who do not experience malnutrition (MNA-SF score 12–14) and are correctly classified.

Results will be graphically represented as paired forest plots: one for sensitivity and one for specificity displaying means, confidence intervals, number of true positives, false positives, true negatives and false negatives for each primary study. A receiver-operating characteristic (ROC) graph will be used to plot individual and summary estimates of sensitivity and specificity. Statistical heterogeneity will be examined using the variance of logit-transformed sensitivity and specificity, with smaller values indicating less heterogeneity between studies. Bayes’ theorem will be applied to determine the post-test probability of malnutrition. Pooled data will be analysed by the Stata V13 software.

Subgroup analysis

If the necessary data are available, subgroup analyses will be completed separately for older adults across different individual healthcare settings (acute care and long-term) and patient characteristics (older adults (65–80 years) and geriatric (>80 years)) to investigate if there are statistically significant subgroup differences. A sensitivity analysis will be conducted to examine the impact of methodological quality on summary estimates of sensitivity and specificity.

Potential limitations

The success of the study depends on the ability to obtain the relevant individual patient data. The proportion of eligible datasets that will be possible to include in the study is not yet known. Incorporation bias is anticipated using the MNA-FF as a reference standard to validate the MNA-SF and this will be interpreted and discussed with caution.

Dissemination

Findings will be disseminated through publication in peer-reviewed journals and through relevant conferences. The rigorous scrutiny of primary studies will identify the strengths and limitations of current research and will provide recommendations for future research. Further, this systematic review of the diagnostic accuracy of the MNA-SF will be of interest to healthcare professionals working in the field of integrated care programmes for older people.

Amendments to protocol

We will carefully report any changes and update PROSPERO should the protocol be amended.

Ethics

As this systematic review will collect secondary data only, ethical approval is not required.

Study status

The study is currently ongoing. The expected end date for the study is December 2021.

Public and patient involvement

Patients and or public were not involved at all in elaborating this systematic review protocol. However, we expect that the findings of this systematic review will assist in the execution of a pilot and feasibility intervention study of early supported discharge from emergency departments with a patient and public involvement component.

Conclusion

The aim of this systematic review is to synthesise the totality of evidence regarding the diagnostic accuracy of the MNA-SF in older adults when compared to the full form Mini Nutritional Assessment to identify malnutrition. This will be conducted through a systematic search of the literature in five bibliographic databases: Pubmed, EMBASE, Cochrane Library, CINAHL and Web of Science. The eligibility criteria for including relevant articles is discussed along with the plans for critical appraisal, data extraction and data synthesis. The systematic review will be written in accordance with the PRISMA statement for systematic reviews. The data extraction and findings will be summarised to present key features, available evidence of MNA-SF performance and an evaluation of the quality of published tests. Findings will then be synthesised narratively. Depending on the nature of the available data from included primary studies, a meta-analysis will be conducted. The findings of the diagnostic accuracy of the MNA-SF will be inform healthcare professionals and researchers working in the field of integrated care programmes for older people where the early intervention of nutrition care can address adverse patient outcomes.
Data availability
Underlying data
No data is associated with this article.

Extended data
Open Science Framework: Diagnostic accuracy of the Mini Nutritional Assessment – Short Form to identify malnutrition among older adults: protocol for a systematic review and meta-analysis. https://doi.org/10.17605/OSF.IO/YFK9X

This project contains the following extended data:
- Search Strategy Prospero CRD42019131847.pdf (search strategy)

Reporting guidelines
Open Science Framework: PRISMA-P checklist for ‘Diagnostic accuracy of the Mini Nutritional Assessment – Short Form to identify malnutrition among older adults: protocol for a systematic review and meta-analysis’. https://doi.org/10.17605/OSF.IO/YFK9X

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