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Original research article

Development of the nutrition risk assessment tool for older adults

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Abstract
Background: Malnutrition is a lack of proper nutrition associated with different chronic diseases, comorbidities, frailty, and a higher prevalence of morbidity and mortality.
Aim: The aim of the study was to determine the most appropriate items that reflect nutrition status in this population group and incorporate them into the nutrition risk screening and malnutrition assessment tool.
Methods: A cross-sectional validation study was conducted in Bosnia and Herzegovina among 300 individuals older than 65 years. An eight-step approach that included correspondence analysis, generation of the pool item, content validity, internal consistency, construct validity, criterion validity, face validity, and reliability was performed.
Results: Correspondence analyses were performed using the contingency table's low-dimensional graphical representation of the rows and columns. After identifying nutrition status assessment-related topics via correspondence analyses, a literature review was performed to determine additional items. The assessment tool's accuracy was measured against clinical judgement as a reference standard. To test face validity of the tool, cognitive interviewing was used. Responses were analyzed and necessary changes were made. The final version of the tool included 14 items. Possible range score on the assessment tool was 0–21. Lower scores indicated nutrition risk. The screening and assessment tool showed acceptable validity and internal consistency.

Keywords: Assessment; Geriatric patients; Malnutrition; Nutrition risk

Introduction

Malnutrition is a lack of proper nutrition (WHO, 2024) associated with different chronic diseases, comorbidities, frailty (Omran and Morley, 2000), a higher prevalence of morbidity, and mortality (Ehwerhemuepha et al., 2018). To improve malnutrition screening and diagnostic assessment in clinical practice, the Global Clinical Nutrition Community developed the Global Leadership Initiative on Malnutrition (GLIM) criteria. According to GLIM recommendations, the first step is malnutrition risk screening using any validated screening questionnaire, such as the Mini Nutrition Assessment-Full form (MNA-FF), Malnutrition Universal Screening Tool, Nutrition Risk Screening 2002, and Subjective Global Assessment (Cederholm et al., 2019; Detsky et al., 1987; Kondrup et al., 2003; Stratton et al., 2004; Vellas et al., 1999). The second step provides an assessment of three phenotypic and two etiologic criteria. Malnutrition can be graded as moderate or severe, based on phenotypic criteria. At least one criterion in each group must be met to diagnose malnutrition. (Cederholm et al., 2019). Recent research suggests that the prevalence of malnutrition according to GLIM criteria may vary significantly when different screening instruments are used due to the large diversity in the measured construct (Isautier et al., 2019). Although the Mini Nutrition Assessment-short form (MNA-SF) and MNA-FF have been commonly used to identify malnutrition among community-dwelling older adults, their use throughout the globe may have no consistent validity and reliability (Pavlović et al., 2021). The study compared the validity of SCREEN II and the MNA-SF in screening for nutritional risk in older community-dwelling individuals. The sensitivity of the Serbian translation of SCREEN II was lower for <54 (moderate nutritional risk) and <50 (high nutritional risk) cut-off points. However, the specificity for detecting nutritional risk was high. To improve the nutritional status of the geriatric population, primary care institutions need to focus on the implementation of screening procedures (Pavlović et al., 2021). Before choosing a specific nutritional screening tool, healthcare providers need to explore its diagnostic accuracy in measurements supported in the use of each screening tool (Pavlović et al., 2000).

The choice of screening instrument has an impact on variations in the malnutrition rate, which can hinder harmonization of the screening process or the provision of reliable data. Low and middle-income countries face a persistent lack of nutritionists/dietitians and nutrition care geographical coverage, particularly in rural areas. Primary care clinicians are expected to bridge the gap bay delivering nutrition risk screenings, and providing assessment of malnutrition and relevant interven-

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tions, despite insufficient training to meet the demands or additional support being needed (Delisle et al., 2017).

The study's aim was to identify the most appropriate items that reflect nutrition risk and GLIM criteria in older adults in primary care and toincorporate those items into the nutrition risk assessment tool.

Materials and methods

A cross-sectional validation study was conducted in urban and semiurban areas of eastern Bosnia and Herzegovina among 300 individuals older than 65 years. The sample size was calculated based on the prevalence of malnutrition in the community-dwelling older adults (15%), with a 95% confidence interval and 5% type I error. Study participants were recruited from family medicine practices. People who have had any of the acute illnesses, people with dementia, cancer, mental disorders, chronic renal failure stage IV/V, and motor impairments were excluded from the study. Signed written informed consent was obtained. Respondents chose whether to participate in the research, which may lead to bias as those interested in the research topic may have been more inclined to participate. The Institutional Ethics Committee approved the study (Number 01-2-1). Data collection has been described previously in detail (Pavlović et al., 2021). MNA-FF and Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) were used for screening of nutrition status and to identify items. MNA-FF categorizes assessed individuals as "well-nourished (≥24), at risk of malnutrition (17–23.5), and malnourished (<17)" (Vellas et al., 1999). As per SCREEN II, the scores <50 indicated high, 50–53 moderate, and >53 low nutrition risks (Keller et al., 2005).

Study participants were asked to report their health status by answering the question: "How would you rate your overall health?" The response scale ranged from "Excellent", to "Very Bad". Participants were asked about using aids; hearing apparatus, walking aids, other assistive devices, dentures, and hobbies.

Non-volitional weight loss, reduced body mass index (BMI), and reduced muscle mass were considered phenotypic criteria for malnutrition. Reduced food intake or assimilation and disease burden/inflammation were considered etiologic criteria for malnutrition. Information on non-volition weight loss was obtained objectively by extracting consecutive BMI values from the electronic medical record over the past six months. Cutoff values applied for BMI were <20 kg/m^2 <70 years of age and <22 kg/m^2 for those 70 or older. Recommendations from GLIM were followed to assess reduced muscle mass (Cederholm et al., 2019). For calf circumference (CC), three measurements were taken at the widest part of each calf, and the highest value out of six was recorded. The first set of CC cutoffs, <33 cm (men) and <32 cm (women), was defined by Gonzalez et al. (2021) using anthropometric and appendicular lean mass data from the NHANES 1999–2006 population sample (Enge et al., 2024). The second set of CC cutoff values of <31 cm (men) and <29 cm (women), was considered ethnic- and sex-specific for the Bosnian population. The MUAC was measured at the midpoint of the upper arm. Cutoff values of <24 cm in men and <23 cm were applied to the study participants (Hadzivukovic et al., 2023). Hand Grip Strength (HGS) (Barazzoni et al., 2022) and Timed Up-and-Go (TUG) were assessed as the supportive measures for muscle function. HGS was measured with a dynamometer on both hands and the highest value on the dominant hand was taken. HGS <27 kg (men) and <16 kg (women) reflected reduced muscle strength (Dodds et al., 2014). For the Timed Up-and-Go (TUG), a threshold of ≥20 sec was considered an indicator of impaired physical function (Bischoff et al., 2003). The functional reach test was used to assess physical function. This measured the position of the end of the third metacarpal joint along the yardstick on the wall, placed at the height of the acromion level, while the patient was reaching as far as possible in a standing position without losing balance (Duncan et al., 1992). GIMA code 27320 caliper was used to measure triceps skinfold thickness.

Food intake was assessed using 24-hour recall dietary assessment and by asking patients to self-report if their food intake decreased for more than 2 weeks. Any gastrointestinal complaints related to eating difficulties, dysphagia, nausea, vomiting, diarrhea, and constipation were recorded to evaluate food assimilation. Clinical data were extracted from the electronic medical record. Clinical signs were used to confirm inflammation. Albumin and ferritin levels were analyzed according to laboratory protocol. Functional performance was evaluated with the Katz Index of Independence in Activities of Daily Living (Katz and Stroud, 1989) and the Lawton Brody Instrumental Activities of Daily Living Scale (Lawton and Brody, 1969). Higher scores on the the Katz and Lawton–Brody Index indicated better functionality and independence. Cognitive assessment was performed with Six-Item Cognitive Impairment Test (6 CIT). Based on the 6 CIT score, cognitive function was categorized as normal (<10), mild impairment (Brooke and Bullock, 1999; Enge et al., 2024), and significant impairment (≥20). Questions about feeling down and losing interest or pleasure in doing things were asked to screen for depression (Whooley et al., 1997).

To determine the most appropriate items to screen nutrition risk and assess malnutrition, an eight-step approach was used, including correspondence analysis, generation of the pool item, content validity, internal consistency, construct, criterion, face validity, and reliability. Expert nutrition assessment was used as the gold standard to test the tool's validity. Kohen's kappa (k) was used to quantify agreement between raters and screening instruments. Agreement was considered perfect (k > 0.90), strong (0.81–0.90), moderate (0.61–0.80), weak (0.41–0.60), and minimal (<0.4) (McHugh, 2012). Correlations between variables were tested using Spearman's and Pearson's coefficients. Chi-square and ANOVA were used to compare different groups. Statistical analyses were performed using the Statistical Package for Social Sciences (Windows, version 29.0) and Microsoft Excel.

Results

Items with similar response categories were identified. If an item was significantly associated with the MNA-FF score, it was found to be appropriate for inclusion in the tool (Table 1). After identifying nutrition status assessment-related topics via correspondence analyses, a literature review was performed. Two items identified through correspondence analysis as indicators of nutritional status were removed to avoid redundancy. Objectively assessed non-volition weight loss replaced self-assessed weight change. Individual items were rated for relevance using a Likert scale, ranging from 1 (completely irrelevant) to 4 (very relevant). The content validity index (CVI) was computed:

$$CVI = \frac{\text{number of raters with 3 to 4 scores}}{\text{overall number of raters}}$$

Table 1. Results of correspondence analyses

Concept	Item	Note
Weight changes, changes in appetite	1. Decrease in food intake due to appetite loss, digestive problem, chewing, or swallowing difficulties (NO) 2. Weight loss during the past three months (NO) 3. Psychological stress or acute illness in the past three months (NO) 4. Weight change in the past six months (NO)	Most study participants respondedNO to a decrease in food intake, loss of weight,psychological stress/acute illness, three items included in MNA-FF, and to the question related to weight change in the past six months.
Food intake, assimilation	Food intake 1. Number of full meals, ≥2 (YES) 2. Fruit and vegetables, ≥2 servings (YES) 3. Meat, fish, poultry intake, every day (YES) 4. Legumes or egg, ≥2 servings per week (YES) 5. Milk or dairy products, ≥1 servings (YES) 6. Fluid intake (NO) 7. Mode of feeding (NO) 8. Grocery shopping (NO) 9. Meal preparation (NO) 10. Skipping meals (NO) 11. Eating meals with company, almost always (YES) 12. Depression (NO) Assimilation 1. Dentures (NO) 2. Chewing food difficulties (NO) 3. Dysphagia (NO) Self-perceived nutritional status (YES) Self-perceived appetite (NO)	The first eight questions are included in MNA-FF. Items 8–11 are included in SCREEN II, except for eating meals with company. Most subjects responded NO Self-perceived nutritional status was included. Self-perceived appetite was excluded.
Medication use	1. Taking over three prescription drugs per day (YES) 2. Taking disease-specific medication (YES)	The first item is included in MNA-FF. The second item covers a broader concept of medication use.
Medical history, self-perceived health status	Medical history 1. Having specific chronic diseases (YES) 2. Having acute diseases (YES) 3. Recent hospitalization (NO) 4. Number of chronic diseases (NO) 5. Cane and walkers (NO) 6. Hearing aids (NO) Self-perceived health status 1. Self-reported health status compared with peears (as good) 2. General health self-perception (good)	First two items could be considered appropriate. First item is included in MNA-FF, second covers broader concept (considered appropriate).
Functional/social performance	1. Mobility (NO) 2. Katz Index ("independent") 3. Lawton-Brody scale ("independent") 4. Timed Up-and-Go (≥20 sec) 5. Having hobbies (YES)	No variation in responses were found regarding the mobility (not included).
Cognitive function	Overall score and individual items corresponded to YES	Items "Say the months of the year in reverse" and "Repeat the address phrase" could replace the 6 CIT test.
Biochemical analyses	1. Albumin level (NO) 2. Ferritin level (NO)	None of the laboratory tests were included.

Each individual question had a CVI of 1, which was considered adequate. Qualitative analysis was used. Most raters stated that the tool should be completed by trained health professionals (rather than self-administered), and suggested minor changes in the wording.

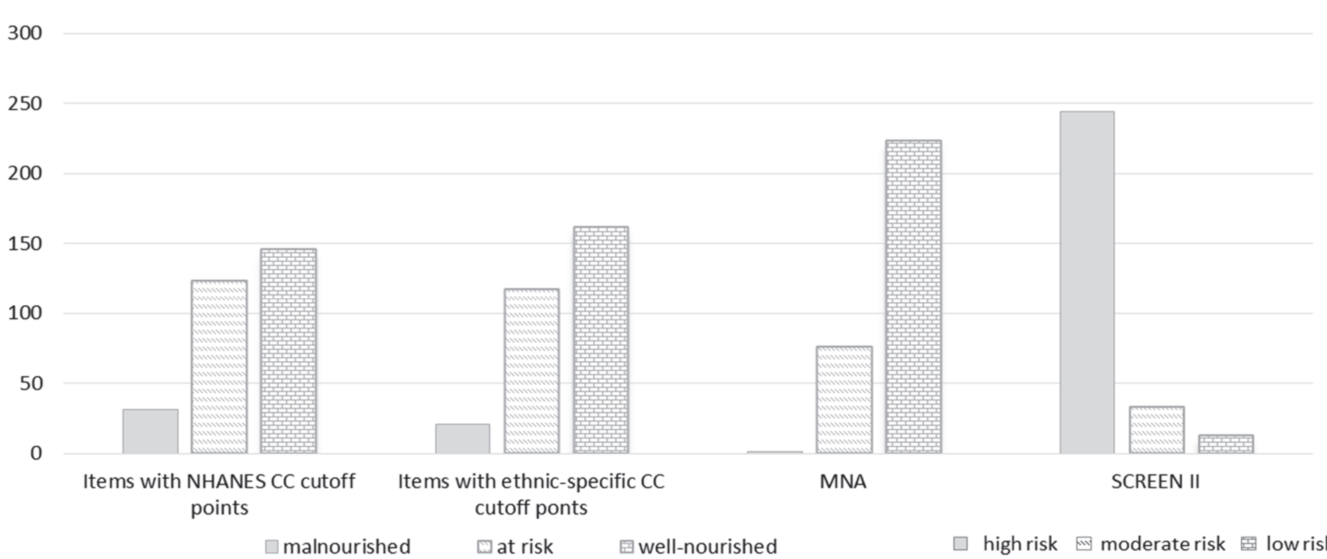
Item discrimination was assessed by analyzing correlations between individual items and the total score (Table 2). In men and women, significant correlations were found between most individual items and the total score. For each item, the minimum recommended Spearman's correlation coefficient of 0.2–0.3 was met, except for the number of full meals. This item was omitted from the questionnaire. BMI was retained because the association between BMI and the total score was significant in women. The last item combined measurements of CC and MUAC with HGS. When NHANES and ethnic-specific CC cutoff points were applied separately, item discrimination did not differ significantly. The final version of the tool included 14 items (see Supplementary materials).

Table 2. Association between individual items and total score in the draft nutrition risk assessment tool

Item	Men	Women	Total
Body mass change	0.364*	0.314*	0.338*
Body mass index	0.148	0.365*	0.276*
Number of full meals	0.063	0.013	0.023
Dairy product intake	0.203***	0.260*	0.233*
Beans/eggs intake	0.600*	0.567*	0.583*
Meat intake	0.670*	0.517*	0.589*
Fruit and vegetable intake	0.640*	0.587*	0.610*
Food intake reduction	0.257**	0.299*	0.280*
Self-perceived nutritional status	0.334*	0.497*	0.423*
Eating with company	0.461*	0.409*	0.431*
Chronic diseases	0.257**	0.403*	0.336*
Use ≥3 medication	0.415*	0.428*	0.420*
Having acute disease/condition	0.201***	0.214*	0.208*
Self-perceived health status	0.388*	0.556*	0.481*
Hobbies	0.378*	0.399*	0.391*
Repeated memory phrase	0.513*	0.464*	0.485*
Muscle mass reduction	0.351*	0.410*	0.367*

Note: Spearman correlation coefficient was used, * $p < 0.001$, ** $p < 0.005$, *** $p < 0.05$

The possible range score on the assessment tool was 0–21. Lower scores indicated nutrition risk. The mean total score in the overall sample was 15.23 ± 3.14 (range 7–21, median 16); for men 14.95 ± 3.18 (range 7–21, median 15) and for women 15.44 ± 3.10 (range 8–21, median 16). When NHANES CC cutoffs (<33 cm / <32 cm) were applied for muscle mass reduction, 31 (10%) participants were identified as malnourished, 123 (41%) were at risk of malnutrition, and 146 (49%) had normal nutrition status. With ethnic-specific CC values (<31 cm for men and <29 for women) as the indicator of muscle mass, 21 (7%) were in the category of malnutrition, 117 (39%) at risk of malnutrition, and 162 (54%) had normal nutrition status. The agreement between MNA-FF (k = 0.505), SCREEN II (k = 0.398), and the assessment tool was minimal to weak (Chart 1).



Legend: MNA-FF – Mini Nutritional assessment full form, SCREEN II – Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II. Nutrition risk categories are shown separately for SCREEN II

Chart 1. Classification of subjects into nutritional risk category

The total score of the assessment tool was compared to screening instruments and objective measures. Positive, statistically significant correlations were found between the total score and MNA-FF score ($\rho = 0.768$, $p < 0.001$), and the SCREEN II score ($\rho = 0.509$, $p <$ 001). Study participants with normal nutrition status or who were at risk of malnutrition had a lower 6 CIT score compared to the individuals with malnutrition (Table 3). The correlation between MUAC and BMI (men, $\rho = 0.465$, $p < 0.001$; women, $\rho = 0.613$, $p < 0.001$) was weak to moderate. The correlation between MUAC and CC was weak to moderate ($\rho = 0.551$ men; $\rho = 0.324$ women, $p < 0.001$).

Table 3. Correlations between the total score of the nutrition risk assessment tool and other indicators of nutrition risk

Test	Men	Women	Total
MNA-FF	0.783*	0.753*	0.768*
SCREEN II	0.524*	0.492*	0.509*
6 CIT	–0.576*	–0.448*	–0.510*
Functional reach test, cm	0.474*	0.483*	0.472*
Timed-up-and-go, sec	0.317*	0.342*	0.330*
ADL	0.103	0.136	0.121***
IADL	0.103	0.103	0.102
BMI, kg/m^2	0.100	0.261*	0.201*
Mid-upper arm circumference, cm	0.108	0.172***	0.043
Calf circumference, cm	0.317*	0.342*	0.330*
Handgrip strength, kg	0.488*	0.408*	0.436*
Triceps skinfold thickness, cm	0.336*	0.352*	0.344*

Note: MNA-FF – Mini Nutritional Assessment full form, SCREEN II – Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, 6 CIT – Six-Item Cognitive Impairment Test, ADL – Activities of Daily Living, IADL – Instrumental Activities of Daily Living, BMI – Body Mass Index, * $p < 0.001$, ** $p < 0.005$, *** $p < 0.05$

The assessment tool's accuracy was measured against clinical judgement as a reference standard. When ethnic-specific CC cutoff values were applied, Se (90.4%), Sp (81.6%), PPV (75.4%), and NPV (93.2%) were considered good to differentiate the primary care patients with normal nutrition status from those with malnutrition/risk for malnutrition. Metrics (Se = 86.1%; Sp = 70%; PPV = 64.3%, and NPV = 89%) were lower with NHANES CC cutoff values. The tool's sensitivity to distinguish all older adults with malnutrition from those with normal nutrition status/risk of malnutrition was higher with NHANES CC cutoff values (95.8% vs. 87.5%), but Sp (97.1% vs. 100%), PPV (74.2% vs. 100%), NPV (89.5% vs. 98.9%) were lower in comparison to ethnic-specific CC cutoff values.

The distribution of mean values for MNA-FF, SCREEN II, 6-CIT, anthropometric measurements, physical function, and functional performance tests according to the scoring categories of the assessment tool is shown in Table 4. To test face validity of the tool, cognitive interviewing was used. Responses were analyzed and necessary changes were made. The final version of the tool included 14 items.

Table 4. Mean values of nutrition risk indicators according to scoring categories of the nutrition risk assessment tool

Test	Scoring categories			p
	Malnourished ≤10	At risk 11–15	Well-nourished 16–21	
MNA-FF	21.59 ± 2.13	24.76 ± 2.46	27.97 ± 1.69	<0.001
SCREEN II	38.59 ± 5.89	40.39 ± 6.29	45.98 ± 5.94	<0.001
6CIT	10.97 ± 5.67	8.52 ± 5.71	4.58 ± 3.12	<0.001
Functional reach test, cm	24.06 ± 9.20	26.73 ± 10.75	35.29 ± 10.10	<0.001
Timed-up-and-go, sec	31.03 ± 3.37	33.94 ± 6.87	34.75 ± 3.26	<0.001
ADL	5.97 ± 0.18	5.99 ± 0.91	6.00 ± 0.00	0.140
IADL	7.87 ± 0.71	7.96 ± 0.32	8.00 ± 0.00	0.104
BMI, kg/m^2	25.87 ± 5.17	27.55 ± 4.84	28.61 ± 4.86	0.010
Mid-upper arm circumference, cm	27.13 ± 3.93	27.49 ± 3.70	27.68 ± 3.42	0.711
Calf circumference, cm	31.03 ± 3.37	33.94 ± 6.87	34.75 ± 3.26	<0.001
Handgrip strength, kg	19.00 ± 3.38	19.77 ± 5.50	24.46 ± 7.86	<0.001
Triceps skinfold thickness, cm	12.62 ± 4.46	15.84 ± 7.87	18.66 ± 6.62	<0.001

Note: MNA-FF – Mini Nutritional Assessment full form, SCREEN II – Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, 6CIT – Six-Item Cognitive Impairment Test, ADL – Activities of Daily Living, IADL – Instrumental Activities of Daily Living, BMI – Body Mass Index

Discussion

This study described the development of the nutrition risk assessment tool in the primary care setting. Concepts incorporated in the tool reflect phenotypic and etiologic criteria, proposed by GLIM consensus (Cederholm et al., 2019). Good internal consistency and correlation with objective measures of nutrition status suggest that this tool may be used as an alternative method when nutrition experts are unavailable, or equipment is limited. The agreement between MNA-FF and the assessment tool in detecting malnutrition was moderate, whereas expert nutrition assessment detected cases of malnutrition that were not identified by MNA-FF. Previous studies have found that the choice of screening instrument has an impact on variations in the malnutrition rate (Enge et al., 2024; Henriksen et al., 2022).

Performing a screening step in older adults who are at risk of malnutrition, such as hospitalized individuals, may be unnecessary. Whether nutrition status screening should be performed on primary care patients prior to the assessment and incorporation of GLIM criteria requires further research, but detailed assessment among this population is needed to identify nutrition problems and plan nutrition care as necessary. Reduced muscle mass was evaluated with the combination of CC and MUAC, whereas HGS was used as a supportive measure (England and Cheng, 2024). In contrast to a "previous studies" the frequency of peripheral edema was not very high in the studied population, and CC measurements were feasible. This finding is in line with the recommendation of Barazzoni et al. (2022). Authors have suggested a CC cutoff value <31 cm as an acceptable alternative for DEXA in the evaluation of reduced muscle mass (Sobestiansky et al., 2021). In the current study, ethnic-and sex-specific MUAC cutoff values were used as a proxy, without adaptation for obesity/overweight. Charlton et al. found a significant correlation between BMI and MUAC and identified MUAC cutoff <24 cm as reference value corresponding to BMI <18.5 kg/m^2 (Charlton et al., 2005). Several other studies have shown a positive correlation between MUAC $\leq$ 22.5 cm and BMI <18.5 kg/m^2 (Musa et al., 2022). There is no consensus regarding the most appropriate MUAC reference standards for sarcopenia and malnutrition in elderly individuals. A recent study conducted in China identified MUAC ≤28.6 cm / ≤27.5 cm as cutoff values for reduced muscle mass against appendicular skeletal muscle mass index as the reference standard (Hu et al., 2021). As GLIM consensus adopted new cutoff values for reduced BMI, BMI may not be considered a good criterion to validate ethnic- and sex-specific MUAC and CC cutoffs.

Future studies are needed to investigate whether recording basic measures of anthropometric parameters in electronic medical records when a comprehensive geriatric assessment is initiated may contribute to monitoring skeletal muscle mass over time. The majority of the study participants had reduced HGS, but low values were more frequently found among older adults categorized as malnourished. Notwithstanding the fact that the contributing factors for the development of malnutrition and sarcopenia frequently follow different pathophysiological pathways, unaffecting each other, these two conditions often coexist (Din et al., 2019). Reduced muscle mass may follow the changes in muscle function or could be the cause of reduced muscle function (Lauretani et al., 2003). The GLIM guidance for evaluating the muscle mass phenotypic criterion (Barazzoni et al., 2022) recommends assessing skeletal muscle function. Evaluation of muscle function may not only add to insights into patients' nutrition status but also their functional performance (Tatum et al., 2018). While we used HGS as an indicator of muscle function, primary care practices could also perform alternative tests, such as a knee/extension test, without a need for specific equipment. The European Working Group on Sarcopenia in older people 2 has recommended several tests to evaluate muscle properties and performance: gait speed, TUG, 4 m walking, and Short Physical Performance Battery Protocol (Cruz-Jentoft et al., 2019). While TUG performance was increased among all study participants, average time to complete the test was longer in individuals with malnutrition or who were at risk of malnutrition. Obesity also negatively affects nutrition status and skeletal muscle mass/function loss through metabolic abnormalities, ectopic muscle fat accumulation, comorbidities, and sedentary lifestyle (Barazzoni and Gortan Cappellari, 2020). To diagnose malnutrition, at least one of three GLIM phenotypic criteria needs to be fulfilled. As a result, the malnutrition assessment could be improved in older adults with high BMI (Barazzoni and Gortan Cappellari, 2020).

Biomarkers have been recommended as alternative indicators. Clinical judgement guided the confirmation of inflammation in relation to the disease burden, integrating the presence of underlying acute conditions, chronic diseases, and clinical signs of inflammation (Cederholm et al., 2024). In our study, CRP measurements were not available to support an assessment of inflammation. Albumin and ferritin test results were available, but albumin and ferritin have little validity in the assessment of inflammation (Evans et al., 2021). In the current tool, only an item evaluating prescription drugs was included. Although a recent study in humans found an association between polypharmacy and pro-inflammatory cytokines levels (Wu et al., 2022), the decision to keep the item related to polypharmacy was led by scientific evidence. This evidence suggests that medications for chronic diseases, such as anti-hypertensives, can reduce food taste perception, leading to appetite loss in the elderly, ultimately resulting in decreased food intake and energy imbalances (Kuzuya, 2023).

To ensure evidence-based evaluation of all parameters included in the assessment tool, collaborative clinical training sections for primary care clinicians, nurses, and nutritionists may be required in the future (Cederholm et al., 2024). It would also be useful to test the tool on a larger sample or apply it to different populations.

Limitations

We evaluated food intake using the retrospective 24-hr dietary recall method. A diet record completed over several days would have provided more information, but it was not feasible in our study. Serial CRP measurements were not performed to confirm the fulfilment of the inflammation criterion. The contribution of inflammation was certain, laboratory confirmation was not required. The MUAC and CC measurements confirmed the low muscle mass criterion. Direct methods were not feasible in primary health care, but these would provide better precision of skeletal muscle mass measurement.

Conclusion

The developed tool has acceptable validity and consistency for providing nutrition risk assessment among older adults in primary care settings. All GLIM criteria were feasible and incorporated into the tool. The findings can be generalized to similar settings and elderly populations. There was no missing data. Further research is necessary to explore how staff training, motivation, acceptability, and designated time influence the performance of the tool in primary care practices and long-term monitoring of its effectiveness. Future studies need to examine the effect of routine nutrition risk assessment on clinical outcomes and malnutrition management. It would also be useful to test the tool on a larger sample or apply it to different populations.

Data availability

The derived data supporting the findings of this study are available from the author (JR) upon request.

Acknowledgement

The SCREEN II questionnaire is the copyright of Dr. Heather Keller and has been used with permission.

Ethical aspects and conflict of interest

The authors have no potential conflict of interest to declare with respect to the research, authorship, and/or publication of this article.

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