Validation of Nutritional Assessment Tool for Ethiopian Old Age People

Ahmed Muhye Seid[1,2,*], Netsanet Fentahun Babbel[3]

ABSTRACT

Introduction: The nutritional status of old age people is frequently overlooked in many low-income countries, like Ethiopia, although appropriate nutritional assessment improves their health. The Mini Nutritional Assessment tool has multiple versions with confirmed validity in diverse languages but not in Amharic. Thus, this study aimed to translate Mini Nutritional Assessment tool into the Amharic language and validate it among old age people in Bahir Dar City. **Materials and Methods:** The study was cross-sectional and conducted in three stepwise phases from January 16 to March 13, 2021. A total of 10 experts and 180 community-dwelling old age people were respectively selected in heterogeneous purposive sampling and multistage cluster sampling from Bahir Dar City. Principal component analysis was used to measure construct validity while Cronbach's alpha was employed to assess internal consistency reliability. **Results:** As experts reviewed, all items in the translated tool are socially acceptable and have no taboo or sensitive words. The translated tool's item content validity ranged from 0.60 to 1.00 and its content validity ratio was 0.93. Moreover, the construct validity of the tool was confirmed with factor loadings ranging from 0.47 to 0.89 with a Cronbach's alpha of 0.65. The tool had a sensitivity and specificity of 97% and 83%, respectively. **Conclusion:** The Amharic version of the Mini Nutritional Assessment tool showed good cross-cultural adaption, internal consistency reliability, and construct validity in Bahir Dar community-dwelling old age people. The tool can be used in regular care activities for aged people.

Keywords: Malnutrition, MNA tool, Old age people, Translation, Validation, Ethiopia.

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INTRODUCTION

Expansions in public health, along with changes in clinical interventions, have resulted in a rise in life expectancy in almost every area of the world. As a result, the global population shifted towards an older age structure, known as population ageing, which is progressive and rapid. The rate of ageing has been faster in low and middle-income countries than in high-income countries.[1]

Ethiopia has also been undergoing rapid reductions in infant and child mortality, fertility, and increases in life expectancy, putting the country in the third stage of demographic transition.[2,3] The proportion of old age people increased to 5.3% (5,553) at the end of 2017.[4] The country was also ranked in the 29th place of the top 50 countries with the largest number of old age people (65 years and above) in 2019.[5] If the current demographic projections for the country hold, population ageing would accelerate and 19.4 million (about 10.3%) of its population would join the club of the elderly by 2050.[6]

Various physiological and pathological changes occur as people get older that could influence their nutritional intake and efficiency of nutrient utilization. Impaired nutritional status simultaneously aggravates existing disease conditions and worsens the health status of older adults.[7] Globally, malnutrition prevalence among older people varies based on the definition used, screening tools, study settings, diversity of study members, and geographical location. This impedes the comparison between studies.[8,9]

To the best of our knowledge, the nutritional measurement tool was neither developed for nor has yet been rigour validated for Ethiopian old age people. The lack of validated tools troubles the accuracy of the data generated and its extrapolation to a larger population, as well as the ability to compare findings through studies. Subsequently, low-quality data can have a negative influence on policies and services, as well as the efficient use of resources.[10] Therefore, this study aimed to translate and validate the Mini Nutritional Assessment (MNA) tool for Ethiopian old age people in order to fill these gaps and support future nutrition interventions in Ethiopia. Hence, this study was designed to translate Mini Nutritional Assessment tool into the Amharic language and validate it among old age people in Bahir Dar City.

MATERIALS AND METHODS

Study setting

This study was conducted in Bahir Dar City, the capital of the Amhara Regional State. Bahir Dar is located in Amhara Regional State, Northwest Ethiopia, which is 565 km away from Addis Ababa, the capital city of Ethiopia.

Study design and period

A cross-sectional study design was conducted from January 16 to March 13, 2021.

Study population

This study utilized two groups of the population. The first group were health care experts used for content validation, and the second group were community-dwelling old age people for psychometric validation.

Sample size and sampling procedures

For the expert judgment, 10 healthcare experts were selected based on the guideline recommendation for the Delphi technique.[11] Two health care professionals each from human nutrition and clinical pharmacy trained at masters' degree level, nurses trained at BSc level, general medical practitioners, and internists were selected as the panelists. These professionals were selected based on the maximum variation or heterogeneous purposive sampling for their professional experience in the care of old age people. Furthermore, their familiarity with research (at least in his/her graduate paper) and a minimum of one year of working experience were considered as inclusion criteria.

For the psychometric validation, a participant-to-variables ratio of 10:1 was followed as a rule of thumb. The rule states that at least 10 participants are required for each questionnaire item for factor analysis.[12] Since MNA has 18 items, a minimum of 180 study participants were selected for this validity test. Community-dwelling old age people selected in multistage cluster sampling from Belay Zeleke, one of the sub-cities of Bahir Dar City, were used for this study. Community-dwelling old age people who fulfill the following inclusion criteria were selected for the study: age 60 years and above, living in the city administration at least for six months, being capable of describing their lived experience, and able to understand and speak the Amharic (local) language. This study excluded participants who had significant spine curvature (scoliosis or kyphosis) and had both extremities amputated.

Validation process

We followed standard COSMIN Study design[13] and reporting[14] guidelines for this tool translation and validation study. The study was conducted in three stepwise phases. The first phase was reviewing existing nutritional assessment tools for old age people. In the second phase, selection, translation, and review of the tool by experts were conducted. In the last phase, psychometric validation among community-dwelling old age people was performed.

Review of Existing Nutritional Assessment Tools

There is no international consensus on a single best nutritional measurement tool for old age people.[15] Over the last decades, more than 48 nutrition screening and/or assessment tools have been developed across different care settings (community, care-home, hospital).[8] Thirty-four of these tools have been validated in older adults, and 23 of them were created expressly for this population.[16] Furthermore, undoubtedly, there may be many unpublished, validated or not tools that the investigators are unaware of.

From the several old age nutritional assessment techniques available, the Mini Nutritional Assessment (MNA) instrument was chosen to translate and culturally modify for our community due to its simple and rapid assessment of nutritional status that fulfils the following criteria: (a) a reliable scale, (b) threshold definitions, (c) consistency with the skills of a specialist assessor, (d) minimum bias introduced by the data collector, (e) patient acceptability, and (f) low cost.[17] Furthermore, the MNA questionnaire is (a) effective for assessing the intake of nutrient-dense food groups and allowing nutritional intervention,[18] (b) self-or interviewer-administered,[19] which is preferable for our study participants that include majorly illiterate people.

The MNA is both a screening and assessment tool[19] that was developed in 1989 by the Nestle Nutrition Institute in Lausanne, Switzerland for elderly people.[20] It is the most often validated and accepted tool, even considered as a 'semi-gold standard' nutritional assessment tool for old age people, no matter the care settings.[8] It has different versions with confirmed validity in different languages, except in Amharic.[21] The original version consists of 18 questions/items (A-R) grouped into four domains: anthropometric measurements (4 items), dietary assessment (6 items), general health assessment (6 items), and subjective self-perception of health and nutritional status (2 items). Each question on the entire MNA has a weighted score, which is added to the overall assessment score to determine the nutrition categorization. The collective score ranges from zero to 30, grouped into three types. The MNA scores below 17 indicate malnutrition, scores of 17 to 23.5 indicate the study participant is at risk of malnutrition, and any score of 24 or higher shows the normal nutritional status.[19,22]

Translation and Cultural Adaptation of the MNA Tool

Permission was granted by email from the Nestle Nutrition Institute in Lausanne, Switzerland, the tool's original developers and owners, to translate and culturally adapt an Amharic version of the MNA. The English version of the MNA questionnaire was initially translated into the Amharic version (local mother tongue) independently by bilingual internists and human nutritionists trained at master's degree level. These two translators were selected respectively as they are experienced in care providing for old age people and nutrition research and might be familiar with the intent of each item and/or the tool as a whole. The two Amharic versions were then combined, and any inconsistencies were settled by consensus. The translated Amharic version was next translated back into the original English language to ensure the accuracy of the translation. This was done again by two independent bilingual, native Amharic-speaking language translators trained at masters' degree level. Finally, the experts' group reviewed both versions of the translations and reached a conclusion on all items to get a final version of the translated questionnaires (Figure 1).

Data collection

Data were conducted from two groups: healthcare experts and community-dwelling old age people, in exploratory mixed qualitative and quantitative methods. Each expert evaluated the content validity of the tool through face-to-face contact. The content validity survey includes a cover letter describing why experts were requested to participate, evaluation forms with simple and clear instructions on how to assess each item, and the Amharic version of the MNA questionnaire. The evaluation forms focus on the following four questions: (1) the relevance of each item and response options in the tool; (2) the essentiality of each item and response options; (3) the clarity of words in each item and response options; and (4) suggestions for item and response options improvement. A three-point Likert scale was included in the responses. The relevancy scale was 1 to 3, with 1 being not relevant, 2 being slightly
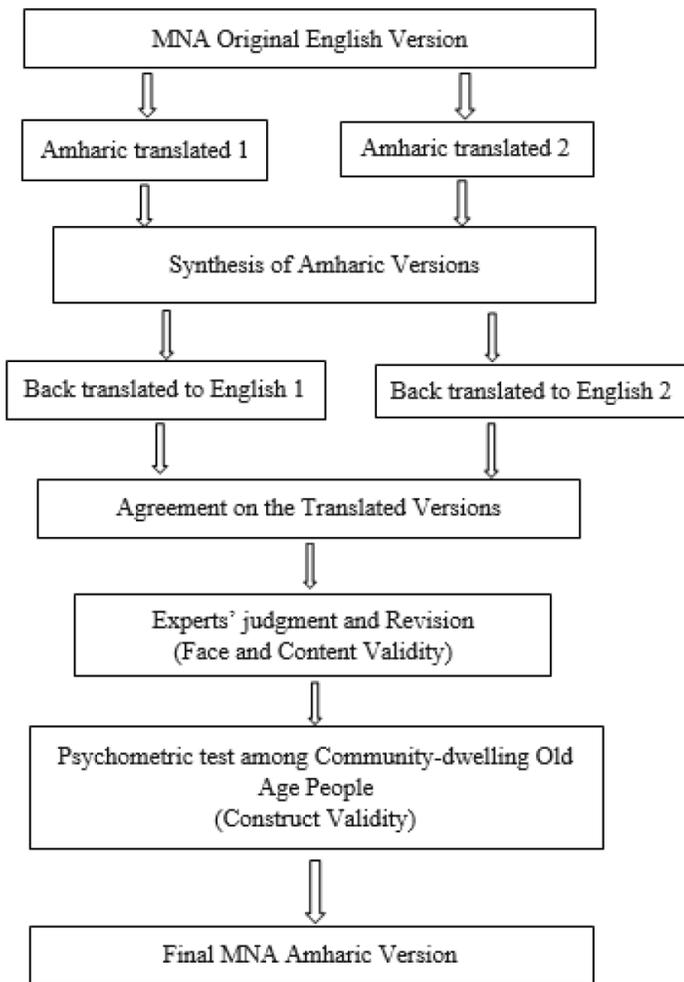
Figure 1: Validation process of the Amharic version of MNA tool, Bahir Dar City, 2021.

relevant, and 3 being very relevant. The essentiality scale went from 1 to 3, with 1 being non-essential, 2 being useful but not essential, and 3 being essential. Similarly, the clarity rating was: 1 = not clear; 2 = item requires some editing; and 3 = very clear. Items with ratings of 1 and 2 are estimated invalid/not essential/not clear, while items with ratings of 3 are considered valid/essential/clear.[23-25]

After incorporating the experts' comments, psychometric evaluation was conducted among community-dwelling old age people. The data were collected by six urban health extension workers and six BSc nurses after two days of training. A master's degree-trained nutritionist supervised the data collection process. Face-to-face interviews were conducted first, followed by anthropometric measurements using the standardized Amharic version of the MNA questionnaire. The standard procedures for nutritional assessment of old age people[19,26,27] were followed in the data collection procedures. The height and weight were measured using a portable stadiometer and weight scale (Seca 213 scales, Hamburg, Germany), respectively. The calf and mid-upper arm circumferences were quantified with an inelastic tape measure from the nondominant leg and arm, respectively.

Data Analysis

The international business machines corporation statistical package for the social science (IBM SPSS) version 23[28] was used to analyze the data. The statistical assumptions of normality and outliers were first checked. No severe multivariate outliers were found using the squared Mahalanobis distance ($d^2 > 0.05$)[29] for each item, and none were eliminated.

Validity measurement

Data for face and content validity were analyzed using both qualitative and quantitative methods in between two rounds of Delphi techniques. The experts' and old age people's comments were used for language clarity, grammar, suitable scoring, and item applicability in the qualitative content validity approach.

The numerical content validity was measured by three content validity indexes to evaluate the experts' agreement. Item content validity index (I-CVI) was first calculated by dividing the number of experts who gave the instrument a 3 (relevance) rating by the total number of experts who rated it. When there are more than five experts, I-CVI should not be less than 78%.[24] The second content validity index was the scale content validity index (S-CVI), which was estimated using two indices. The first was the universal agreement by experts (S-CVI/UA), calculated as the proportion of items on the scale rated as 3 (relevance) by experts out of the total number of items. The second was the average agreement by experts (S-CVI/Ave), calculated as the total scores of I-CVI (relevance) by the total number of items. Both the S-CVI/UA and S-CVI/Ave indexes have an acceptable standard of 80%.[24,25]

The third content validity was the content validity ratio (CVR), estimated using the formula: , where N is the total number of panelists and Ne is the number of panelists who indicate essentiality scale3(essential).[23] Then, items with more than 0.62 CVR value based on Lawshe's table for 10 experts[30] were deemed acceptable and kept for further investigation.

After integrating the comments and suggested corrections given by experts, the semi-final Amharic versions of the tool were produced for psychometric validation. We utilized principal component analysis (PCA) with Promax rotation to examine if the items in the study were structured similarly to the original questionnaires. To assess the appropriateness of the factor analysis, we first utilized Bartlett's test of sphericity ($p = 0.05$) and the Kaiser-Meyer-Olkin (KMO) measure of sample adequacy (with values more than 0.60 considered acceptable). Then, the following recommendations were taken into consideration during the data analysis: the eigenvalues ≥ 1.0 and screen plot to determine the number of factors; more than 60% of the variance explained by the factors represented in the data; and factor loading greater than 0.4.[31]

Furthermore, the concurrent criterion validity of MNA was investigated using two independent statistical methods: Spearmen's correlation coefficient (ρ=Rho) and a receiver operating characteristic (ROC) curve. The coefficients of Spearman's rank correlation between the overall MNA score and the criteria of other items were determined. Participants' anthropometric measurements (BMI, CC, MUAC) as well as self-perceived nutritional status were utilized as a reference to validate MNA using ROC curves. Youden J statistics were applied to determine the sensitivity and specificity cutoff values.[32] Finally, the reliability of the tool was measured based on the internal consistency of the Cronbach's alpha (α) coefficient.[33]

Reliability measurement

The Cronbach's alpha (α) coefficient of 0.60 and above was recognized as an indication of the internal consistency of the tool.[33] Additionally, the item-total correlation (ITC) was calculated using the Spearman correlation coefficient between the individual item's score and the total of the remaining item's scores. With values greater than 0.30, indicating item suitability.[34]

RESULTS

Profiles of the study participants

A total of 10 experts from both sexes evaluated the Amharic version of the MNA questionnaire. The majority of the experts were males, aged between 25 and 34 years, and had more than two years of working experience. Although they were conscious of the existence of the tool, they were not trained and not used it (Table 1).

Moreover, a total of 180 community-dwelling old age people aged from 60 to 90 years old participated in the psychometric evaluation. The mean age was 69.44, with a standard deviation of 6.8. The majority of the study participants were females (61.7%) and orthodox religious followers (73.9%). More than half (53.3%) of the respondents were married, and 40% of them could not read and write. Only 10.6% of those surveyed lived alone, while other respondents lived with their spouses (54.4%), their children (32.8%), and other people (2.3%) (Table 2).

Validity of the Amharic Version of the Mini Nutritional Assessment Tool

Face and content validity

As experts reviewed, all items in the tool were socially acceptable and had no taboo or sensitive words. Based on the experts' comments and recommendations, however, minor and major modifications were made after the first round and sent for the second-round evaluation. The minor changes included elaborations to make the item clearer and more precise, as well as the substitution of more relevant Amharic terms and phrases. The major modifications were to the item sequences and the replacement of one item (H: lives independently or not in nursing homes) with another important item. Most experts raised a question about the importance of asking a participant about "living in a nursing home" when there is a lack of nursing homes or institutions for aged people in Ethiopia. Even where it is available, most elderly people are not interested in living there, while others live there due to economic problems and not only physical dependency.

Hence, we assemble all the anthropometric measurement items at the end of the questionnaires to make it easy for both data collectors and study participants. In addition, we replaced item (H) with the experts' recommendation of "having chronic diseases" by reversing the point given for the choice of answers (Yes = 0, No = 1). While item (F: calculation of body mass index) was included for the second-round evaluation, through most experts expressed reservations about its applicability. This is because the experts' worries were the lack of materials to measure it

Table 1: Demographic characteristics of experts for content validation of Amharic versions of MNA tool, Bahir Dar, 2021.

Sl. No	Experts' characteristics		Frequency	Percentage
1.	Sex	Females	3	30
		Males	7	70
2.	Age	25-29	4	40
		30-34	6	60
3.	Department	Human nutrition	2	20
		Nurse	2	20
		Medicine	4	40
		Clinical pharmacy	2	40
4.	Years of working experiences	2- 5 years	4	40
		> 5 years	6	60

Table 2: Demographic profiles of the study participants for psychometric evaluation of Amharic versions of the MNA tool, Bahir Dar, 2021.

Sl. No	Respondents' characteristics		Frequency	Percentage
1.	Sex	Females	111	61.7
		Males	69	38.3
2.	Age	60-64	40	22.2
		65-69	56	31.1
		70-74	42	23.3
		75-79	23	12.8
		80-84	11	6.1
		≥ 85	8	4.4
3.	Religion	Orthodox	133	73.9
		Islam	45	25
		Protestant	2	1.1
4.	Marital status	Single	5	2.8
		Married	96	53.3
		Divorced	5	2.8
		Widowed	74	41.1
5.	Educational status	Cannot read and write	72	40.0
		Can read and write	45	25.0
		Primary education	35	19.4
		Secondary education	16	8.9
		Certificate and above	12	6.7
6.	Occupation	House wife	75	41.7
		Pension	62	34.4
		Merchant	25	13.9
		No work	12	6.7
		Daily-laborer	6	3.3
7.	Lived with	Spouse	96	54.4
		Children	59	32.8
		Alone	21	10.6
		Other persons	4	2.3

as well as the challenges of height measurements for elderly people. The resource problem is common in low-income countries, yet the item is one of the key indicators of nutritional problems and mortality in old age people.[35] The height measurement can also be replaced by doubling half the arm-span if the participant is unable to stand, as recommended in the MNA manual.[19]

I-CVI results: each item's relevance

All content validity calculations presented here were after the second round of the Delphi technique. Except for one item, 17 items (94.4%) were marked as relevant, and I-CVIs ranged from 0.60 to 1.00. Nine items had I-CVI score of 1.00, four items had a score of 0.8, and three items had 0.9. One item (E) had 0.6 and another item (L) had 0.7. The I-CVI calculations for the relevancy of each item are presented in Table 3.

Table 3: Ten experts' rating scales on the relevance and clarity of the MNA items and decisions made, Bahir Dar, 2021.

Item code	I-CVI (relevance)	Interpretation	I-CVI (clarity)	Interpretation	CVR	Interpretation	Decision
	1	Relevance	1	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	0.8	Clear	1	Remained	Take the item for psychometric test
	0.9	Relevance	1	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	1	Clear	1	Remained	Take the item for psychometric test
	0.8	Relevance	0.6	Somewhat Clear	0.7	Remained	Take the item for psychometric test
	1	Relevance	0.9	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	0.9	Clear	1	Remained	Take the item for psychometric test
	1 (after another item replacement)	Relevance	1	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	1	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	1	Clear	0.7	Remained	Take the item for psychometric test
	1	Relevance	0.8	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	0.7	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	1	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	1	Clear	0.9	Remained	Take the item for psychometric test
	1	Relevance	1	Clear	0.6	Remained	Take the item for psychometric test
	1	Relevance	0.8	Clear	1	Remained	Take the item for psychometric test
	0.7	Relevance	0.8	Clear	1	Remained	Take the item for psychometric test
	1	Relevance	0.9	Clear	1	Remained	Take the item for psychometric test
Total scores of I-CVI (relevance)		17.4					
Total scores of UA		15					
S-CVI/Ave		0.97					
S-CVI/UA		0.83					

Abbreviations: CVR = content validity ration   I-CVI = item-content validity index   UA = universal agreement
S-CVI/Ave = scale- content validity index/ average agreement   S-CVI/UA = scale- content validity index/ universal agreement

S-CVI results: overall relevance of the questionnaire

We estimated the universal agreement of the overall questionnaire's relevance (S-CVI/AU) by adding all I-CVI's equal to 1.00 (15 items) divided by the whole number of items (18), while the average agreement (S-CVI/Ave) took the sum of all I-CVI (17.4) divided by the whole number of items (18). As shown in Table 3 above, the S-CVI/UA was 0.83 and the S-CVI/Ave was 0.97. Overall, both the universal agreement and the average approach show the high content validity of the MNA.

CVR results

Each item had its own CVR. The Lawshe table has a CVR of 0.62 for a total of 10 experts.[30] Fourteen items had a CVR of 1.00, one had a score of 0.90, and two had a score of 0.70. The average CVR value was 0.94. Fourteen of the items had a CVR of 1.00, one of 0.90, and two of 0.70. Despite the fact that one item (Q) was on the border of being necessary (0.60 versus 0.62), it was not deleted. The CVR was 0.94 on average. An instrument's CVR calculations can be found in Table 3 above.

Table 4: Principal component analysis for Amharic version of MNA among community-dwelling old age people in Bahir Dar city, 2021.

Domains	List of items	Component					
		1	2	3	4	5	6
Dietary assessment	Two or more servings of fruits/vegetables	0.732	-0.041	-0.106	0.029	-0.134	0.058
	Fluid intake	0.683	0.168	0.185	-0.110	0.047	0.015
	Serves of high protein intake	0.568	0.077	-0.089	0.176	-0.373	0.037
	Feeding mode	0.070	0.790	0.357	0.148	0.364	0.168
	Appetite	0.028	0.233	0.220	0.692	0.276	0.134
	Number of meals per day	0.120	-0.045	0.082	0.210	0.248	0.728
Global assessment	Mobility	0.045	0.785	0.293	0.206	0.286	0.156
	Neuropsychological problems	-0.022	0.651	-0.165	0.180	-0.139	-0.018
	More than 3 prescription drugs per day	-0.149	0.197	0.890	0.143	0.112	-0.007
	Non communicable disease	0.051	0.117	0.880	0.029	0.028	-0.129
	Pressure sores or skin ulcers	-0.064	0.059	0.043	0.096	0.821	0.070
	Psychological stress	-0.052	0.357	0.068	0.291	0.725	0.238
Subjective assessment	Self-view of nutritional status	0.103	0.034	0.148	0.732	0.265	0.425
	Self-view of health status	0.361	0.422	0.317	0.474	0.150	0.298
Anthropometric measurements	Involuntary weight loss	-0.011	-0.201	0.057	-0.774	0.048	0.081
	Body mass index (BMI)	0.141	0.308	-0.197	-0.014	-0.120	0.687
	Mid-upper arm circumference (MUAC)	0.638	-0.160	-0.133	0.185	0.129	0.409
	Calf circumference	0.605	0.022	-0.149	0.056	-0.045	0.491

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

High factor loadings are highlight in boldface to indicate the link with the principal components

I-CVI: Clarity

Nine items had a clarity rating of 1.00 by the experts. While four items scored 0.8, three scored 0.9, one scored 0.7, and another scored 0.6. This indicates 16 items had over 80% agreement of clarity, while the other two items had 70% and 60%, respectively. Thus, all items were included for the psychometric evaluation.

Furthermore, the psychometric study participants were also qualitatively asked at the end about the understandability and acceptability of item questions and responses. Yet, there was no major issue mentioned. Moreover, 20 to 25 min were taken to finish the interview. All study participants answered the questionnaire with no missed responses, which seemed to measure what it has been alleged to do. The authors concluded that the tool did not need modification since the participants' responses were clear and connected to the questions inquired about, and participants did not ask for further clarification.

Construct validity

For the psychometric evaluation, principal component analysis (PCA) was conducted with Promax rotation and Kaiser normalization. The results demonstrated that the KMO quantity of sample adequacy was 0.66 and the significant Bartlett's test of sphericity (chi-square (X^2) = 776.83, degree of freedom (df) = 153, $p<0.001$). It explained 62.8% of the overall variance. All factor loadings were over 0.40 in the component analysis, ranging from 0.47 to 0.89. The items, however, were dispersed and were not organized in the construction in accordance with the four dimensions suggested in the original questionnaire (Table 4).

Moreover, criterion concurrent validity was conducted between the overall MNA score and the anthropometric measures of nutritional status using Spearman's correlation test. At a p-value less than 0.001, total MNA scores were found to have a positive significant correlation with BMI

Table 5: Discrimination values of Amharic version of MNA among community-dwelling old age people in Bahir Dar City, 2021.

Measures	AUC	p-value with 95% CI	Sensitivity	Specificity	Youden's index
BMI (< 18.5 kg/m²)	0.814	0.001(0.706-0.921)	0.70	0.68	0.38
MUAC (≤ 21 centimeter)	0.729	<0.001(0.646-0.812)	0.97	0.83	0.80
CC (<31 centimeter)	0.764	<0.001(0.696-0.831)	0.98	0.69	0.68
Participant's self-perceived as being malnourished	0.823	<0.001(0.763-0.883)	0.97	0.86	0.85

Abbreviations: BMI: Body mass index; CC: Calf circumference; MUAC: mid upper arm circumference

(ρ = 0.580), CC (ρ = 0.443), and MUAC (ρ = 0.348). Likewise, the total MNA score has a positive correlation with the participants' self-perceived nutritional status (ρ=0.579; $p< 0.001$). Furthermore, the area under the curve (AUC) of receiver operating characteristics (ROC) for the MNA and the anthropometric measures showed adequate discrimination values (Table 5).

The AUC for BMI was 0.81 (95%CI: 0.706-0.921, p=0.001), yet the MUAC was more sensitive (97%) and specific (83%), with the best accuracy, maximizing the Youden's index (0.80). While the participant's self-perceived as being malnourished had an AUC of 0.823 (95% CI: 0.763-0.883, $p<0.001$) with more sensitivity (97%) and specificity (86%) than others (Figure 2).
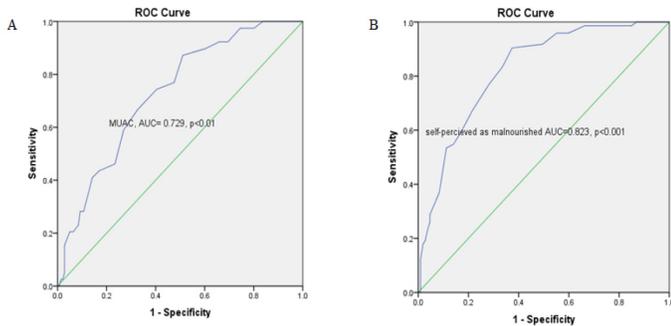
Figure 2: Area under the curve of receiver operating characteristics for MNA total score to predict (A) MUAC < 21 centimeter (B) perceived as malnourished among community-dwelling old age people in Bahir Dar city, 2021.

Reliability

The Cronbach's alpha (α) for the 18 items was 0.65, indicating that the tool has a satisfactory level of internal consistency (reliability). In addition, the corrected item-total correlation (ITC) ranged from 0.106 to 0.526 and the values were relatively low for non-communicable diseases (0.106), dementia (0.125), and the presence of skin ulcers or pressure sores (0.130). The omission of any question, however, lead to a lower Cronbach's alpha level, except for involuntary weight loss, which resulted in 0.661. As a result, we did not want to remove any of the items.

Similarly, the items had a substantial positive Spearman's correlation with the MNA total score, indicating that the tool is reliable. The exception was observed under the item dementia, where the correlation was not significant (Table 6).

DISCUSSION

Given the importance of a valid and reliable tool in the theoretical design and evaluation of health interventions,[18] the findings of this study revealed that the translated Amharic versions of the MNA tool were valid and reliable instruments. According to the experts, the majority of the MNA items were relevant and straightforward to comprehend by the study participants. The wording of a few items has been changed to provide additional clarity according to the face validity findings.

In addition, the values of CVR, S-CVI/Ave, and S-CVI/AU were respectively 0.93, 0.97, and 0.83, which were satisfactory.[36] The CVI is a viable technique for determining the content validity of a novel or reviewed scale. When employing CVI, however, scale designers should remember that all components of the circumstances are being assessed. If the CVI is minimal, it could mean that the items were poorly operationalized versions of the underlying construct, that the construction specifications or instructions to the experts were insufficient, or that the experts themselves were biased, insufficiently skilled, or unpredictable.[37]

In the current study, the PCA revealed all four dimensions of the MNA, and all factor loadings were greater than 0.40. This is consistent with the study conducted in Brazil.[38] However, the overall explained variance of the present study is better than that of the Brazilian study (62.8% versus 52.6%).[38]

While the specificity and sensitivity of the MNA tool presented a broader range due to the lack of a gold standard reference for old age people's nutritional assessment.[15,39] Consequently, the criteria for the validation of the MNA tool vary from simple anthropometry to other nutritional evaluation methods. The initial MNA tool designers claimed that it had a better sensitivity of 96% and specificity of 98%.[22] However, they reviewed

Table 6: Reliability and Spearman's correlation between the 18 items and MNA total score among community-dwelling old age people in Bahir Dar city, 2021 (α = 0.65).

Sl. No	MNA Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Spearman's correlation (ρ)	p-value
1.	Change in dietary intake in the past 3 months	0.429	0.615	0.53	<0.001*
2.	Involuntary weight loss during the last 3 months	0.212	0.661	0.484	<0.001*
3.	Mobility status	0.386	0.640	0.383	<0.001*
4.	Stress or acute disease in the past 3 months	0.266	0.636	0.351	<0.001*
5.	Neuropsychological problems	0.125	0.651	0.109	0.147
6.	Non communicable diseases	0.106	0.655	0.230	0.002***
7.	More than 3 prescription drugs per day	0.162	0.648	0.285	<0.001*
8.	Pressure sores or skin ulcers	0.130	0.650	0.147	0.049***
9.	Number of full meals per day	0.244	0.639	0.369	<0.001*
10.	Protein intake	0.191	0.647	0.240	0.001**
11.	Consumption of fruits or vegetables per day	0.140	0.651	0.274	<0.001*
12.	Fluid intake per day	0.215	0.643	0.303	<0.001*
13.	Mode of feeding	0.376	0.632	0.365	<0.001*
14.	Self-View of Nutritional Status	0.443	0.608	0.579	<0.001*
15.	Self-perceived health status	0.526	0.599	0.613	<0.001*
16.	Body Mass Index (BMI)	0.320	0.637	0.580	<0.001*
17.	Calf circumference (CC)	0.307	0.631	0.443	<0.001*
18.	Mid-upper arm circumference (MUAC)	0.295	0.640	0.348	<0.001*

*Significant at $P< 0.001$ ** Significant at $P=0.001$ *** Significant at $P< 0.05$

40 studies after 25 years of MNA tool development and found that the sensitivity and specificity of the tool ranged from 67-80% and 46-68%, respectively, against a wide range of criteria.[18]

Using body mass index (BMI < 18.5 kg/m²)[40] as a reference criterion, our results of 70% sensitivity and 68% specificity are in line with the findings from Brazil[38] and Iran,[41] where sensitivity and specificity were 74% vs 69% and 63% vs 60%, respectively. Whereas, the results are lower than those conducted in Addis Ababa, Ethiopia[42] (88% and 90%), Hawassa, Ethiopia (80% and 73%), and Nepal[43] (86% and 67%). This variation might be due to the use of varied BMI cut-off points ranging from 18.5 kg/m² to 26 kg/m²,[44] which affect the tool's sensitivity and specificity in identifying people at risk.

Unfortunately, calculating BMI using height might not be practical or reliable for elderly people. As humans age, they develop vertebral collapse, skeletal abnormalities, and other degenerative changes, that lead to osteoporosis and difficulty in standing straight (kyphosis).[45] As a result, the half-arm span was utilized as a proxy measure for height in this study based on promising findings from earlier literature.[46-48]

Moreover, other alternative anthropometric indicators such as the mid-upper arm circumference (MUAC) and calf circumference (CC) are

utilized as geriatric health measurement scales since they are easier to collect[49,50] and good predictors of mortality risk.[51] In the present study, high sensitivity (97%) and specificity (83%) with the best accuracy maximizing the Youden's index (0.80) of the instrument were obtained using the MUAC. In comparison to CC, MNA has good sensitivity (98%) but low specificity (69%). These are in agreement with the results from Brazil, where sensitivity and specificity were respectively 82.8% and 76.9% against MUAC, whereas 66.7% and 80% compared to CC.[38]

In reviews of the literature, the MNA was found to have high sensitivity (80%) but low specificity (64%) over a wide variety of criteria.[18] This means that the tool is more likely to have "false positives" than "false negatives". In addition, increased sensitivity is considered to be critical for screening and assessment tools.[52] In practice, this is an advantage in giving more attention to an older person who has been misdiagnosed as malnourished. Education, dietary supplements, and increased health monitoring are likely to be used as interventions, with no negative consequences for those who have been over-diagnosed.[43]

The Cronbach's alpha value in this study was 0.65, indicating that the instrument is reliable enough[33] to detect the nutritional status of old age people. Likewise, various investigations in various regions of the world, including Hawassa, southern Ethiopia (0.65),[53] Addis Ababa, Ethiopia (0.70)[42] and Iran (0.66),[41] have shown that MNA meets internal consistency standards.

Furthermore, items of the MNA tool were significantly positive in spearman's connection with the total score, supporting the tool's internal consistency. An exception was observed under the items of stress or acute diseases and dementia. This might be due to most of the study participants giving the same answer, as they do not have these problems. Similar studies from Hawassa, Ethiopia,[53] Brazil,[38] Nepal,[43] and Iran[41] reported a strong association between all MNA items and the total MNA score. As a result, the MNA appears to be a reliable and sensitive instrument for nutritional assessment among the Ethiopian old age people.

To our knowledge, this is the first study to simultaneously validate the content and criterion validity of the MNA tool. Though content validity is low rank in the validity hierarchy, it is commonly used, a crucial quality indicator of an instrument's validity, and a source of information about its feasibility and practicability.[37,54] Second, MUAC was used as the gold standard for nutritional status during the tool validation. There is no need to measure height in functionally weakened people when MUAC is utilized instead of BMI.[19] Third, since this is a community-based research project with a good response rate, the results are more generalizable and may be applied to comparable situations.

Despite these strengths, this research has few limitations. The primary weakness is the self-reported nature of the tool components, which can lead to the under-or overrepresentation of malnutrition risk factors. Second, it was conducted among community-dwelling old age people persons in urban locations; as a result, the findings may not apply to those living in rural or institutional settings.

CONCLUSION

The current study found that the translated Amharic versions of the MNA tool indicated robust internal consistency and construct validity. The instrument can be utilized in routine care provision activities among the community-dwelling old age people in Bahir Dar, Northwestern Ethiopia.

A future study verifying the MNA against more stringent criteria, such as dietary and clinical data, should be investigated. It is desirable to conduct a laboratory diagnosis of nutritional status using blood samples, which offers information about several biomarkers that can be used to better analyze the validity and reliability of MNA cut-off values in various circumstances.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

BMI: Body mass index; **CC:** Calf circumference; **CVI:** Content validity index; **CVR:** Content validity ratio; **I-CVI:** Item content validity index; **MNA:** Mini nutritional assessment; **MUAC:** Mid upper arm circumference; **S-CVI/Ave:** Scale content validity index average; **S-CVI/AU:** Scale content validity index universal agreement.

Ethical approval and formal consent

Before beginning the translation and adaption process, email permission from the original tool developer, Nestle Nutrition Institute, was secured. This research was conducted as part of a Ph.D. dissertation that received ethical approval from Bahir Dar University (R.N./IRB/003/2021). In addition, the choice of participants was entirely voluntary and every participant gave verbal informed consent.

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