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Research Article

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Predictive ability of the Mini Nutritional Assessment short-form (MNA-SF) as compared to serum albumin concentration in the community dwelling elders, Meki, East Ethiopia: Cross-Sectional Validation Study

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Abstract

Background: *Various tools have been used to perform nutritional screening and assessment, and the Mini Nutritional Assessment [MNA] is one of the most widely used and recommended tools in the geriatric population. MNA is available in two lengths: long and short. MNA short-forms, on the other hand, have not been evaluated in Ethiopia. As a result, the purpose of this study was to validate MNA short form against serum albumin concentration in Ethiopian elders.*

Methods: *The community based cross-sectional validation study included 176 elderly people who were recruited at random. Those who had limbs amputated, were bedridden, or had an obvious abnormality were not eligible, a known liver and/or kidney disorder. The original MNA questions were translated into Afan Oromo and Amharic. All translated and pretested MNA questionnaires were administered to each participant. Anthropometrics and albumin levels in the blood were determined. Positive predictive value [PPV] and negative predictive values [NPV] were calculated, as well as reliability, validity, sensitivity, and specificity. A receiver-operating characteristic curve [ROC-curve] study for MNA was used to calculate the area under the curve [AUC] and appropriate cut-off value for predicting malnutrition.*

Result: *A strong association between serum albumin concentration score and MNA-short form score Spearman's rank correlation coefficients of BMI-MNA-SF 0.526, p 0.05 and CC-MNA-SF 0.501, p 0.05. At 95 percent CI, the agreement between the long and short forms of MNA was found to be a weighted kappa of 0.404[0.288, 0.521] for BMI-MNA-SF and 0.426[0.333, 0.519] for CC-MNA-SF. These results show a moderate agreement with serum albumin concentrations. The BMI-MNA-SF and the CC-MNA-SF have a high level of agreement 0.400. [0.322, 0.478]. Furthermore, high power to distinguish two categories using serum albumin concentration as the gold standard and AUC for BMI –MNA-SF 0.789 [0.722-0.855] and 0.791 [0.726-0.857] for CC-MNA-SF at 95% CI. Diagnostic accuracy for BMI-MNA-SF showed that 37.1% sensitivity, 90.8% specificity, 58.5% PPV, and 80.5% NPV. Similarly, sensitivity 77.5%, specificity of 64.4% PPV 73.7%, and 69.0%, NPV for CC-MNA-SF. Total Diagnostic accuracy for BMI-MNA-SF 63.64%, and 71.02% for CC-MNA-SF.*

Conclusion: *Both types of MNA-SF have been shown to be effective screening tools as compared to serum albumin concentration levels in the elders in Meki town, East Ethiopia.*

Keywords: Ethiopia, MNA-SF, Meki, Geriatrics.

Introduction

The term "elderly" refers to adults who are 60 years or older [1, 2]. The world population is radically rising and aging at an unprecedented rate in the twenty-first century. By 2050, the number of people aged 60 and up will have doubled, rising from 12% to 22%. In poorer countries, this will be especially true

[3]. In Ethiopia, one of the developing countries in East Africa, this age group is rapidly growing, with more than three million people aged 60 and up residing in urban areas, accounting for 4.42 percent of the overall population [1]. Furthermore, the country's life expectancy has been increased to 67.8 years [4, 5]. The elderly are highly prone to a variety of degenerative diseases and malnutrition due to a variety of variables, particularly those connected to aging and physiologic change in this age group [6]. This age group is currently burdened by the twin burden of chronic noncommunicable diseases and malnutrition as a result of these factors [7, 8]. Malnutrition is described as the excessive or insufficient consumption of nutrients that are critical for the health and growth of the elderly [9]. Malnutrition, on the other hand, was utilized to refer to undernutrition in this case.

Undernutrition is a condition caused by insufficient dietary intake is a particular concern in the elderly because it causes a variety of consequences, including morbidity and mortality [10, 11]. This type of malnutrition is nearly misdiagnosed, and its severity varies by context. The incidence was determined to be 15% in the population, 23-62% in hospitals, and more than 80 percent in care units in developed countries [12]. In undeveloped countries, the incidence varies by country; for example, in South Africa, 50 percent of the population is hospitalized in Chile 58% in hospital Egypt 26.5% in the community and Ethiopia 28.3% were malnourished in the community [13-15]. Because the old population is growing, the prevalence of undernutrition among the elderly will grow as well. As a result, it's critical to set up programs at all levels that allow for early detection of those who are at danger of malnutrition, as well as appropriate treatments. Furthermore, it has been argued that early detection of malnutrition using a credible malnutrition screening instrument can aid in the prevention of malnutrition and its complications [16].

Malnutrition screening is a quick and simple method that uses a reliable malnutrition screening tool to identify older persons who may require assistance [17]. The majority of malnutrition screening methods are structured questionnaires that include risk factors for malnutrition [such as difficulty chewing, appetite loss, or functional limits] as well as signs of malnutrition [for instance, involuntary recent weight loss] [18]. They are very simple to use and can be administered by any skilled expert. However, the accuracy of these instruments is critical when doing any screening process.

A valid tool is one that measures the things that are supposed to be measured. Valid tools guarantee that persons at risk of malnutrition are accurately identified and that nutritional intervention is made easier [19]. The validity of a tool is usually determined by comparing it to a gold standard tool [criterion-related validity] [20]. The MNA, a regularly used and valid malnutrition screening test for elders from diverse nations, is one of many viable screening tests used in the geriatric field to screen for malnutrition [21].

MNA was first published in 1994 after being created in the early 1990s [22]. It comes in two lengths: short and long. In the community and in health care, both types of MNA can be used [23, 24]. The MNA long-form consists of 18 items with a maximum of 30 points, and it takes about 10-15 minutes to complete [22]. To address the time burden of MNA long-form, Rubenstein and colleagues devised a short form with only six items from eighteen that can be completed in three to five minutes. In addition, there are two versions of this tool, BMI Based [BMI-MNA-SF] and Calf circumference based [CC-MNA-SF] [25]. The major goal of this short form is to classify the nutritional state of the elderly population as well-nourished or at risk for malnutrition, and then the professional just has to know the Serum albumin concentration if the individuals are at risk for malnutrition. However, at the moment, works alone to categorize into three categories, one of which is malnutrition [24].

Multiple screening instruments, such as the malnourished universal screening tool, have also been used to investigate the practical advantage of short-form a brief nutritional evaluation questionnaire and nutritional risk screening 2002[18]. This mini nutritional assessment primarily used BMI, despite the fact that for some Asian and African populations, weight was not a common health measure; instead, they used CC and mid-upper arm circumference [MUAC], with the exception of the nutrition screening tool for South African elders, which only included mid-upper arm circumference [26-28]. Furthermore, a ten-year-old MNA short-form tool was validated, and it had high sensitivity, specificity, and correlation with long-form MNA at the time [29]. The primary goal of this short form is to categorize the nutritional status of the geriatric population as well-nourished or at risk of malnourishment, and the professional only needs the full form if the subjects are classified as at risk of malnourishment. However, it works alone to classify into three categories, one of which is malnutrition [24]. Nonetheless, the MNA short-form is still a valid and recommended tool for assessing nutritional status among elderly people in a different country [30]. MNA also has a relationship with serum albumin concentration [31].

All proteins are measured using serum after plasma clotting or by removing fibrosis [32, 33]. The normal range of protein is 6.5-8.5 g/dl [34, 35]. Out of this albumin accounts large percent 50-60% with normal range 3.5-5 g/dl [34, 35]. It has half-life of 20-22 days. Whereas its precursor pre albumin [transthyretin] has only 2 to 4 days[36]. According to a systematic review published in 2017 by Zhang and colleagues, albumins and other biomarkers such as prealbumin, hemoglobin, total cholesterol, and total protein should be used for nutritional assessment in elderly people regardless of inflammation status [37]. The pre albumin [transthyretin],retinol-binding protein and transferring are markers of short term nutritional status [38]. Serum albumin also used as a predictor of morbidity and mortality in elderly people [39]. Based on serum albumin level in elderly people malnutrition can be classified as malnutrition less 3.0 g/dl, at risk of malnutrition 3 to 3.5 g/dl and above 3.5 to 5 g/dl well-nourished [40, 41].

Despite the fact that this tool has been validated and is in use in another country, it is not easily applicable to other countries. This

is due to the fact that population characteristics differ from country to country, particularly in terms of anthropometric measurement and nutritional characteristics. For Ethiopian elders, the MNA was attempted to be validated [15, 42]. However, both of these studies made systematic and methodological errors in using BMI as the gold standard to validate tools, despite the fact that BMI is a major component of MNA. Furthermore, there is a research gap regarding whether the MNA short-forms and their established cut-off point are appropriate for screening and assessing malnutrition among the elderly population in Ethiopia. As a result, this study was conducted in Ethiopia to validate MNA short-forms using serum albumin concentration as a gold standard.

Methods and materials

Participants

In 2020, the research was carried out in Meki town, East Ethiopia. One hundred and seventy-six elderly people were randomly selected for this study using a sample frame developed after house-to-house surveys of elderly people. All elderly people over the age of 60 were included. An elderly person who was amputated, bedridden, had a visible deformity, or had a history of liver and/or renal disease was excluded.

Nutritional assessment

Serum albumin is used to distinguish between elderly people who are malnourished, those who are at risk of malnutrition, and those who are well-nourished. After a full overnight fast, a blood sample was collected in the morning, before 9:30 a.m., with a cupper-and-zinc-free syringe, and serum albumin concentration was measured using the automated Bromocresol green method with BCG reagent and its standard manufactured by Jourilabs[43]. All sample was handled according WHO guidelines on standard operating procedures for clinical chemistry[35], and reagent with its standard manufacturer order [43]. It classify as malnutrition less 3.0 gram/deciliter [g/dl], at risk of malnutrition 3 to 3.5 g/dl and 3.5 to 5 g/dl well-nourished [31, 40, 41].

Following the pretest, all participants were given new MNA questionnaires that had been translated into their native language. The weight, height, MUAC, and CC of each participant were all measured. For this study, each was measured twice and the average record was used. A stadiometer [Seca 213, Germany] was used to measure participants' height, with bare feet, buttocks, heels, and occiput part touch board. The participant's height was measured to the nearest 0.1cm. The weight was recorded to the nearest 0.1 kilograms using calibrated digital scales placed on a hard-flat surface with the participant wearing light clothing and bare feet [kg]. After each measurement, the weighing scale was checked with a 2kg standard weight. MUAC was measured at the midpoint between the Acromion and Olecranon processes on the back of the upper arm while the subject's forearm was held freely horizontal and recorded to the nearest 0.1cm. CC was measured to the nearest 0.1 cm at the widest circumference between ankle and knee using flexible tape in a sitting position with leg 90 degree [90°] at the knee. Body mass index [BMI] is calculated by dividing body weight in kilograms by height in meters squared. All data were gathered by trained Nurses and Public Health professionals.

Data processing and analysis

The data were entered into Epidata version 3.1 before being exported and analyzed with SPSS version 25. Means and standard deviations were used to describe the variables of interest. To define statistical significance, a P-value of 0.05 was used. Cronbach's alpha was used to assess the overall internal consistency of the MNA short forms in order to assess their reliability. The alpha value of 0.60-0.70 is acceptable, 0.70-80 is adequate, and 80 is excellent [44]. Also, MNA short forms correlation with its 6-item assessed by Spearman's rank correlation coefficient.

Criterion-related validity MNA short-forms were evaluated by Spearman's rank correlation coefficient. Spearman's rank correlation coefficient value: 0.90 -1.00 very high,0.70- 0.90 high, 0.50-0.70 moderate, ≤ 0.50 lower [45]. Weighted kappa was used to assess the inter-method agreement between the MNA short-form and serum albumin concentration using 3x3 cross-tabulation. Weighted kappa value:0.80-1.0 perfect agreement,0.61-0.80 significant,0.41-0.60 moderate,0.21-0.40 fairly [46].

The sensitivity, specificity, PPV, and NPV of MNA short-forms were calculated using 2x2 cross-tabulation and a gold standard of serum albumin concentration. Malnutrition markers Serum albumin concentration score of < 3.5g/dl or MNA short-forms < 11points.

The MNA short-form tool's ROC curve was plotted using serum albumin concentrations of 3.5g/dl as markers of malnutrition to determine AUC and a new optimal cut-off value. The AUC was used to evaluate the MNA tool's overall accuracy. AUC value 0.9 is excellent, 0.8-0.9 is good, 0.7-0.8 is satisfactory, and 0.6-0.7 is poor [47]. Using Youden's index [sensitivity + specificity -1] new optimal cutoff values were calculated [48].

Results

Characteristics of study participants

One hundred and seventy-six elders took part in the study. There were 78 [44.3 percent] males among this group. The participants' mean [standard deviation] age was 67.56 [5.791] years, with ages ranging from 60 to 84 years. Overall, the participants' mean [SD], total serum albumin concentration, BMI-MNA-SF, and CC-MNA-SF were 3.68,0.60, 11.78,1.74, and 9.99 1.64, respectively [Table 1].

Table 1: Characteristics of study participants elderly people aged 60 and above years in the community, Meki town, East Ethiopia, 2020.

Sex	Male (no, %)	78 (44.3%)
	Female (no, %)	98 (55.7%)
Age category in year) (no, %)	60 – 64	61 (34.7%)
	65 – 69	63 (35.8%)
	70 - 74	24 (13.6%)
	75 -79	23 (13.1%)
	≥ 80	5 (2.8%)
Age in year (*mean, SD*)		67.56 (5.79)
Weight in Kg (*mean, SD*)		70.72 (10.15)
Height in meters (*mean, SD*)		1.70 (0.07)
Serum albumin score in g/dl (mean, SD)		3.68 (0.60)
BMI-MNA- short form(sum score) (*mean, SD*)		11.78(1.74)
CC-MNA-short form(sum score) (*mean, SD*)		9.99(1.67)

Reliability of MNA

Cronbach's Alpha of 0.205 for BMI-MNA-SF and 0.319 for CC-MNA-SF indicated adequate homogeneity between the six MNA-SF items [Table 2]. Furthermore, both versions of the MNA-SF total score have a significant correlation with all of their items [Spearman's rho > 0.759, P-value 0.05].

Table 2: Cronbach's alpha for the MNA-SF tool applied in the elderly population aged 60 and above years in the community, Meki town, East Ethiopia, 2020.

Items	Cronbach's α (BMI-MNA-SF)	Cronbach's α (CC-MNA-SF)
1. Decreased food intake	0.065	0.234
2. Weight loss	0.085	0.0249
3. Mobility status	0.219	0.333
4. Acute stress	0.171	0.246
5. Depression	0.213	0.310
6. BMI/CC category	0.277	0.277
Overall Cronbach's alpha	***0.205***	***0.319***

Validity of MNA

The BMI-MNA-SF and CC-MNA-SF tools had significant criterion-related validity when compared to serum albumin concentration, with correlation coefficients spearman's rho [rs] of 0.526 and 0.501, respectively [Table 3]. Diagnostic accuracy for BMI-MNA-SF according to the original cut off point was 37.1 percent sensitivity, 90.8 percent specificity, 58.5 percent PPV, and 80.5 percent NPV. CC-MNA-SF has a similar sensitivity of 77.5 percent, specificity of 64.4 percent, PPV of 73.7 percent, and NPV of 69.0 percent [Table 3]. Furthermore, the total diagnostic accuracy for BMI-MNA-SF is 63.64 percent, while CC-MNA-SF is 71.02 percent [Table 3].

Table 3: Measure of correlation, agreement, and diagnostic test between MNA-SF and serum albumin concentration of participant elderly aged 60 and above years in the community, Meki town, East Ethiopia, 2020.

MNA-SF correlation by Spearman's rho(rs)		
BMI-MNA-SF With serum albumin	0.526, P-value <0.05	
CC-MNA-SF With serum albumin	0.501, P-value <0.05	
MNA-SF agreement with Serum albumin	**BMI-MNA-SF**	**CC-MNA-SF**
* Weighted kappa (95% CI)	0.404 (.288,0.521)	0.426(0.333,0.519)
** Weighted kappa (95% CI)	0.277(.158,0.396)	0.420(0.286,0.553)
Diagnostic accuracy	**BMI-MNA-SF**	**CC-MNA-SF**
Sensitivity	37.1%	77.5%

Specificity	90.8%	64.4%
PPV	58.5%	73.7%
NPV	80.5%	69.0%
Total Diagnostic accuracy	63.64%	71.02%

Malnutrition, risk of malnutrition, well-nourished

****"Malnutrition and risk of malnutrition", well-nourished***

The area under the ROC curves for BM-MNA-SF and CC-MNA-SF showed the highest values of 0.789 and 0.791, respectively, using serum albumin concentration as the gold standard [Figure 1]. The AUC [95 percent CI] value indicates that both versions of MNA-SF had excellent diagnostic accuracy for malnutrition, with overall accuracy of 78.9 percent [72.2, 85.5] for BMI-MNA-SF and 79.1 percent for CC-MNA-SF [72.6, 85.7]. Furthermore, the maximum Youden's index calculated using the ROC curve was 0.441 for BMI-MNA-SF and 0.419 for CC-MNA-SF, respectively. The newly developed optimal cut off value for the BMI-MNA-SF tool at these Youden's index values was 12.5, and 10.5 for the CC-MNA-SF tool to detect malnutrition markers [i.e., merged at risk of malnutrition and malnutrition]. Based on the new cut off value, sensitivity increased to 59.8 percent for BMI-MNA-SF total score 12.5 points as markers of malnutrition, while specificity decreased to 84.3 percent for CC-MNA-SF total score 10.5 points as markers of malnutrition, sensitivity increased to 64.4 percent, and specificity decreased to 77.5 percent.

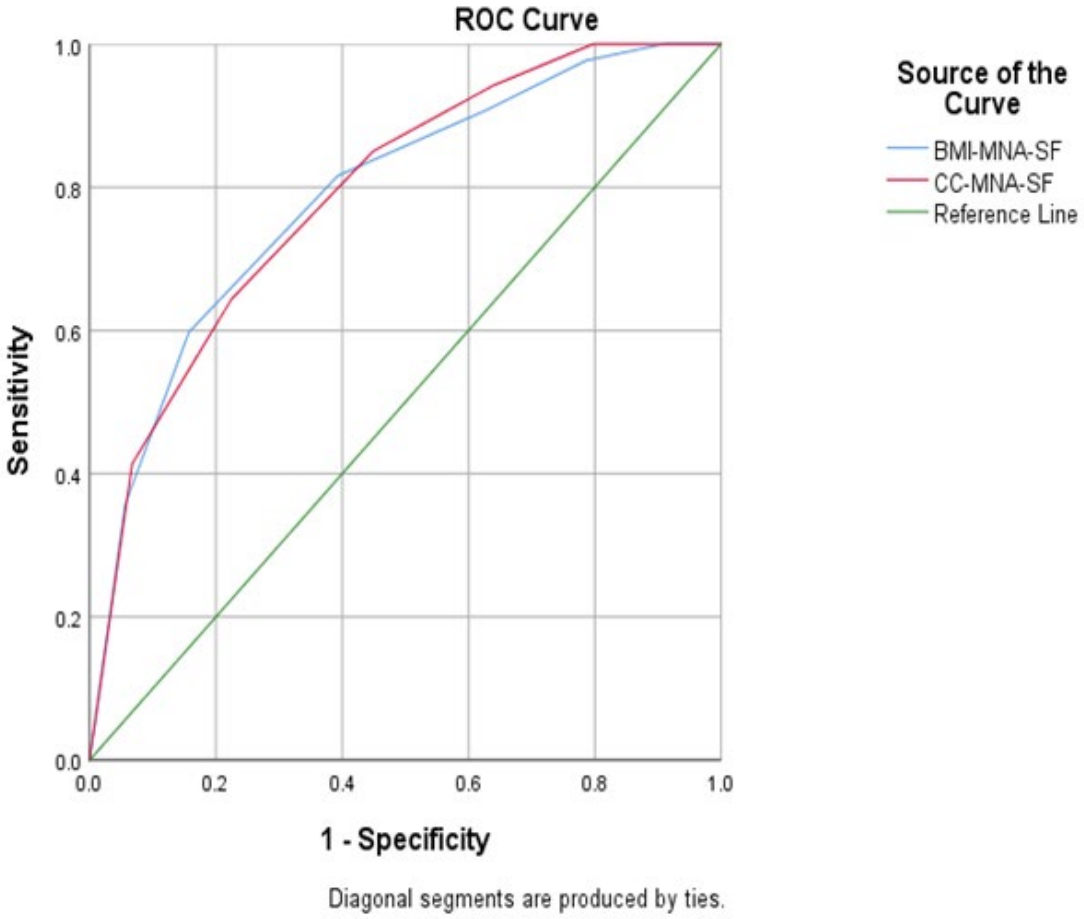

Figure 1: The ROC curves of one hundred and seventy-six samples for the MNA-short form tools as compared to serum albumin concentration of participant elderly people aged 60 and above years in the community, Meki town, East Ethiopia, 2020.

Discussion

The BMI-MNA-SF and CC-MNA-SF had acceptable internal consistency within their six items, with Cronbach's alpha values of 0.205 and 0.319, respectively, in this study. Furthermore, BMI-MNA-SF and CC-MNA-SF demonstrated significant criterion related validity with Spearman's rho [rs] 0.526 and 0.501 for serum albumin concentration, respectively. Furthermore, BMI-MNA-SF and CC-MNA-SF had a moderate agreement with serum albumin concentrations, with weighted kappa values of 0.404 and 0.426, respectively.

Both versions of the MNA-SFs demonstrated a high level of

overall diagnostic accuracy when compared to the previously established cut off value. The CC-MNA-SF results were slightly lower than the BMI-MNA-SF results. This could be explained by CC-score characteristics. Furthermore, both versions have a higher PPV than an NPV, which could be due to the prevalence of malnutrition. When compared to a study conducted in Germany, this study revealed a higher specificity and Spain for both versions. However, showed lower sensitivity and specificity than the original developers [42, 50, 25]. The variation in sensitivity and specificity could be attributed to the setting and selection of the gold standard for validating the MNA. However, according to a newly developed best fit cut-off value of 12.5 [at Youden's index maximum 0.441] to detect markers of malnutrition, sensitivity increased to 59.8 percent and specificity decreased to 84.3 percent, while sensitivity increased to 64.4 percent and specificity decreased to 77.5 percent for CC-MNA-SF score 10.5 [at Youden's index maximum 0.419]. In this study, BMI-MNA-SF correctly classified 63.64 percent of malnutrition, while CC-MNA-SF correctly classified 71.02 percent. Furthermore, the new cut off value is more sensitive than the original cut off points. As a result, additional research is required to evaluate the newly developed cut-off value for Ethiopian elders using dietary and biomarkers as the gold standard.

Study limitation

Finally, this study had some limitations. One of the limitations of this study was the lack of use of multiple nutritional assessment methods. The dietary and biochemical assessments, in particular, were not evaluated. Another limitation of this study is that only one gold standard was used to validate it.

Conclusion

This study showed that both versions of MNA short-form was valid and reliable tools for Ethiopian elders. Nevertheless, this study did not show cost effectiveness due to the nature of cross-sectional study. Therefore, better to do future study that assess cost effectiveness of MNA short-form.

Abbreviation

AUC = Area under Curve
BMI =Body Mass Index
CC = Calf Circumference
CI = Confidence Interval
MNA = Mini Nutritional Assessment
MNA-LF = Mini Nutritional Assessment Long-Form
MNA-SF= Mini Nutritional Assessment Short-Form
MUAC =Mid-Upper Arm Circumference
NPV=Negative Predictive Value
PPV =Positive Predictive Value
ROC-Curve = Receiver-Operating Characteristic Curve

Declaration

Ethics and consent to participate

This study was conducted according to the guidelines laid down in the World Medical Association [WMA) Declaration of Helsinki and all procedures involving research study participants were reviewed and approved by Jimma University, Institute of Health, Ethical review committee [ERC). Written informed consent was obtained from all participants.

Consents for publication

Not applicable

Availability of data and materials

All data generated or analyzed for this study are available from the corresponding author, megurgessa@gmail.com , upon reasonable request.

Competing of interest

There are no competing interests.

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Author's contribution

This manuscript done only one author. The corresponding author done all.

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