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Research Article

Evaluation of the Mini Nutritional Assessment short-form [MNA-SF] as Compared to Serum Albumin Concentration in the Community Dwelling Elders, Meki, East Ethiopia

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Abstract

Background: Different tools have been used to perform a nutritional screening and assessment, and MNA is one of the widely used and recommended tools in the geriatric's population. MNA has two forms, long and short. However, MNA short-forms have not been evaluated in Ethiopia. Therefore, this study was aimed to evaluate MNA short form against serum albumin concentration among Ethiopian elders.

Methods: One hundred and seventy-six randomly selected elders entered into the community-based cross-sectional validation study. Amputated, bedridden, those with visible deformity were excluded. Original MNA questionnaires were translated to Afan Oromo and Amharic languages. All translated and pretested MNA questionnaires were administered to each participant. The anthropometrics and serum albumin concentration were measured. Reliability, validity, sensitivity, specificity, positive and negative predictive values were calculated. Receiver-Operating Characteristic curve [ROC-curve] analysis was plotted for MNA, to identify the Area Under the Curve [AUC] and optimal cut-off value for prediction of malnutrition.

Result: Strong association between serum albumin concentration score and MNA-short form score indicated by spearman's rank correlation coefficients of BMI-MNA-SF 0.526, p <0.05 and CC-MNA-SF 0.501, P<0.05. Similarly, the agreement between the long and short form of MNA was found to be a weighted kappa 0.404 [0.288, 0.521] for BMI-MNA-SF and 0.426[0.333, 0.519] for CC-MNA-SF at 95% CI. These values indicate moderate agreement with the serum albumin concentration. There is very good agreement between the BMI-MNA-SF and CC-MNA-SF 0.400[0.322, 0.478]. Also, high power to identify two categories using serum albumin concentration as golden standard with 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. Similar 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 versions of MNA-SF were found to be valid screening tools in the Ethiopian elders against serum albumin concentration.

Keywords: MNA-SF, Meki, Geriatrics

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

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Introduction

Elderly people refer to older persons aged 60 and above years. In this 21st century, the world population is radically increasing aging at the fastest rate. By 2050, elderly population aged 60 and above will double from 12% to 22%. Particularly will increase in developing country. In one of the developing countries found in East Africa, Ethiopia, also this age group is dramatically increasing with aged 60 years and above is more than three million with 4.42% of the total population are living in Urban. Moreover, the country's life year expectancy is raised to be 67.8 years. Because of various factors especially those related to aging and physiologic change in this age group, the elderly peoples are highly vulnerable to several degenerative diseases and malnutrition. Due to these currently, this age group is affected by the dual-burden of chronic non-communicable diseases and malnutrition. Malnutrition is defined as over or under consumption of nutrients, those very crucial for the health and growth of elderly people. However, here malnutrition was used to refer to undernutrition [1-9].

Undernutrition, a condition resulting from inadequate consumption of nutrients, is a specific concern in the elderly population because it leads to different complications including morbidity and mortality. This type of malnutrition is almost undiagnosed and its magnitude varies from setting to setting. In developed countries, the incidence found that 15% in the community, 23-62% in hospitals, and more than 80% in care units. In developing countries similarly incidence varies from country to country, for instance, in South Africa 50% in the hospital, in Chile 58% in hospital [6], Egypt 26.5% in the community, and Ethiopia 28.3% were malnourished in the community. Given that the elderly population is increasing, the prevalence of undernutrition among the elderly population will also increase. Therefore, it is crucial to arrange programs at all levels that enable the early detection of at risk for malnutrition, and that followed by appropriate intervention. Moreover, it has been proposed that early detection using valid malnutrition screening tool is help to prevent malnutrition and its complication [12-16].

Malnutrition screening is a rapid and easy process using a valid malnutrition screening tool, aimed to detect elderly people who may need intervention. Malnutrition screening tools are mostly structured questionnaires, containing risk factors for malnutrition (for instance, difficulty of chewing, appetite loss, or functional limitations) and indicators of malnutrition (for instance, involuntary recent weight loss). Moreover, they are simple and administered by any trained professional. However, the validity of these tools is very crucial to carry out any screening process [17,18].

A valid tool is a tool that measures what it is suggested to measure. Valid tools ensure the accurate detection of those at risk for malnutrition and facilitate nutritional intervention. Validity of tool usually measured by correlation with a golden standard tool (criterion-related validity). There are different valid screening tools used in the geriatric field to screen malnutrition, among these MNA is a widely used and valid malnutrition screening tool for different country's elders [19-21].

MNA was developed in the early 1990s and published in 1994. It has two forms, short and long. Both types of MNA can be used in the community and health care setting. The MNA long-form has 18 items with a maximum of 30 points, completed in 10-15 mins. Subsequently, Rubenstein and colleagues developed a short form that only contains six items from eighteen that complete within 3 to 5 minutes to overcome the time burden of Serum albumin concentration. Also, this tool has two forms Body Mass Index [BMI]- MNA short-form and Calf Circumference (CC)-MNA short-form. The first main aim of this short form is to categorize the geriatric population's nutritional status as well-nourished or at risk for malnutrition, and then the professional needs only the Serum albumin concentration if the subjects were categorized as at risk for malnourishment. But, currently works alone to categorize into three categories including malnutrition [22-25].

Moreover, the practical advantage of short-form was tested by multiple screening instruments such as the malnutrition universal screening tool, short nutritional assessment questionnaire and nutritional risk screening 2002 [18]. This mini nutritional assessment was used BMI mostly even though some Asian and Africa population weight was not a common health measure, instead, they use CC and Mid-Upper Arm Circumference [MUAC] with exception nutrition screening tool for South African elder include only mid-upper arm circumference. However, MNA short form uses both BMI and CC. In addition, ten years ago MNA short-form tool was validated and at the time it has high sensitivity, high specificity, and high correlation with long-form MNA. The first main aim of this short form is to categorize the geriatric population's nutritional status as well-nourished or at risk of malnourishment, and then the professional needs only the full form if the subjects are categorized as at risk for malnourishment. But it works alone to categorize into three categories including malnutrition. Still, nowadays MNA short-form is a valid and recommended tool used to assess nutritional status among elderly people in a different country. Additionally, MNA has correlation with serum albumin concentration [26-31].

Serum albumin is type of protein. There is different type of protein that circulates in plasma. These all types of protein measured by means of serum after plasma clotted or by removing fibrosis. The normal range of protein is 6.5g - 8.5g / dl. Out of this albumin accounts large percent 50-60% with normal range 3.5g - 5g / dl. It has half-life of 20-22 days. Whereas its precursor pre albumin (transthyretin) has only 2 to 4 days. According to a systematic review done by Zhang and colleagues in 2017 they recommended to use albumins and other biomarkers like pre albumin, hemoglobin, total cholesterol and total protein for elderly people's nutritional assessment regardless of inflammation status. The pre albumin (transthyretin), retinol-binding protein and transferring are markers of short-term nutritional status. Serum albumin also used as a predictor of morbidity and mortality in elderly people. Based on serum albumin level in elderly people malnutrition can be classified as malnutrition less 3.0 g/dl, at risk of malnutrition 3g to 3.5g / dl and above 3.5g to 5 g / dl well-nourished [32-41].

Even though this tool is validated and used in a different country, it is not readily applicable to other countries. This because population characteristics are varying from country to country especially in terms of anthropometric measurement and nutritional characteristics. The MNA was tried to validated for Ethiopian elders [15]; but both of these studies had systematic and methodological error in using BMI as golden standard to validate tools since BMI is a major component of MNA. Moreover, there is a research gap on whether the MNA short-forms and its established cut-off point are applicable to screen and assess malnutrition among the elderly population in the Ethiopian context. Therefore, this study was done to validate MNA short-forms using serum albumin concentration as a golden standard in Ethiopia [42].

Methods and Materials

Participants

The study was conducted in Meki town, East Ethiopia, in 2020. One hundred and seventy-six elders were entered into this study randomly using a sample frame developed after house-to-house elderly people surveyed. All elderly people aged 60 and above years were included. Whereas an elderly person, who was amputated, bedridden, visible deformity and known liver and/or renal disorders were excluded.

Nutritional assessment

Serum albumin used to identify malnutrition, at risk of malnutrition and well-nourished elderly people. The blood sample was collected in the morning, before 9:30 am, after a full overnight fast using cupper- and zinc-free syringe and serum albumin concentration was measured by automated Bromocresol green method using BCG reagent and its standard manufactured by Jourilabs. All sample was handled according WHO guidelines on standard operating procedures for clinical chemistry and reagent with its standard manufacturer order. It classifies as malnutrition less 3.0g / dl (g / dl), at risk of malnutrition 3g to 3.5g / dl and 3.5g to 5g / dl well-nourished [43].

Novel MNA questionnaires were translated to local language and administered to all participants after doing the pretest. All participant's weight, height, MUAC and CC were measured. Each measured twice and the average record was used for this study. Height was measured using a stadiometer (Seca 213, Germany), with participant bare feet, buttock, heels, and occiput part touch board. The participant's height was recorded to the nearest 0.1cm. The weight was measured using calibrated digital scales placed on a hard flat surface with the participant in light clothes, bare feet, and recorded to the nearest 0.1 kg. The weighing scale was checked after each measurement with a 2kg standard weight. MUAC was measured at the mid-point between the tip of the Acromion and Olecranon process on the back of the upper arm while the subject's forearm held a freely horizontal position and recorded nearest 0.1cm. CC was measured at the widest circumference between ankle and knee to the nearest 0.1 cm using flexible tape in a sitting position with leg 90o at the knee. Body mass index [BMI] computed as body weight in kilograms divides squares of height in meters. All data were collected by trained BSc Nurses and BSc Public health.

Data processing and analysis

The data were entered into Epidata version 3.1, then exported and analyzed by SPSS version 25. The variables of interest were described by using means, standard deviations. A P-value < 0.05 was used to define statistical significance. To evaluate the reliability, the overall internal consistency of the MNA short forms were evaluated by Cronbach's alpha. The alpha value of 0.60-0.70 acceptable, 0.70-80 adequate, and ≥ 80 good. Also, MNA short forms correlation with its 6-item assessed by Spearman's rank

correlation coefficient [44].

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].

The inter-method agreement was assessed by weighted kappa, between the MNA short-form and Serum albumin concentration, using 3x3 cross-tabulation. Weighted kappa value:0.80-1.0 perfect agree,0.61-0.80 substantial,0.41 -0.60 moderate,0.21 -0.40 fairly [46].

Sensitivity, specificity, PPV, and NPV of MNA short-forms were calculated by 2x2 cross-tabulation using Serum albumin concentration a golden standard. Markers of malnutrition Serum albumin concentration score < 3.5g/dl or MNA short-forms < 11points.

To determine AUC and new optimal cut-off value, the MNA short-form tool's ROC curve was plotted using Serum albumin concentration < 3.5g / dl as markers of malnutrition. The AUC was used to assess the overall accuracy of the MNA tool. AUC value ≥ 0.9 excellent 0.8 - 0.9 Good, 0.7- 0.8 satisfactory and 0.6-0.7 not good. New optimal cutoff values were calculated using Youden's index [sensitivity + specificity - 1] [47,48].

Results

Characteristics of study participants

Total one hundred and seventy-six elders participated in the study. From this, 78 (44.3%) were males. The mean [SD] age of the participants was 67.56 [± 5.791] years and ranged from 60 to 84 years. Overall, the mean [SD], total serum albumin concentration, BMI-MNA-SF and CC-MNA-SF of the participants were 3.68 ± 0.60, 11.78 ± 1.74 and 9.99± 1.64 respectively (**Table 1**).

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)

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

Reliability of MNA

The overall homogeneity between the six MNA-SF items was adequate with Cronbach's Alpha of 0.205 for BMI-MNA-SF and 0.319 for CC-MNA-SF. In addition, both version MNA-SF total score significantly correlate with all their items at Spearman's rho > 0.759, P-value < 0.05 (**Table 2**).

Items	Cronbach's α (BMI-MNA-SF)	Cronbach's α (CC-MNA-SF)
Decreased food intake	0.065	0.234
Weight loss	0.085	0.0249

Mobility status	0.219	0.333
Acute stress	0.171	0.246
Depression	0.213	0.31
BMI/CC category	0.277	0.277
Overall Cronbach's alpha	0.205	0.319

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.

Validity of MNA

Criterion-related validity of the BMI-MNA-SF and CC-MNA-SF tools were significant as compared to serum albumin concentration with correlation coefficient spearman's rho [rs] of 0.526 and 0.501 respectively. According original cut off point Diagnostic accuracy for BMI-MNA-SF showed that 37.1% sensitivity, 90.8% specificity, 58.5% PPV, and 80.5% NPV. Similar sensitivity 77.5%, specificity of 64.4% PPV 73.7%, and 69.0%, NPV for CC-MNA-SF. Moreover, total Diagnostic accuracy for BMI-MNA-SF 63.64%, and 71.02% for CC-MNA-SF **(Table 3)**.

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	37.10%	77.50%
Specificity	90.80%	64.40%
PPV	58.50%	73.70%
NPV	80.50%	69.00%
Total Diagnostic accuracy	63.64%	71.02%

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

The area under ROC curves using the serum albumin concentration as golden standard the area showed the highest values 0.789 for BM-MNA-SF and 0.791 for CC-MNA-SF. AUC [95% CI] value indicates that both version MNA-SF had excellent diagnostic accuracy to diagnosis malnutrition with overall accuracy of 78.9% [72.2%, 85.5%] for BMI-MNA-SF and for CC-MNA-SF 79.1% [72.6%, 85.7%] (**Figure 1**).

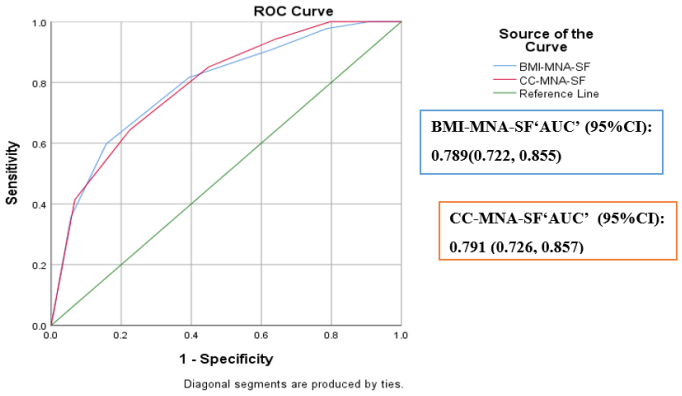

Figure 1: The ROC curves of one hundred and seventy-six samples for the MNA-short form tools as compared to serum albumin concentration of participant elderly people aged 60 and above years in the community, Meki town, East Ethiopia, 2020.

In addition, Maximum Youden's index calculated using ROC curve was 0.441 and 0.419 for BMI-MNA-SF and CC-MNA-SF respectively. At these Youden's index values, the newly developed optimal cut off value for BMI-MNA-SF tool was 12.5, and 10.5 for CC-MNA-SF to detect the markers of malnutrition (*i.e.*, merged at risk of malnutrition and malnutrition). Based on new cut off value, BMI-MNA-SF total score < 12.5 points as markers of malnutrition, sensitivity increased to 59.8%, and specificity decreased to 84.3% while for CC-MNA-SF total score < 10.5 points as markers of malnutrition, sensitivity increased to 64.4%, and specificity decreased to 77.5%.

Discussion

In this study, the BMI-MNA-SF and CC-MNA-SF had acceptable internal consistency within its six items of Cronbach's alpha value 0.205 and 0.319 respectively. In addition, BMI-MNA-SF and CC-MNA-SF showed significant criterion related validity with serum albumin concentration of Spearman's rho [rs] 0.526 and 0.501 respectively. Moreover, BMI-MNA-SF and CC-MNA-SF had a moderate agreement with serum albumin concentration of weighted kappa 0.404 and 0.426 respectively.

According to the originally established cut off value, both version MNA-SFs showed a strong overall diagnostic accuracy. Results for CC-MNA-SF slightly lower than the BMI-MNA-SF this might be explained by characteristics of CC-score. Moreover, both version shows high PPV than NPV this might due to malnutrition prevalence. This study showed higher specificity higher as compared to study done in Germany and Spain for both versions. Whereas, showed lower than the original developers of sensitivity and specificity [25]. The variation in sensitivity and specificity may due to the setting and selection of the golden standard to validate the MNA [49,50].

However, according to newly developed best fit cut-off value for BMI-MNA-SF score of < 12.5 [at Youden's index maximum 0.441] to detect markers malnutrition sensitivity increased to 59.8%, and specificity decreased to 84.3% while for CC-MNA-SF score <10.5 (at Youden's index maximum 0.419) increased to 64.4%, and specificity decreased to 77.5%. In this study, BMI-MNA-SF correctly classify 63.64%, while CC-MNA-SF correctly classify 71.02% malnutrition. Moreover, the new cut off value brings sensitivity than the original cut off points. Therefore, further studies needed to evaluate newly developed cut-off value for Ethiopian elders using dietary and biomarkers as golden standard.

Study Limitation

Lastly, this study had its limitation. One of this study limitation was combined different nutritional assessment methods were not used. Especially, the dietary assessment and biochemical were not assessed. Other limitation in this study only one golden standard used to validate.

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.

Declaration

Ethical standards disclosure

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.

Author's Contribution

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

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