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Journal of Aging Science

Research Article

# Evaluation of the Mini Nutritional Assessment Short Form Tool Among Elderly Population from Ethiopia

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## ABSTRACT

**Background:** For nutritional screening and assessment, various tools have been used, and the Mini Nutritional Assessment (MNA) is one of the most widely used and recommended tools in the geriatric population. However, neither the Body Mass Index-Based Mini Nutritional Assessment Short-Forms (BMI-MNA-SF) nor the Calf Circumference-Based Mini Nutritional Assessment Short-Forms (CC-MNA-SF) have been evaluated in Ethiopia. As a result, this study was conducted in Ethiopia to compare MNA-SFs to the MNA long-form tool.

**Methods:** The community-based cross-sectional validation study included 176 elders who were chosen at random. Elders who were amputated, bedridden, or had visible deformities were excluded. The original MNA questionnaires have been translated into Afan Oromo and Amharic. Each participant received an MNA questionnaire that had been translated and pretested. All participants had their anthropometric measurements taken, which included their weight, height, Calf Circumference (CC), and Mid-Upper Arm Circumference (MUAC). For statistical analyses, IBM SPSS software version 25 was used. The following variables were calculated: Reliability, Validity, Sensitivity, Specificity, Positive Predictive Values (PPV), and Negative Predictive Values (NPV). For MNA, a Receiver-Operating Characteristic Curve (ROC-curve) analysis was performed to determine the Area Under the Curve (AUC) and optimal cut-off value for malnutrition prediction.

**Results:** A strong association was observed between MNA-long and MNA-short form score indicated by spearman's rank correlation coefficients of BMI-MNA-SF 0.771, p <0.05 and CC-MNA-SF 0.759, P<0.05. The agreement between the long and short form of MNA was found to be a weighted kappa 0.396(0.318, 0.474) for BMI-MNA-SF and 0.546(0.422, 0.669) for CC-MNA-SF at 95% CI. These values indicate moderate agreement with the MNA-long form. There is very good agreement between the BMI-MNA-SF and CC-MNA-SF 0.400(0.322, 0.478). Moreover, the overall accuracy using MNA long-form as golden standard with AUC for BMI –MNA-SF 0.908 (0.865-0.951) and 0.880 (0.831-0.929) for CC-MNA-SF at 95% CI. Diagnostic accuracy of both versions of MNA-SF showed that 34.2% sensitivity, 100.0% specificity, 100.0% PPV, and 41.5% NPV for BMI-MNA-SF. Similar sensitivity 75.8%, specificity 83.9%, PPV 91.0%, and 61.8% NPV for CC-MNA-SF. Total Diagnostic accuracy for BMI-MNA-SF 55.12%, and 78.41% for CC-MNA-SF.

**Conclusion:** In comparison to the Long-form MNA, both versions of MNA-SF were found to be valid screening tools in Ethiopian elders.

**Keywords:** MNA-SF; Validity; Reliability; Geriatrics; Ethiopia

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**Received:** January 11, 2022; **Accepted:** January 26, 2022; **Published:** February 02, 2022

**Citation:** Urgessa M (2022) Comparison Evaluation of the Mini Nutritional Assessment Short Form Tool Among Elderly Population from Ethiopia. J Aging Sci. 9: 262.

## ABBREVIATIONS

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

## INTRODUCTION

Elderly people refer to older persons aged 60 years and above [1,2]. In the 21st century, the aging world population is radically increasing at the fastest rate. By 2050, the elderly population aged 60 and above particularly in the developing country will double from 12% to 22% [3]. Ethiopia is one of the developing countries found in East Africa with this age group dramatically increasing. More than three million elders of the total population are living in urban areas. Moreover, the country's life expectancy is 67.8 years [4,5]. Because of various factors especially those related to aging and physiologic change in this age group, the elderly are highly vulnerable to several degenerative diseases and malnutrition [6]. Due to these currently, this age group is affected by the double-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 under nutrition.

Malnutrition (Under nutrition), a condition resulting from inadequate consumption of nutrients, is 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 prevalence found that 15% in the community, 23-62% in hospitals, and more than 80% in care units. In developing countries similarly the prevalence varies from country to country, for instance, in South Africa 50% in the hospital, in Chile 58% in hospital, Egypt 26.5% in the community, and Ethiopia 28.3% were malnourished in the community. Given that the elderly population is increasing from 11% to 22%, the prevalence of under nutrition 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 [6].

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.

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 is 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.

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 minutes. 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 MNA long-form. 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 MNA long-form if the subjects were categorized as at risk for malnourishment. But, currently it works alone to categorize into three categories including malnutrition [7].

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. 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. Even though this tool is validated and used in a different country, it is not readily applicable to other countries. This is because population characteristics are varying from country to country especially in terms of anthropometric measurement and nutritional characteristics. However, only long-form MNA was validated for Ethiopian elders. MNA short-forms have not been validated for the Ethiopian elderly and 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 MNA long-forms as a golden standard in Ethiopia [8].

# MATERIALS AND METHODS

## Participants

The community-based cross-sectional validation study was conducted in Meki town, East Ethiopia, in 2020. Meki town purposively selected because of second populated and having diversified population. Moreover, town has been home of different ethnic groups due to throughout the year agricultural irrigation related in migration people from different part of Ethiopia. Buderer's formula was used for sample size calculation in at the required absolute precision level, prevalence in particular study area, sensitivity and specificity. Data from previous studies was used the expected sensitivity of 96%, specificity 98% and prevalence of malnutrition among Ethiopian elderly by MNA is 0.283 (28.3%). Maximum difference accepted between estimated sensitivity or specificity (degree of precision) is 4% for CI 95% (alpha=0.05), considering nonresponse rate 10%, total sample size become one hundreds seventy-six. 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 years and above were included, whereas an elderly person, who was amputated, bedridden and has a visible deformity were excluded.

## Nutritional assessment

MNA long-form is used to identify malnutrition, at risk for malnutrition, and well-nourished elderly people. It classifies as malnutrition less than 17 points, at risk of malnutrition 17 to 23.5 points, and well-nourished: 24 to 30 points.

Original MNA questionnaires were translated to local language and administered to all participants after doing the pretest on 5% of none study sample size. MNA long form and MNA-SF data were collected face-to-face using structured questionnaires. All participants' socio-demographic and anthropometric measurements included weight, height, MUAC and CC were measured. Each was measured twice and the average record was used for this study. Height was measured using a stadiometer with participant bare feet; buttock, heels, and occiput part touch board. The participant's height was recorded to the nearest 0.1 centimeters (cm). 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 kilograms (kg). The weighing scale was checked after each measurement with a 2 kg 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 0.1 cm. CC was measured at the widest circumference between ankle and knee to the nearest 0.1 cm using inflexible tape in a sitting position with leg 90 degrees 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 Nurses and Public health workers. Training was given on how to measure anthropometric measurements and how to record using MNA-guideline [9].

## Data processing and analysis

The data were entered into Epidata version, then exported and analyzed by IBM SPSS software program version. Socio-demographic and anthropometric measurement's variables were described by using means, standard deviations. AP-value <0.05 was used to define statistical significance.

To evaluate the reliability, the overall internal consistency of the MNA short-form tools (BMI-MNA-SF and CC-MNA-SF) were evaluated by Cronbach's alpha. The alpha values are 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.

Criterion-related validity MNA Short-Forms (BMI-MNA-SF and CC-MNA-SF) 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.

The inter-method agreement was assessed by weighted kappa, between the MNA short-forms (BMI-MNA-SF and CC-MNA-SF) and MNA long-form, using 3 x 3 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.

The discriminatory ability of MNA short-forms was assessed by calculating PPV and NPV but both value not used for diagnostic accuracy of the tool since both depend on setting and magnitudes of malnutrition. Sensitivity, specificity, PPV, and NPV of MNA short-forms (BMI-MNA-SF and CC-MNA-SF) were calculated by 2 x 2 cross-tabulation using MNA long forms a golden standard. Markers of malnutrition MNA long-form score <24 points or MNA short-forms (BMI-MNA-SF and CC-MNA-SF) <11points.

To determine AUC and new optimal cut-off value, the MNA short-forms (BMI-MNA-SF and CC-MNA-SF) tool's ROC curve was plotted using MNA long-form <24 points as markers of malnutrition. The AUC was used to assess the overall accuracy of the MNA tool. The value of AUC ranging from 0 to 1 was used to determine the classification ability of MNA short-forms (BMI-MNA-SF and CC-MNA-SF) as at risk of malnourished and well-nourished. 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) [10].

# RESULTS

## Characteristics of study participants

Total one hundred and seventy-six elders participated in the study. From this, 78(44.3%) were males. From the results, more than 50% elders were female and as compared to male life expectancy females were slightly higher. The mean (SD) age of the participants was 67.56 (± 5.791) years and ranged from 60 to 84 years. Moreover, mean age showed that average age of elders was nearly the country life expectancy which in turn support there is fast growth of elderly population size. Overall, the mean (SD), total MNA score, BMI-MNA-SF and CC-MNA-SF of the

participants were 20.70 ± 3.46, 11.78 ± 1.74 and 9.99 ± 1.64 respectively (Table 1). This implies that more than 50% elders were need nutritional intervention or they were classified under markers of malnutrition according sum score of MNA score, BMI-MNA-SF and CC-MNA-SF.

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

| Category | Percentage |
|---|---|
| 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) |
| MNA (sum score) (mean, SD) | 20.70(3.46) |
| 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

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's MNA-SFs total scores significantly correlate with all their items at Spearman's rho >0.759, P-value <0.05 (Table 2).

**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) |
|---|---|---|
| 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 |

## Validity of MNA

Criterion-related validity of the BMI-MNA-SF and CC-MNA-SF tools was significant as compared to MNA long form with correlation coefficient spearman's rho (rs) of 0.771 and 0.759 respectively. According to the original cut-off point BMI-MNA-SF had a sensitivity of 34.2 %, specificity of 100%, PPV of 100%, and NPV 41.5% of MNA with a total diagnostic accuracy of 55.12%. Similarly, for CC-MNA-SF had a sensitivity of 75.8 %, specificity of 83.9% PPV of 91.0 %, and NPV 61.8% of MNA with a total diagnostic accuracy of 78.41% (Table 3).

**Table 3:** Measure of correlation, agreement, and diagnostic test between MNA-SF and MNA-LF 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 MNA-LF | 0.771, P-value <0.05 | |
| CC-MNA-SF With MNA-LF | 0.759, P-value <0.05 | |
| MNA-SF agreement with MNA-LF | BMI-MNA-SF | CC-MNA-SF |
| Weighted kappa (95% CI) | 0.396 (.318,0.474) | 0.583(0.485,0.681) |
| Weighted kappa (95% CI) | 0.248 (.167,0.329) | 0.546(0.422,0.669) |
| Diagnostic accuracy | BMI-MNA-SF | CC-MNA-SF |
| Sensitivity | 34.20% | 75.80% |
| Specificity | 100.00% | 83.90% |
| PPV | 100.00% | 91.00% |
| NPV | 41.50% | 61.80% |
| Total Diagnostic accuracy | 55.12% | 78.41% |

The area under ROC curves using the MNA long-form as golden standard showed the highest values of 0.908 for BM-

MNA-SF and 0.880 for CC-MNA-SF (Figure 1). AUC (95% CI) value indicates that both versions of MNA-SF had excellent diagnostic accuracy to diagnosis malnutrition with an overall accuracy of 90.8% (86.5, 95.1) for BMI-MNA-SF and CC-MNA-SF 88.0% (83.1, 92.9). In addition, Maximum Youden's index calculated using ROC curve was 0.654 and 0.597 for BMI-MNA-SF and CC-MNA-SF respectively. At these Youden's index values, the newly developed optimal cut-off value for the 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 the new cut off value, BMI-MNA-SF total score <12.5 points as markers of malnutrition, sensitivity increased to 82.1%, and specificity decreased to 83.3% while for CC-MNA-SF total score <10.5 points as markers of malnutrition, sensitivity increased to 83.9%, and specificity decreased to 75.8%.

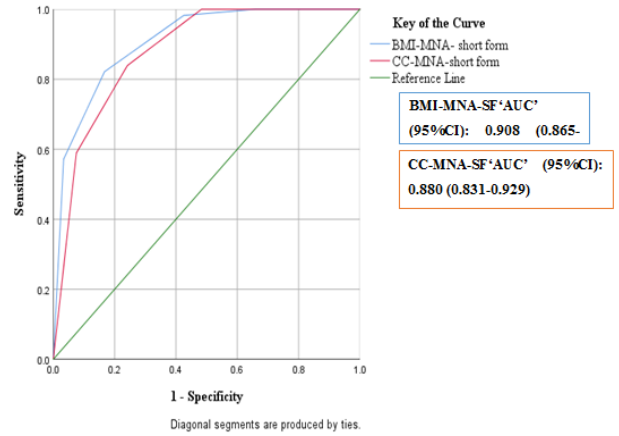


**Figure 1:** The ROC curves of one hundred and seventy-six samples for the MNA-short form tools as compared to MNA-long form of participant elderly people aged 60 and above years in the community, Meki town, East Ethiopia, 2020. Note: — : BMI-MNA-Shortform; — : CC-MNA-Shortform; —:Reference line.

# 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 MNA long-form of Spearman's rho (rs) 0.771 and 0.759 respectively. Moreover, BMI-MNA-SF and CC-MNA-SF had a moderate agreement with MNA long-form of weighted kappa 0.396 and 0.583 respectively [11].

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

However, according to newly developed best fit cut-off value for BMI-MNA-SF score of <12.5 (at Youden's index maximum 0.654) to detect markers malnutrition sensitivity increased to 82.1%, and specificity decreased to 83.3% while for CC-MNA-SF score <10.5 (at Youden's index maximum 0.597) increased to 83.9%, and specificity decreased to 75.8%. In this study, BMI-MNA-SF correctly classifies 65.4% while CC-MNA-SF correctly classifies 59.7% malnutrition. Moreover, the new cut-off value brings more sensitivity than the original cut-off points. Therefore, further studies are needed to evaluate newly developed cut-off value for Ethiopian elders using dietary and biomarkers as the golden standard [12].

## Study limitation

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

Both versions of the MNA short-form were found to be valid and reliable tools for Ethiopian elders in this study. Nonetheless, due to the nature of the cross-sectional study, this study did not demonstrate cost-effectiveness. As a result, it is preferable to conduct a future study that evaluates the 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). The approval number of the ERC was ERB-00063/2020. 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 authors upon reasonable request.

## Competing of interest

There are no competing interests.

# Funding

The author received no funding for this study from any external body.

## AUTHOR'S CONTRIBUTION

This manuscript is done by only one author. The corresponding author has done all.

## ACKNOWLEDGEMENTS

I would like to Institute of health, faculty of Public Health, Jimma University. I was also grateful to the study participants, data collectors and supervisors.

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