Original Article

Validation and Reliability Assessment of the Mini-Nutritional Assessment–Short Form Questionnaire among Older Adults in South India

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Abstract

Background: Nutrition of the elderly affects immunity and functional ability and leads to increased morbidity and mortality. Validation of a short-form (SF) scale will make the assessment easier for primary care physicians. Hence, the study was done to assess the validity and reliability of Mini-Nutritional Assessment–SF (MNA-SF) Questionnaire among elderly in Puducherry. **Methods:** A cross-sectional study among 279 elderly was conducted in four villages of rural Puducherry. We have used three forms of MNA questionnaire. Diagnostic accuracy of the MNA-SF was assessed and internal consistency was interpreted using Cronbach's alpha. **Results:** The prevalence of malnutrition by the MNA full-form scale was 17.9%. Similar prevalence was reported by the body mass index (BMI) MNA-SF (16.5%), but calf-circumference (CC) MNA-SF overestimated the prevalence (38%). Sensitivity was higher in CC-MNA-SF (92%) when compared to BMI-MNA-SF (72%), while specificity was higher in BMI-MNA-SF (95.6%) when compared to CC-MNA-SF (73.8%). The positive predictive value was higher in BMI-MNA-SF (78.3%) when compared to CC-MNA-SF (43.4%), while the negative predictive value almost similar in both the scales. Reliability of the questionnaire showed the highest value for MNA full form (alpha = 0.71). **Conclusion:** This shows that both the forms of MNA-SF (BMI-based, CC-based) were valid and can be recommended as a screening tool for the assessment of nutritional status of the elderly.

Keywords: Aged, frail elderly, malnutrition, nutrition assessment, reliability, validation studies

Introduction

The World Health Organization estimated that the elderly population would reach 1.2 billion by 2025 worldwide, with almost 840 million in low- and middle-income countries.[1] In India, the elderly population constitutes 7.7% of the total population and this number is escalating. Therefore, health status of the elderly has a significant impact on health status of the country. Older adults are particularly vulnerable to malnutrition as they face many practical issues in achieving adequate nutritional intake.

Nutrition of the older adults affects immunity and functional ability, important components that warrant further attention.[2] Factors such as reduced metabolic rate, feeding difficulty, loss of appetite, decreased mobility, comorbidities, social neglect, and psychological distress make older persons more vulnerable to malnutrition.[3] Studies conducted around India have reported varying prevalence of malnutrition among older adults ranging from 13% to 54%.[3-5] Hence, it is important to diagnose early the older persons with risk of malnutrition or already malnourished. It will help in preventing severe disability and development of complications. Planning of strategies and National Health Programs focusing on older adults also require data on malnutrition.

Various scales have been used around the world for the rapid assessment of nutritional status of older adults. Mini-Nutritional Assessment (MNA) Questionnaire is one such validated scale which is simple and reliable for screening and detecting the older adults with malnutrition or at risk of malnutrition.[6]

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This internationally validated scale has a short version for the screening of older adults for malnutrition using six items from the full version. This short form (SF) was introduced initially in 2001 for detecting the older adults who are at risk of malnutrition and those at risk will be further assessed using the original version for malnutrition.[7] However, it will help to describe that the current version categorizes individuals as "normal nutritional status," "at-risk malnutrition," or "malnourished." It may also be of interest to note that the short-form version of the MNA as "the preferred form of the MNA for clinical use."[8]

Studies around the world have found that the above-mentioned short-form scale has similar diagnostic accuracy when compared to full-form scales.[8-11] Hence, validation and usage of the SF scale will make the assessment easier for primary care physicians and health-care providers involved in taking care of frail and sick older adult patients, at home or hospitals. However, limited studies were done in validating the MNA short-form scale in the Indian setting, especially in South India. Hence, the current study was done to assess the validity and reliability of MNA SF questionnaire among older adults in rural Puducherry, South India.

Methods

We conducted a cross-sectional study among the older adults residing in the rural field practice area of a tertiary care institute in Puducherry. The rural health center caters to a total population of 10,000 in four villages: Pillayarkuppam, Ramanathapuram, Thondamanatham, and Thuthipet. This was conducted as part of another study, which was done to report the prevalence of malnutrition among older adults and data collection was planned before the index test and reference test was performed. The study was carried out from November to December 2016. Inclusion criteria for the study were the older adults who are community dwelling and belonging to the age group of 60 years or more.

The sample size was calculated by OpenEpi v3.01 (Atlanta, Georgia, USA) for the primary study using data from the previous study, the prevalence of malnutrition among older adults to be 24.8%, absolute precision 5%, and confidence interval 95%, the sample size was calculated as 287.[12] However, 279 participants completed the questionnaire. The primary sampling unit was households. The total number of households needed from each of the four villages was calculated using proportionate to size sampling after which, systematic random sampling was employed to select the households from the villages. Individual aged 60 years or more was the study unit and were recruited into the study randomly from the selected households.

We have used the full form of MNA questionnaire for the assessment of nutritional status among older adults and divided the same into two shorter forms. MNA full-form questionnaire consists of 18 items in two sections, with first section containing six items including subjective assessment of decline in food intake, stress, weight loss, mobility, neuropsychiatric symptoms, and body mass index (BMI). The second section contains questions pertaining to independent living status, pressure sores, prescription drugs intake, frequency of meals, proteins, fruits and vegetables, fluid intake, mode of feeding, self-assessment of health and nutritional status, mid-arm circumference (MAC), and calf circumference (CC).[6] A maximum score of 30 can be obtained. A score below 17 points indicates "malnutrition;" score of 17–23.5 points indicates "at-risk malnutrition;" and score of 24 or higher indicates "normal" nutritional status. Two versions of MNA-SF are differentiated based on the anthropometric measurements. One is BMI-MNA-SF questionnaire which contains the first six items in full-form and another is CC-MNA-SF questionnaire which replaces BMI with CC. A maximum score of 14 can be obtained. Score of 12–14 indicates normal nutritional status, score of 8–11 indicates "at risk of malnutrition," and score <8 indicates "malnutrition."

Data collection was started after obtaining informed consent from the selected individual. The purpose of the study and procedure involved in the study was explained before administration of the questionnaire. The interview was conducted by house-to-house visit. The questionnaire had been standardized for our research by forward translation, expert panel back translation, pretesting, and cognitive interviewing and was arrived at the final version.

Anthropometric components measured were height, weight, BMI, MAC, and CC. Height was measured in centimeters with the help of a measuring tape in the standing position. Weight was recorded in kilograms with a bathroom scale. MAC was measured using measuring tape at the mid-point between the tip of the shoulder and the tip of the elbow. CC was measured at the level of the largest circumference of the calf.

Data were entered into Epidata v 3.01 software and analysis was done using STATA version 12. Continuous variables were summarized as mean and standard deviation (SD). Categorical variables were summarized as proportions. Spearman's correlation test was used to assess the relationship between the scores obtained using the MNA full-form and SF questionnaire. The Cohen's kappa coefficient was calculated to determine the agreement over and above the amount we would expect by chance. First, the kappa coefficient was estimated based on dichotomous categorization to classify the patients who require (malnutrition and at-risk older adults) and do not require nutritional intervention (normal nutritional status). Diagnostic accuracy of the MNA-SF was assessed using the sensitivity, specificity, and positive and negative predictive values with MNA full form as the gold standard. We performed a nonparametric estimation of the receiver operator characteristic curve to obtain the area under the curve (AUC) for both SFs and both the curves were compared to see which SF has better diagnostic accuracy. $P < 0.05$ indicates that there was statistically significant. Internal consistency (reliability) of all the three forms of the questionnaire was assessed using Cronbach's alpha coefficient.

Results

In total, there were 767 older adults residing in the study setting, out of which 287 were selected for the study. However, 279 (97.2% response rate) individuals responded to the questionnaire. Eight older adults were unable to respond to the questionnaire properly. The mean (SD) age was 69.37 ± 8.12 years. Among 279 older adults interviewed, majority (68.1%) was females; almost three-fourth had no formal education; and majority (94.6%) were unemployed.

Table 1 shows the results of nutritional status among the study population assessed based on all the three forms of the MNA scale. The prevalence of malnutrition as per the MNA full form was 17.9% (95% confidence interval [CI]: 13.6%–22.9%). Assessment of nutritional status using BMI-MNA-SF scale showed almost similar prevalence 16.5% (95%CI: 12.3%–21.4%). However, there was an overestimation of prevalence by CC-MNA-SF, which showed a 38% (95%CI: 32.3%–44%) prevalence. The prevalence of "at risk of malnutrition" was found to be almost similar across all the three scales (MNA full form – 58.8%, BMI-MNA-SF – 52.7%, and CC-MNA-SF – 56.6%).

Spearman's correlation coefficient shows that there is significant correlation between the scores of MNA full form with both forms of MNA-SF (BMI-MNA-SF rho = 0.88, $P < 0.001$; CC-MNA-SF rho = 0.81, $P < 0.001$) [Table 2]. There was also significant correlation between the scores of BMI-MNA-SF and CC-MNA-SF (rho = 0.91, $P < 0.001$).

There was substantial agreement found between MNA full form and BMI-MNA-SF (agreement = 86%; kappa = 0.65 $P < 0.001$). However, only fair agreement was found between MNA full form and CC-MNA-SF (agreement = 80.6%; kappa = 0.26, $P < 0.001$) and slight agreement between BMI-MNA-SF and CC-MNA-SF (agreement = 73.8%; kappa = 0.20, $P < 0.001$). Kappa coefficient was also estimated for three categorizations as the MNA is originally designed for classification into normal, malnourished and at-risk malnutrition. Similar finding was found as MNA full form and BMI-MNA-SF had substantial agreement (Agreement = 77.4%; kappa = 0.62, $P < 0.001$), while CC-MNA-SF with both MNA full form (agreement = 58.1%; kappa = 0.28, $P < 0.001$) and BMI-MNA-SF (agreement = 52.3%; kappa = 0.23, $P < 0.001$) had fair agreement.

Table 3 shows the results of diagnostic accuracy and internal consistency between both the SF scales. AUC had significantly higher values in both BMI-MNA-SF (AUC = 0.95; 95% CI: 0.93–0.98) and CC-MNA-SF scales (AUC = 0.91; 95% CI: 0.87–0.95) [Figure 1]. Comparison of both the curves showed that BMI-MNA-SF had significantly higher AUC compared to CC-MNA-SF ($P = 0.006$). Keeping MNA full-form as the gold standard, the sensitivity was higher in CC-MNA-SF (92%) compared to BMI-MNA-SF (72%), while specificity was higher in BMI-MNA-SF (95.6%) compared to CC-MNA-SF (73.8%). The positive predictive value was higher in BMI-MNA-SF (78.3%) compared to CC-MNA-SF (43.4%), while the negative predictive value is almost similar in both the scales (94% vs. 97.7%). Cronbach's alpha showed the highest value and acceptable internal consistency for MNA full form (alpha = 0.71), while BMI-MNA-SF (alpha = 0.61) and CC-MNA-SF (alpha = 0.55) showed slightly lesser internal consistency.

Table 1: Results of nutritional status diagnosed based on mini-nutritional-assessment full form, body-mass-index-mini-nutritional-assessment short form, and calf-circumference-mini-nutritional-assessment short-form scales among the study participants ($n = 279$)

Nutritional status	Proportion (95% CI)
Prevalence of malnutrition	
Based on MNA full form scale	17.9 (13.6-22.9)
Based on BMI-MNA-SF	16.5 (12.3-21.4)
Based on CC-MNA-SF	38 (32.3-44)
Prevalence of "at risk of malnutrition"	
Based on MNA full-form scale	58.8 (52.7-64.6)
Based on BMI-MNA-SF	52.7 (46.6-58.7)
Based on CC-MNA-SF	56.6 (50.6-62.5)

MNA: Mini-nutritional-assessment, BMI: Body mass index, CC: Calf-circumference, MNA-SF: Mini-nutritional-assessment short-form, CI: Confidence interval

Table 2: Measurement of Spearman's correlation coefficient and agreement between mini-nutritional-assessment full form and mini-nutritional-assessment short-form ($n = 279$)

Scales	Coefficients	*P*
Spearman's correlation		
MNA full form and BMI-MNA-SF	ρ=0.88	<0.001
MNA full form and CC-MNA-SF	ρ=0.81	<0.001
BMI-MNA-SF and CC-MNA-SF	ρ=0.91	<0.001
Agreement (2 category classification–malnutrition-risk of malnutrition versus normal)		
MNA full form and BMI-MNA-SF	κ=0.65	<0.001
MNA full form and CC-MNA-SF	κ=0.26	<0.001
BMI-MNA-SF and CC-MNA-SF	κ=0.20	<0.001
Agreement (3 category classification–malnutrition versus risk of malnutrition versus normal)		
MNA full form and BMI-MNA-SF	κ=0.62	<0.001
MNA full form and CC-MNA-SF	κ=0.28	<0.001
BMI-MNA-SF and CC-MNA-SF	κ=0.23	<0.001

MNA: Mini-nutritional-assessment, BMI: Body-mass-index, CC: Calf-circumference, MNA-SF: Mini-nutritional-assessment short form

Discussion

This was a community-based cross-sectional study done to find the validity and reliability of MNA-SF questionnaire among older adults in rural Puducherry, South India. In total, 17.9% had malnutrition and 58.8% were "at-risk" as per the MNA full form. BMI-MNA-SF showed a similar finding as 16.5% were malnourished and 52.7% were "at-risk." However,

Table 3: Measurements of diagnostic accuracy and internal consistency between mini-nutritional-assessment full form and mini-nutritional-assessment short form ($n=279$)

Characteristics	BMI-MNA-SF	CC-MNA-SF
Diagnostic accuracy (correctly diagnosing malnutrition)		
Area under curve	0.95 (95% CI: 0.93-0.98)	0.91 (95% CI: 0.87-0.95)
Sensitivity	72	92
Specificity	95.6	73.8
Positive predictive value	78.3	43.4
Negative predictive value	94	97.7
Internal consistency		
Cronbach's α	0.61	0.55

BMI: Body-mass-index, CC: Calf-circumference, MNA-SF: Mini-nutritional-assessment short-form, CI: Confidence interval

CC-MNA-SF overestimated the prevalence of malnutrition to 38% while showing a similar prevalence of "at-risk" (56.6%) compared to the standard scale. A similar prevalence of malnutrition and "at-risk" was reported in other studies conducted among older adults in South India.[5,12]

There was a significant correlation between the scores of MNA full form and SF scales. The agreement was slightly higher in BMI-MNA-SF (86%) than CC-MNA-SF (80.6%) on dichotomous categorization. Studies conducted by Kaiser *et al*.[8] in Germany, Kostka *et al*.[9] in Poland, and Montejano Lozoya *et al*.[10] in Valencia also showed that the BMI-MNA-SF has slightly better agreement when compared to CC-MNA-SF.

The current study also found that both BMI-MNA-SF and CC-MNA-SF have high diagnostic accuracy with AUC more than 0.90. Similar findings were found in studies conducted by Lera *et al.* (2016)[11] in five Latin American countries (Chile, Brazil, Cuba, Mexico, and Uruguay) and Montejano Lozoya *et al*.[10] in Valencia in which AUC was significantly higher in both SF scales ranging from 0.87 to 0.90. BMI-MNA-SF showed slightly higher AUC compared to CC-MNA-SF, which was also similar compared to the above-mentioned studies.[10,11] Sensitivity and specificity were also good in both the SF scales, with CC-MNA-SF having better sensitivity (92%) compared to BMI-MNA-SF (72%) and BMI-MNA-SF having better specificity (95.6%) compared to CC-MNA-SF (73.8%). Similar sensitivity and specificity were found in previous studies conducted in other parts of the world.[10,11] However, a study conducted in South India by Mathews *et al*.[13] showed slightly less sensitivity (61%) and specificity (89%) in both the BMI-MNA-SF and CC-MNA-SF scales.[14] Possible reasons could be the difference in sociocultural characteristics between the study participants in both the studies.

The current study finding had a slightly lesser reliability coefficient (0.71) than other studies conducted in India like study by Gaiki and Wagh[14] in Central India and Mathews *et al*.[13] in South India where it was 0.78 and 0.80, respectively. Although the reliability coefficient was lower for both SF

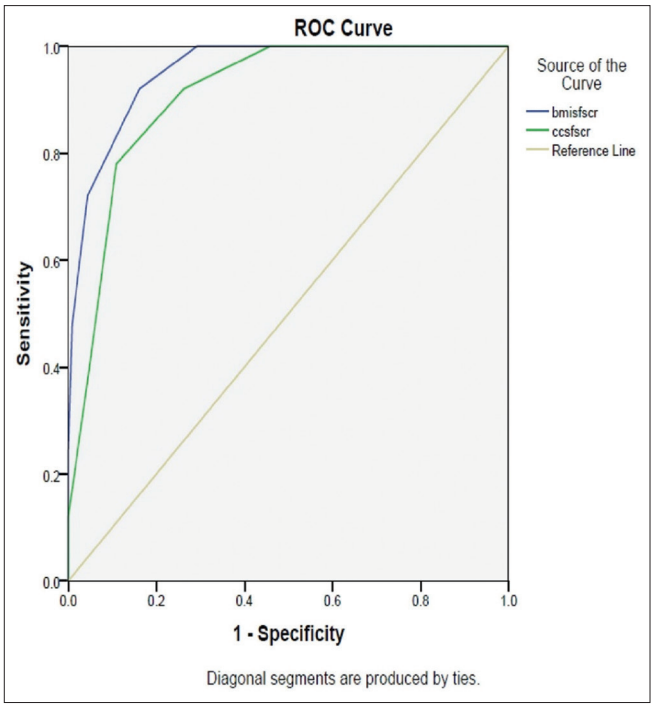

Figure 1: Receiver operator characteristics curve showing sensitivity and specificity of Mini-Nutritional-Assessment–Short form compared to Mini-nutritional-assessment full form

scales, we found that BMI-MNA-SF (0.61) had better internal consistency than CC-MNA-SF (0.55).

The major strength of the study was the comprehensive reporting of correlation, agreement, diagnostic accuracy, and internal consistency of MNA full-form and MNA-SF form questionnaires. Higher response rate and community-based design were added strengths to the study as it makes the generalizability better. The current study adds to the limited literature available regarding the diagnostic accuracy and reliability characteristic of MNA-SF form in Indian settings.

In spite of these strengths, there were certain limitations in the study. The current study was done with cross-sectional design. However, most of the diagnostic studies adopt cross-sectional as the study design. The obtained results in the current study can differ in other population in India like people in North India because of difference in sociocultural characteristics. Hence, further research among North Indian states and other settings like facility-based and rehabilitation center-based studies can help in finding the applicability of the scale in the relevant settings.

The current study has certain implications. The findings of this study will inform the policymakers regarding the short, reliable, and easily administered scale (MNA-SF) for screening and early diagnosis of malnutrition. This will help the policymakers to formulate strategies for an inclusive engagement and training of primary care providers to identify and manage the cases of malnutrition among older adults at the earliest. Opportunistic screening can be done by primary

health-care workers as it can be applied within 5 min. At the household level, primary caregivers can also be trained in identifying older adults at risk of malnutrition as it is easily admissible. However, further research can be done to validate the MNA-SFs in the hospital setting as it will be helpful in providing recommendations for opportunistic screening of older adults in primary health-care center.

Conclusion

The current study showed that both the forms of MNA-SF (BMI and CC based) were valid and can be recommended as a screening tool for the assessment of nutritional status of older adults. This was confirmed by the strong correlation, good agreement, and high diagnostic accuracy of both BMI-MNA-SF and CC-MNA-SF with MNA full form.

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Conflicts of interest

There are no conflicts of interest.

References

1. WHO|Nutrition for older persons [Internet]. WHO. Available from: http://www.who.int/nutrition/topics/ageing/en/index1.html [Last accessed on 2018 Jul 11].
2. Lesourd B. Nutrition: A major factor influencing immunity in the elderly. J Nutr Health Aging 2004;8:28-37.
3. Kikafunda JK, Lukwago FB. Nutritional status and functional ability of the elderly aged 60 to 90 years in the Mpigi district of central Uganda. Nutrition 2005;21:59-66.
4. Lahiri S, Biswas A, Santra S, Lahiri S. Assessment of nutritional status among elderly population in a rural area of West Bengal, India. Int J Med Sci Public Health 2015;4:569.
5. Vedantam A, Subramanian V, Rao NV, John KR. Malnutrition in free-living elderly in rural south India: Prevalence and risk factors. Public Health Nutr 2010;13:1328-32.
6. Vellas B, Guigoz Y, Garry PJ, Nourhashemi F, Bennahum D, Lauque S, *et al*. The mini nutritional assessment (MNA) and its use in grading the nutritional state of elderly patients. Nutrition 1999;15:116-22.
7. Rubenstein LZ, Harker JO, Salvà A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: Developing the short-form mini-nutritional assessment (MNA-SF). J Gerontol A Biol Sci Med Sci 2001;56:M366-72.
8. Kaiser MJ, Bauer JM, Uter W, Donini MD, Stange I, Volkert D *et al*. Prospective validation of the modified mini nutritional assessment short-forms in the community, nursing home, and rehabilitation setting. J Am Geriatrics Society 2011;59:2124-8.
9. Kostka J, Borowiak E, Kostka T. Validation of the modified mini nutritional assessment shortforms in different populations of older people in Poland. J Nutr Health Aging 2014;18:366-70.
10. Montejano Lozoya R, Martínez-Alzamora N, Clemente Marín G, Guirao-Goris SJA, Ferrer-Diego RM. Predictive ability of the mini nutritional assessment short form (MNA-SF) in a free-living elderly population: A cross-sectional study. PeerJ 2017;5:e3345.
11. Lera L, Sánchez H, Ángel B, Albala C. Mini nutritional assessment short-form: Validation in five Latin American cities. SABE study. J Nutr Health Aging 2016;20:797-805.
12. Kalaiselvi S, Arjumand Y, Jayalakshmy R, Gomathi R, Pruthu T, Palanivel C. Prevalence of under-nutrition, associated factors and perceived nutritional status among elderly in a rural area of Puducherry, South India. Arch Gerontol Geriatr 2016;65:156-60.
13. Mathews AC, Jose J, Athira S, Vijayakumar M. The reliability of mini nutritional assessment (MNA) questionnaire in screening malnutrition among elderly aged 60 years and above. Asian Pac J Health Sci 2015;2:47-8.
14. Gaiki V, Wagh V. Reliability of mini-nutritional assessment scale in rural setup of a tertiary health care hospital in central India. J Acad Ind Res 2014;2:638-41.