

THE DIAGNOSTIC ACCURACY OF THE REVISED MINI NUTRITIONAL ASSESSMENT SHORT FORM FOR OLDER PEOPLE LIVING IN THE COMMUNITY AND IN NURSING HOMES

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Abstract: *Objective:* The aim of this study was to determine the diagnostic accuracy of the CC-SF, which was developed to use calf circumference (CC) instead of BMI in the MNA-SF, for elderly people living in the community and in nursing homes. It also aimed separately to determine the correlation of CC-SF and BMI-SF with the full MNA. *Study Design and Methods:* The study included 640 elderly people living in their community and 243 elderly people living in nursing homes. Accuracy was assessed by determining the sensitivity and selectivity of the nutritional assessments. The correlations between the MNA-SFs and the full MNA were analyzed. *Results:* The correlation between MNA-SFs and full MNAs was strong, significant and almost identical both in the community and in nursing homes ($r=0.86-0.88$; $p<0.001$). The observed agreement between the BMI-SF and the full MNA was 82.2% in the community and 77.8% in the nursing homes. There was a substantial agreement by kappa values in the comparison of community and nursing homes (the Kappa value of the BMI-SF was 0.63 in the community and 0.62 in the nursing homes, and the kappa value of the CC-SF was 0.62 in the community and 0.63 in the nursing homes). When compared to the full MNA the MNA-SFs tended to underestimate nutritional status. Both MNA-SFs had similarly high sensitivity and selectivity, both in the community and nursing homes. (when dichotomized as "malnourished-at risk of malnutrition" versus "well nourished" and "malnourished" versus "at risk of malnutrition-well nourished") (over 80%). *Conclusion:* In cases where BMI cannot be determined, the CC-SF is a good substitute for the BMI-SF.

Key words: Elderly people, malnutrition, mini nutritional assessment, diagnostic accuracy.

Introduction

The Mini Nutritional Assessment (MNA) is commonly used to determine the nutritional status of elderly people. The scale was first developed in 1994 (1, 2). It includes eighteen questions including anthropometric, general nutritional and subjective assessment. The assessment classifies individuals as well nourished, at risk or malnourished. The MNA is a tool of high sensitivity and specificity. It is easy to apply and can be completed in about fifteen minutes (3). The Short Form of the MNA includes six questions (MNA-SF) and was developed in 2001 (4). The advantage of this short form is that it is a suitable screening tool and can be used for very quick evaluation. On the other hand, the disadvantage of the form is that it involves Body Mass Index (BMI). It is very important to use easy and quicker evaluation tools for the elderly. It is especially difficult to measure the height and weight of elderly people who are bedridden or having difficulties with mobility. In addition, BMI is not an appropriate index in some Asian and African communities due to variations in height/weight ratio (5, 6). Furthermore, the height of elderly people may be reduced by chronic degenerative diseases and by increasing the microfractures and kyphosis secondary to osteoporosis. Such reductions in height can result in misleading BMI results (6, 7). For these reasons, the possibility of using the MNA-SF without BMI was considered, and the MNA-SF was first revised by Kaiser et al. The CC-SF was developed to use calf circumference (CC) instead of BMI in the MNA-SF (8, 9).

Subsequently, two other studies examined the usefulness of the CC-SF. One of them analyzed the correspondence of both short forms with the full MNA when used for community-dwelling older people, nursing home residents and older adults in rehabilitation facilities (10). The other study validated the consistency of both short forms with the full MNA for elderly people living in nursing homes (11).

The aim of this study was to determine the diagnostic accuracy of the BMI-SF and the CC-SF in comparison with full MNA for elderly people living in the community and in nursing homes. It also aimed separately to determine the correlation the CC-SF and the BMI-SF with the full MNA.

Study Design and Methods

The data was obtained from two separate cross-sectional studies of people aged 65 and over. The first study was a community-based study that included 640 elderly people living in a neighborhood in the Balçova district of the province of Izmir. Balçova is an urban settlement inhabited mainly by blue and white collar workers as well as retirees. There are six neighborhoods in the district, and the neighborhood selected by this study was chosen due to its economically heterogeneous structure. In this neighborhood there were 1,858 elderly people, and 756 of them were included the sample group (accessibility rate: 84.7%) (12). The second study was conducted in nursing homes. In central Izmir there were seven public nursing homes, four local authority owned nursing homes and twenty-eight

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private nursing homes. Among them one public, one local authority owned and two private nursing homes were randomly chosen and weighted according to their number of inhabitants. There were 243 elderly nursing home residents who agreed to participate and were found to be eligible for the study. In Turkey, public nursing homes accept residents who are 60 years or above, whereas private ones accept residents at 55 years or older. This study excluded residents younger than 65 years of age. Moreover, elderly people who had communication problems, or cognitive impairment or were incapable of performing daily activities were excluded from the study. Data were collected through face-to-face interviews either at homes or in nursing homes in both of the studies.

Measurements: BMI was obtained by dividing weight (kg) by the square of the participants' height (m²). The Medisana digital scale was used for weight measurement and for height, while for MUAC and CC a rigid elastic tape was used. Weight and height measurements were conducted while participants were wearing light clothes without shoes, standing still, and in Frankfort plane for height measurement (13). For MUAC, the right arm was used and for CC, the right leg was used unless there was a special reason, such as a stroke. The arm was bent 90° from the elbow, and measured from the midway point between the olecranon process and the acromium. CC measurement was conducted while the participant was seated at the height of the largest circumference of the calf (14, 15).

Data Analysis: Statistical analyses were performed with the SPSS Statistics 19.0 program (SPSS Inc. Chicago IL, USA). Descriptive results were given as mean±standard deviation or percentage distributions. The correlations between the different forms of MNA were analyzed using Pearson Correlation Analysis. In the full MNA's classifications, a score of ≥24 means well nourished, a score between 17 and 23.5 means at risk of malnutrition and a score of <17 indicates malnutrition for elderly people (15). In the CC-SF CC is used in the MNA-SF instead of BMI. In the assessment of CC-SF scores, a CC of less than 31 centimeters is scored as 0.0, and 31 cm and over is scored as 3.0 (9). In the classifications of the BMI-SF and the CC-SF, a score of ≥12 means well nourished, a score between 8 and 11 means at risk of malnutrition and a score ≤7 indicates malnutrition for elderly people (9). Kappa values were calculated for consistency. A ROC curve was drawn, and the full MNA was taken as the gold standard for determining sensitivity and selectivity. The full MNA was categorized by the following two dichotomies: "malnourished-at risk of malnutrition" versus "well nourished" and "malnourished" versus "at risk of malnutrition-well nourished" (11). In both categorizations, from the areas under the ROC curves, the degrees of sensitivity and selectivity were determined. As Kaiser et al. advise, misclassifications were compared to the full MNA. Misclassification into a higher MNA-SF category (e.g., malnourished according to the full MNA, but at risk according to the MNA-SF) was described as overestimation and considered potentially harmful to patients since potentially

malnourished elderly people could be missed due to short form screening. On the other hand, placing elderly people into a lower category (e.g., at risk according to the full MNA, but malnourished according to the MNA-SF) was not considered potentially harmful, since, even though the individual might not be at risk, he/she will be given appropriate attention when screened using the MNA-SF (9, 10).

Results

The main characteristics of the 640 elderly people living in the community and the 243 elderly people living in nursing homes included in the study are shown in Table 1. The full MNA found the frequency of malnutrition to be 2.7% in the community and 8.6% in the nursing homes in the study. On the other hand, the BMI-SF found the frequency of malnutrition to be 5.1% in the community and 12.8% in nursing homes, while the CC-SF found a malnutrition rate of 5.4% in the community and 14.8% in nursing homes.

Table 1
Basic characteristics of the study population

Characteristics	Community (n=640)	Nursing home (n=243)
Age Mean±SD	74.1±6.3	79.4±7.0
Sex		
Female n (%)	402 (62.8)	155 (63.8)
Male n (%)	238 (37.2)	88 (36.2)
Full MNA score Mean±SD	24.7±3.4	23.6±4.8
BMI-SF score Mean±SD	11.9±2.4	11.0±2.7
CC-SF score Mean±SD	11.9±2.3	10.9±3.0

There is a strong and significant correlation between the full MNA, the BMI-SF and the CC-SF for the elderly in this study (r=0.86-0.88; p<0.001) (Table 2). A strong and significant correlation was also detected between the BMI-SF and the CC-SF (r=0.95-0.96; p<0.001) (Table 2).

Table 2
The correlations between MNA and its different forms

Characteristic	Community		Nursing home	
	r	p	r	p
Full MNA and BMI-SF	0.86	<0.001	0.88	<0.001
Full MNA and CC-SF	0.87	<0.001	0.87	<0.001
BMI-SF and CC-SF	0.96	<0.001	0.95	<0.001

The observed agreement of BMI-SF with full MNA was 82.8% (520/663) in the community and 77.8% in nursing homes (189/243). In this comparison, 4.1% (26/633) from the community and 6.6% (16/243) from the nursing homes were overestimated, while 13.7% (87/633) and 16.1% (39/243) from the nursing homes were underestimated. There was a

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Table 3
 Agreement between MNA-SF and full MNA

	Malnourished	Full MNA classification n (%)		Total	Kappa
		At risk	Well nourished		
BMI-SF					
Community	17 (2.7)	177 (28.0)	439 (69.3)	633 (100.0)	0.63*
Malnourished	13	19	0	32 (5.1)	
At risk	4	136	68	208 (32.9)	
Well nourished	0	22	371	393 (62.0)	
Nursing home	21 (8.6)	87 (35.8)	135 (55.6)	243 (100.0)	0.62*
Malnourished	18	13	0	31 (12.8)	
At risk	3	62	26	91 (37.4)	
Well nourished	0	12	109	121 (49.8)	
CC-SF					
Community	17 (2.7)	177 (28.0)	439 (69.3)	633 (100.0)	0.62*
Malnourished	15	19	0	34 (5.4)	
At risk	2	138	77	217 (34.3)	
Well nourished	0	20	362	382 (60.3)	
Nursing home	21 (8.6)	87 (35.8)	135 (55.6)	243 (100.0)	0.63*
Malnourished	21	15	0	36 (14.8)	
At risk	0	61	26	87 (35.8)	
Well nourished	0	11	109	120 (49.4)	

*Mc Nemar p<0.001

Table 4
 Agreement between CC-SF and BMI-SF

CC-SF	Malnourished	BMI-SF classification n (%)		Total	Kappa
		At risk	Well nourished		
Community	34 (5.3)	209 (32.9)	393 (61.8)	636 (100.0)	0.92*
Malnourished	31	5	0	36 (5.7)	
At risk	3	201	14	218 (34.3)	
Well nourished	0	3	379	382 (60.1)	
Nursing home	31 (12.8)	91 (37.4)	121 (49.8)	243 (100.0)	0.81
Malnourished	26	10	0	36 (14.8)	
At risk	5	75	7	87 (35.8)	
Well nourished	0	6	114	120 (49.4)	

*Mc Nemar p<0.05

Table 5
 Sensitivity and selectivity of MNA-SF compared to full MNA

	Areas*	Full MNA “well nourished” vs. “at risk+malnourished”		Areas*	Full MNA “well-nourished+at risk” vs. “malnourished”	
		Sensitivity (%)	Selectivity (%)		Sensitivity (%)	Selectivity (%)
BMI-SF (Community)	0.87	88.7	84.5	0.87	76.5	96.9
BMI-SF (Nursing home)	0.85	88.9	80.7	0.90	85.7	94.1
CC-SF (Community)	0.86	89.7	82.5	0.93	88.2	96.9
CC-SF (Nursing home)	0.85	89.8	80.7	0.97	100.0	93.2

* Under the ROC curves

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substantial agreement in the kappa values of both comparisons (Table 3) (16).

The observed agreement of the CC-SF with the full MNA (81.4% in the community; 78.6% in nursing homes), overestimation rates (3.5% in the community; 4.5% in nursing homes), underestimation rates (15.2% in the community; 16.9% in nursing homes) and kappa values were similar to the comparison between the full MNA and the BMI-SF (Table 3).

In the comparison of the CC-SF and the BMI-SF, the observed agreement was 96.1% (611/636) in the community and 88.5% (215/243) in the nursing homes. In this comparison, 1.4% (9/636) from the community and 4.5% (11/243) from the nursing homes were overestimated, while 3.0% (19/636) from the community and 7.0% (17/243) from the nursing homes were underestimated. There was a nearly perfect agreement of kappa values (Table 4) (16).

According to the two different categorizations of the full MNA, the ROC curves of the BMI-SF and the BMI-CC and the area under them, which represents their sensitivity and selectivity, are shown in Table 5.

Discussion

This study was carried out to determine whether using the CC-SF in place of the BMI-SF is suitable for people aged 65 and over who live in the community and in nursing homes.

Our study found the frequency of malnutrition lower in the community than in nursing homes according to the full MNA (2.7%, 8.6%, respectively). Previous studies have found that the frequency of malnutrition fluctuated between 5-10% in the community (17, 18), while another multi-centered study found that malnutrition frequency was 11.9% by MNA-SF and 4.5% by full MNA in Turkey's nursing homes (19). In Kaiser's study of nursing homes in twelve countries, the full MNA found a malnutrition rate of 13.8% in elderly residents (18).

Our study found strong and comparable correlations between MNA-SFs and full MNA both in the community and nursing homes. Moreover, Garcia-Meseguer et al. studied nursing home residents and found a correlation quite similar to that of our study (11). However, unlike our study, Kaiser et al. found a higher correlation between the full MNA and the BMI-SF than that of CC-SF (9). In our study, the nearly identical correlation both in community and nursing homes could be caused by the fact that most of the elderly people living in the nursing homes were healthy due to acceptance conditions of nursing homes. If an elderly cannot perform daily activities nor needs regular care, he is institutionalized in a residential care home not a nursing home.

Our study found the agreement between the full MNA and the MNA-SFs both in community and nursing homes to be substantial and nearly the same. However, the MNA-SFs tended to give lower nutritional status, or MNA scores, than the full MNA both in the community and nursing homes. The correlations determined by Kaiser et al. were lower in the community, but higher in nursing homes, compared to our

results (10). Garcia-Meseguer et al. studied nursing home residents, and the correspondences determined by their study were higher for BMI-SF than our results, but lower for CC-SF (11).

The reason this study's findings for community and nursing homes in the present study were similar could be attributed to the fact that most of the elderly people living in the nursing homes are healthy. Unlike our study, the studies of Kaiser and Garcia-Meseguer found the agreement of the full MNA and the CC-SF to be a little lower than the full MNA's agreement with the BMI-SF. An important finding of our study is that the people determined to be malnourished according to the full MNA were not found to be well-nourished by the MNA-SFs, and people found to be well-nourished by the full MNA were not determined to be malnourished by the MNA-SFs. This was also the result demonstrated by both the other studies (10, 11). Another finding the current study shares with the two other studies is that when people were tested with the full MNA, well-nourished people tended to be at risk of malnutrition or people at risk of malnutrition tended to have malnutrition. Another indication of this tendency is that our study found that the rates of malnutrition indicated by the BMI-SF and the CC-SF were higher. The rates of over- and underestimation by the BMI-SF and the CC-SF were found to be close to each other in our study. Since MNA-SFs were only used for screening purposes, misclassifications by the short form could not cause harm to people. After screening with MNA-SF, expert analysis and observation is necessary.

In our study, the sensitivity and selectivity of MNA-SFs were higher or similar to full MNA both in the community and nursing homes (over 80%). In terms of validation, CC-SF is just as effective as the BMI-SF. It has even been claimed that it is more sensitive. Kaiser et al. and Garcia-Meseguer et al. determined levels of sensitivity and selectivity similar to those of our study (9, 11). In addition, the areas under the ROC curve indicate that the full MNA and both other tests have good validity.

Diekmann et al. demonstrated in their study that malnutrition in nursing home residents with dementia is high, so it is not appropriate to exclude elderly people with cognitive deficits from the study (20). This point of view is also correct, but it is very hard to apply MNA to elderly people with cognitive impairment. This could be considered a limitation of this study. However, this study did not collect new data, but used data from two different cross-sectional studies. Moreover, the data from these two studies were collected from an urban population from central Izmir, so we cannot generalize our findings for the entire elderly population. This could also be considered a limitation.

Conclusions

The correlations of both short forms with the full MNA were strong and significant in both the community and the nursing homes, and they had substantial agreement. When compared to

the full MNA the MNA-SFs tended to underestimate nutritional status, placing elderly people in a lower category than they should have been. This is protective for the elderly. Both MNA-SFs had similarly high sensitivity and selectivity, both in the community and in the nursing homes. Both short forms can thus be used as quick and reliable nutritional screening programs in the community and in nursing homes. In cases where BMI cannot be determined, the CC-SF is a good alternative to the BMI-SF.

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