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VALIDATION OF THE MINI NUTRITIONAL ASSESSMENT-SHORT FORM IN A POPULATION OF FRAIL ELDERS WITHOUT DISABILITY. ANALYSIS OF THE TOULOUSE FRAILTY PLATFORM POPULATION IN 2013

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Abstract: *Objective:* To assess the validity of the Mini Nutritional Assessment-Short Form (MNA-SF) in elderly patients from the Toulouse Frailty Platform. *Participants:* Overall, 267 patients aged 65 and over, without severe cognitive impairment (i.e. Mini Mental Status Examination > 20 and CDR<1), no physical disability (i.e. Activities of Daily Living ≥ 5) and no active cancer history (over the past 12 months) were included in 2013. *Measurements:* Receiver operating characteristic (ROC) analyses were used to assess the predictive validity of the French version of the MNA-SF for good nutritional status (defined as a full MNA score≥24/30). Analyses were conducted in the overall sample and then in subgroups of frail and pre-frail subjects according to the frailty phenotype. Optimal cut-off points were determined to obtain the best sensitivity/specificity ratio and the highest number of correctly classified subjects. *Results:* Among 267 patients, mean age=81.5±5.8; women=67.0%; 138 (51.7%) were frail, 98 (36.7%) were pre-frail and 31 (11.6%) were robust. Given their MNA-SF scores, 201 (75.3%) had a good nutritional status, 61 (22.8%) were at risk of malnutrition and 5 (1.9%) were malnourished. In the overall sample, but also in subgroups of pre-frail or frail elders, the areas under ROC curves were 0.954, 0.948 and 0.958 respectively. The 11 points cut-off provided the best correct classification ratio (91.4%); sensitivity=94.0%, specificity=83.3%. *Conclusion:* The MNA-SF appeared to be a validated and effective tool for malnutrition screening in frail elders. Implementing this tool in clinical routine should contribute to improving the screening of malnourished frail individuals.

Key words: Malnutrition, elderly, Mini Nutritional Assessment, frailty.

Introduction

In western aging societies, protein-energy malnutrition defined as an energy deficit due to chronic deficiency of all macronutrients appears as a major Public Health concern that affects 5 to 15% of community dwelling older subjects (1-3). Since a poor nutritional status is associated with adverse clinical and economic outcomes such as increased mortality or increased costs of hospitalization (4, 5), the need for formal screening procedures has emerged. Promising perspectives of interventional procedures (e.g. dietary protein supplementation) aiming at reversing the burden of malnutrition have also been suggested (6, 7).

Numerous tools have been validated for malnutrition screening in the elderly (8). Among them, the Mini Nutritional Assessment® (MNA) (9) has demonstrated several strengths. For example, in community dwelling elderly, the MNA® can detect risk of malnutrition while albumin and BMI are in the normal range and life style characteristics are associated with nutritional risk (9). In outpatients and hospital patients, the MNA® is predictive of outcome and cost of care (10). However, this test requires substantial time to complete (up to 15 minutes) (8). Therefore, a shorter version of the MNA has been elaborated: the MNA short-form (MNA-SF), which consists of 6 items and takes only 3 minutes to be completed, albeit keeping the usefulness and accuracy of the full version (3). Subjects can be classified in 3 categories: normal nutritional status, at risk of malnutrition and malnourished. In addition, the revised version of the MNA-SF proposed by Kaiser and colleagues (11) allows to assess the calf circumference (instantly measured with a tape) when the BMI is unavailable. Thus, this brief tool may represent a first-choice instrument for clinicians looking for a quick and efficient malnutrition screening instrument, designed for elderly patients.

Frailty is a state of extreme vulnerability, characterized by insufficient homeostatic reserves to efficiently cope against stressors (2). This condition is also known to be a "dynamic state", suggesting that frail people can transit to non-frail status with ad hoc interventions (12). Despite the absence of consensual definition of frailty, the frailty phenotype proposed by Fried and colleagues is considered as an operational delineation of this condition (2). This tool consists of five criteria: exhaustion, involuntary weight loss, low activity, slow walk and poor grip strength. Older adults meeting these criteria are at higher risk of developing impairment of activities of daily living and show higher morbi-mortality (13-15). In the former subjects, nutrition surely represents a cornerstone to maintain good functional performances and prevent poor health outcomes. Screening malnourished (or at risk of malnutrition) frail elders enables to perform a geriatric assessment, review critically their diet and offer them corrective measures and

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nutritional support (16). Precisely, the MNA-SF was designed to assess malnutrition is different populations of vulnerable older adults such as hospitalized patients, nursing home residents or demented subjects (9). However, to our knowledge this instrument has not been validated yet in a frail outpatients population meeting Fried and colleagues' criteria.

Therefore, in the present study, we aimed at validating the screening accuracy of the French version of the MNA-SF compared with the full French MNA in outpatients from the geriatric Frailty Platform (structured as a Day Hospital) of Toulouse, France. The cut-point of 12 points and over was shown to be the most appropriate for nutritional screening in a heterogeneous population of hospitalized elders and community dwelling older adults (17). We hypothesized that this very cut-off is correct to screen frail elderly patients for malnutrition.

Methods

Population

All the outpatients who were admitted to the Toulouse Frailty Platform, France in 2013 were eligible for the present analyses. Participants were referred either by their general practitioner, by hospital specialist consultants or by the oncogeriatrics consulting team. The detailed methodology of the Frailty Platform has been published previously (18, 19). Briefly, the main objective of this day hospital is to provide a comprehensive assessment of the medical, functional, cognitive, nutritional and social resources of frail older individuals. Although these patients usually meet frailty criteria, they do not present disability in activities of daily living (ADL) or major cognitive impairment. Accordingly, personalized interventions may be provided by a dietitian (e.g. nutritional counseling), a physical trainer (e.g. training program for muscle reinforcement) or a neuropsychologist (e.g. thorough cognitive evaluation).

Before July 1st, 2013 the MNA-SF scores of the patients were not recorded in our database. However, only data with both the MNA-SF and the full MNA available were considered in the present analyses. The inclusion criteria were: age≥65 years, no active cancer history over the past 12 months (since the fraily phenotype has been questionned in cancer patients) and an ADL score≥5 (i.e. no physical disability). As the frailty phenotype has never been validated in demented subjects, subjects with an MMSE score <21 or a Clinical Dementia Rating score≥1 have also been excluded.

Variables

In the present study, the French version of the MNA-SF and the full MNA were used (20). Sociodemographic characteristics were obtained through questionnaire. A medical interview performed by a geriatrician provided the following: medical and surgical history, ongoing medication and physical examination. Height and weight were measured and Body Mass Index (BMI) was calculated as the weight in kg divided by the square of the height in meters. Daily self-care activities were assessed with the ADL (21) and the Instrumental ADL (IADL) (22) scales.

Frailty assessment was performed by specialized nurses and was based on Fried's frailty phenotype (2) i.e. involuntary weight loss, self-reported exhaustion, muscle weakness, slow gait speed, and low physical activity. A 5 kg-weight loss over the past year (either measured or reported by the patient) was considered to be significant. The exhaustion criterion was met if the answer was "Much or most of the time" when asked, "How often in the last week did you feel this way" to either of the following two statements: "I felt that everything I did was an effort" and "I could not get going." The muscle weakness criterion was met when the average of 3 handgrip strength measurements by a handheld dynamometer, was less than or equal to the sex- and BMI specific cutoff points provided by Fried and colleagues. Slow usual gait speed (assessed over a 4-meter distance, starting from a still position) was defined either as a time of more than 6 seconds for men whose height is less than or equal to 173 cm (or women ≤ 159 cm respectively); or as a time of more than 5 seconds for men whose height is more than 173 cm (or women > 159 cm respectively). We defined as "sedentary" those participants who had performed no physical activity, spent most of the time sitting, or rarely had a short walk (or other non-demanding physical activity) in the past year according to a validated interviewer-administered questionnaire (23). The Fried score was defined with these five items; patients with a 0 score were considered as robust, those with a 1 or 2 score were considered as pre-frail, and those with a 3 to 5 score were frail. The physical evaluation was completed with the Short Physical Performance Battery (24).

Statistical analyses

Receiver operating characteristic (ROC) analyses were used to assess the predictive validity of the MNA-SF. The reference was a good nutritional status (defined as a score above 23.5/30 according to the full MNA). Analyses were conducted in the overall sample and after categorization of our participants in frail and pre-frail groups. Optimal cut-off points were determined to obtain the best sensitivity/specificity ratio and the highest number of correctly classified subjects. Analyses were performed using STATA v11.0 (Stata Corp., College Station, TX).

Results

Data of 412 subjects from the Toulouse Frailty Clinic were recorded in our 2013 database. Fifty nine of them were excluded because of their low cognitive performances (MMSE<21), 57 were because they had insufficient Activities of Daily Living performances (score of less than 5) and one because he was under 65 years old. Two MNA scores had missing items. Twenty six had active cancer history. Thus, 145 subjects were excluded, and our final sample comprised 267 individuals. The flow-chart for participants' selection is presented in Figure 1.

Figure 1
Flow chart of patients' selection for the present analyses

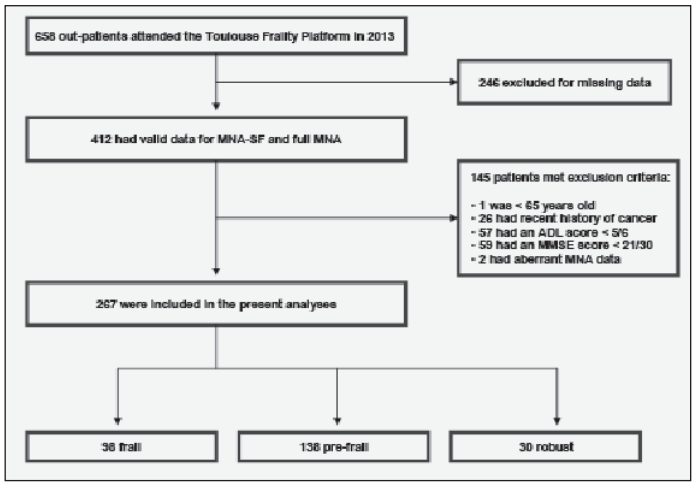
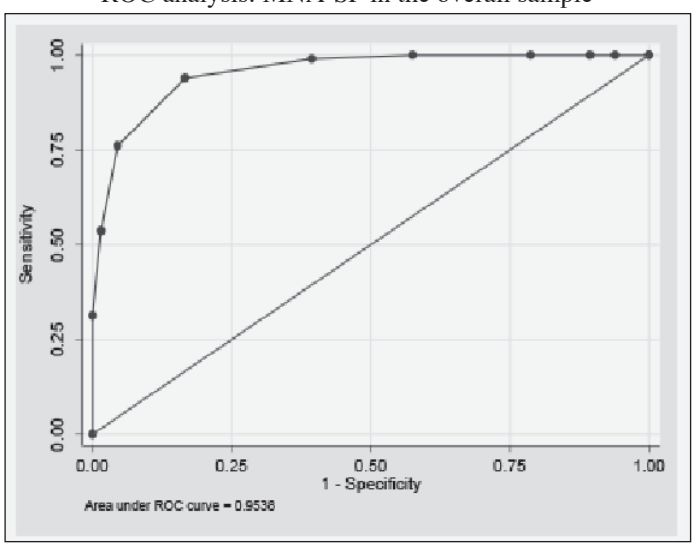


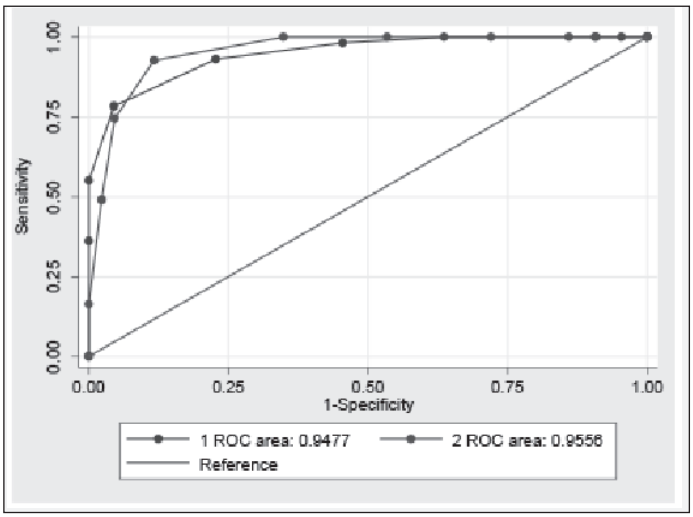
Figure 2
ROC analysis: MNA-SF in the overall sample



The main nutritional and physical characteristics of the study sample are presented in Table 1. Mean age was 81.5 (Standard deviation (SD) 5.8) years old; 67.0% were women; 57.9% had a normal ADL score (6/6) and 63.9% a 7 to 8 IADL score. According to the Fried frailty criteria, 11.3% of the participants were robust, 51.9% were pre-frail and 36.8% were frail. All of our malnourished participants were frail.

In the overall sample (Figure 1) as well as in pre-frail and frail considered separately (Figure 2), the areas under ROC curves were 0.954 95% Confidence Interval (CI) 0.928-0.980, 0.948 95% CI 0.908-0.987 and 0.956 95% CI 0.906-0.996 respectively. The 11 points cut-off allowed the best correct classification ratio (91.4%), with a sensitivity of 94.0% and a specificity of 83.3%. With a 12 points cut-off the sensitivity was: 76.1, and the specificity: 95.5% (Table 2). After stratification on pre-frail and frail status, there was no significant difference of areas under curve between the former and the latter individuals (0.95 vs. 0.96, p = 0.78).

Figure 3
ROC analysis: MNA-SF in frail and pre-frail subjects



Discussion

In this study, the MNA-SF appeared to be an accurate tool for malnutrition screening in patients meeting frailty criteria. The best cut-point for good nutritional status was a score of 11 and above, allowing a sensitivity of 94.0% and specificity of 83.3%, hence a Youden's index of 0.77. Given this threshold, 91.4% of our subjects were correctly classified. Pre-frail and frail older adults share common characteristics and are significantly more affected by nutritional issues than robust elders (25). In our sample, there was no significant difference of correctly classified subjects using the MNA-SF between pre-frail and frail elders. Therefore, this study confirms that the MNA-SF compares well with the full MNA and represents a valid instrument for nutritional screening in a frail out-patients population.

Our findings were consistent with previous validation studies of the MNA-SF (3, 26). However, the usual MNA-SF threshold for good nutritional status is a 12 out of 14 score. As a result, subjects with a score below 12 need to complete the full MNA. Rubenstein and colleagues (3) had already acknowledged that the 11 cut-point provided a better sensitivity/specificity ratio to indicate undernutrition. Yet, raising the threshold to 12 reduced the number of persons incorrectly identified as well-nourished despite a higher number of false negative (i.e. people without malnutrition who will be referred to the dietician). Frail elders represent primary targets for nutritional screening. Consistent with the foregoing study, we assumed that failing to screen a malnourished elder would be of greater concern than requiring additional evaluation for people mistakenly identified as malnourished. Thus, the previously established 12 threshold appears as appropriate in our population of frail older adults.

Malnutrition and frailty are two interrelated syndromes. Firstly, malnutrition is very common among the elderly frail populations (25). Secondly, this condition may directly

Table 1
Characteristics of our population

Characteristics, M (SD)	Overall N=265	Robust N=30	Pre-frail N=137	Frail N=98
Age (years)	81.5 (5.8)	78.1 (4.6)	81.1 (5.6)	83.2 (5.7)
Female gender, % (N)	67.0 (179)	73.3 (22)	64.5 (89)	68.4 (67)
ADL score, % (N)				
6/6	57.9 (154)	66.7 (20)	9.5 (13)	50.0 (49)
5.5/6	30.4 (81)	23.3 (7)	28.5 (39)	34.7 (34)
5/6	11.7 (31)	10.0 (3)	62.0 (85)	15.3 (15)
IADL score, % (N)				
7-8/8	63.9 (170)	90.0 (27)	63.7 (101)	41.8 (41)
5-6/8	15.6 (68)	6.7 (2)	21.2 (29)	37.8 (37)
≤ 4/8	20.5 (28)	3.3 (1)	5.1 (7)	20.4 (20)
Height (cm)	158.2 (9.5)	160.7 (10.0)	158.7 (9.3)	156.8 (9.5)
Weight (kg)	65.6 (15.2)	68.7 (18.6)	65.4 (14.4)	65.0 (15.1)
Body Mass Index (kg/m^2)	26.0 (4.7)	26.3 (5.2)	25.8 (4.5)	26.3 (4.8)
SPPB score, % (N)				
10-12/12	35.1 (93)	63.3 (19)	39.7 (54)	19.4 (19)
7-9/12	39.2 (104)	33.3 (10)	46.3 (63)	31.6 (31)
≤ 6/12	25.7 (68)	3.3 (1)	14.0 (19)	49.0 (48)
Fried frailty criteria				
Involuntary weight loss, % (N)	19.1 (51)	0 (0)	10.9 (15)	36.7 (36)
Handgrip strength (kg)	20.5 (7.4)	26.7 (8.6)	21.2 (7.0)	17.5 (6.1)
Usual gait speed (m/s)	0.86 (0.26)	1.10 (0.24)	0.92 (0.20)	0.69 (0.24)
Sedentarity, % (N)	55.4 (148)	0 (0)	45.7 (63)	86.7 (85)
Exhaustion, % (N)	42.3 (113)	0 (0)	30.0 (40)	74.5 (73)
Nutritional status (MNA-SF)				
Good	75.3 (201)	96.7 (29)	84.1 (116)	56.1 (55)
At risk of malnutrition	22.8 (61)	3.3 (1)	15.9 (22)	38.8 (38)
Malnourished	1.9 (5)	0 (0)	0 (0)	5.1 (5)

ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; M: mean; MNA-SF: Mini Nutritional Assessment-Short Form; SPPB: Short Physical Performance Battery; SD: standard deviation.

Table 2
Sensitivity, specificity and ratio of correctly classified subjects according to the MNA-SF cut-off in pre-frail and frail individuals

Cut-off	Sensitivity (%)	Specificity (%)	Correctly classified (%)
5	100	0	75.3
6	100	6.1	76.8
7	100	10.6	77.9
8	100	21.2	80.5
9	100	42.4	85.8
10	99.0	60.6	89.5
11	94.0	83.3	91.4
12	76.1	95.5	80.9
13	53.7	98.5	64.8
14	31.3	100	48.3

impact the Fried's Frailty phenotype. Weight loss reflects both conditions. An imbalance between energy intake and expenditure leads to muscle weakness that may in turn impact the four remaining criteria: poor muscle strength, slowness, exhaustion and reduced functional activities (27). Diet quality and frailty have also been largely studied. Overall diet quality is lower in frail than in robust older adults (28). High protein diet reduces the risk of incident frailty (29). Conversely, low serum micronutrient concentrations were shown to be an independent risk factor for frailty in community-dwelling women (30). Frailty also increases muscle protein catabolism and enhances age-related loss of muscle mass resulting in sarcopenia and impaired mobility (31). Of note, all of our malnourished participants (N=5) were frail according to the frailty phenotype.

The identification of a pre-disability state (i.e., frailty) enables to detect older persons at risk of adverse health events who may still benefit from preventive interventions against disability. Our population was specifically recruited by general practitioners or specialists to meet these frailty criteria. The good accuracy of the MNA-SF in this population encourages

expanding its use in these subjects so as to improve the screening of malnutrition.

This study also had limitations. Our sample was smaller than many studies focused on the effectiveness of the MNA-SF (26, 32-34). We also excluded a substantial number of participants (246) due to missing data. However, we achieved comparable results to the main validation studies of this tool. We did not compare the results of the screening test with a dietitian assessment but with another test (i.e. the full MNA) which was used as a surrogate for the diagnosis of malnutrition. Nevertheless, the MNA was demonstrated to be both a screening and assessment tool with a good internal consistency and inter-observer reliability and validity (8, 9). The aim of the MNA-SF is definitely not to replace the full MNA, but to refine the selection of subjects who should be tested with the full version.

Conclusion

The MNA-SF has already been suggested as an accurate screening tool in various populations of elderly subjects. This study confirmed its usefulness among frail (and pre-frail) older adults, with similar cut-points to indicate good nutritional status than in previous studies. All the subjects with a MNA-SF score below 12 should undergo a full MNA to establish whether they present under-nutrition or not. Malnourished frail elders are priority targets for comprehensive assessment and multidimensional management, and in particular for nutritional interventions. Therefore, The MNA-SF allows a quick and appropriate screening of frail older adults and may indeed be advantageously part of the clinical routine of general practitioners as well as hospital specialists.

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