**MINI NUTRITIONAL ASSESSMENT SCALE-SHORT FORM CAN BE USEFUL FOR FRAILTY SCREENING IN OLDER ADULTS**

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**ABSTRACT (235/250)**

**Aim:** Mini Nutritional Assessment-Short Form (MNA-SF) is used to assess nutritional status in older adults, but it is not known whether it can define frailty. It was aimed to investigate that the MNA-SF can identify frailty status defined by Fried criteria.

**Methods:** 1003 outpatients aged 65 or older were included the study. All patients were performed comprehensive geriatric assessment. Frailty status was evaluated by Fried criteria: unintentional weight loss, exhaustion, low levels of activity, weakness and slowness. 1 point is assigned for each criterion: 0 points, not frail; 1-2 points, prefrail; ≥3 points, frail. If the total score of MNA-SF was <8, 8-11, >11, it was accepted that there was malnutrition, risk of malnutrition, and no malnutrition, respectively.

**Results:** Of the 1003 outpatients, of whom the mean age was 74.2 ± 8.5 years, 313 participants (31.2%) were considered frail and 382 (38.1%) pre-frail. Among frail patients and pre-frail patients, 49.2 and 25.1% were at risk of malnutrition and 22.0% and 1.6% were malnourished, respectively. MNA-SF with a cut-off point of 11.0 had a sensitivity of 71.2% and a specificity of 92.8% to detect frail participants, and with a cut-off point of 13 had a sensitivity of 45.7% and a specificity of 78.3% to detect pre-frailty. The area under the curve of MNA-SF was 0.906 and 0.687 for the estimation of frailty and pre-frailty, respectively.

**Conclusion:** MNA-SF can be useful for frailty screening in older adults.

**Key words:** mini nutritional assessment-short form; screening; frailty status; nutritional status; older adults

1. **INTRODUCTION**

Malnutrition and frailty are two important geriatric syndromes, and in recent years, it has been speculated that these two syndromes are likely associated.[1](#_ENREF_1),[2](#_ENREF_2) There are several plausible mechanisms that may explain such an association. Weight loss can aid the development of both malnutrition and frailty. An imbalance between energy intake and expenditure can cause muscle weakness which may be associated with poor muscle strength, slowness, exhaustion, and reduced functional activities.[3](#_ENREF_3),[4](#_ENREF_4) Additionally, higher protein and specific micronutrient intake, dietary pattern with more phytonutrient-rich plant foods, omega-3-rich fish, and other protein-rich foods are associated with lower incidence of frailty.[5](#_ENREF_5),[6](#_ENREF_6) Moreover, malnutrition related negative outcomes such as sarcopenia, depression, cognitive impairment, falls, delayed immune response, and increased risk of infection further the development of frailty.[7-11](#_ENREF_7) When older patients develops frailty, their muscle protein catabolism increases and age-related loss of muscle mass enhances, which results in impaired mobility and dependency on others.[12](#_ENREF_12) Therefore, frail patients have more difficulties in the selection, preparation and intake of food, and they have greater loss of appetite, eating problems, and swallowing problems,[3](#_ENREF_3),[13](#_ENREF_13) As a result, a vicious cycle develops between malnutrition and frailty. The screening of frailty and nutritional status as well as early diagnosis are needed to implement appropriate interventions.

The Mini-Nutritional Assessment Scale- Short Form (MNA-SF) [14](#_ENREF_14) is a screening scale to assess nutritional status, but it also queries other geriatric issues, including cognitive impairment and depression, mobility, acute disease or psychological stress, weight loss, food intake, which can define not only malnutrition, but also provides information regarding frailty and prefrailty.[14](#_ENREF_14) Moreover, MNA-SF may be quicker than doing the measures required by Fried phenotypic criteria, and give additional information about some health issues, which are not evaluated by Fried criteria, such as cognition.[15](#_ENREF_15) Additionally, there have been few studies which found the associations between MNA-SF scores and frailty.[16](#_ENREF_16),[17](#_ENREF_17)

Therefore, it was aimed to investigate whether or not the MNA-SF can identify frailty status defined by Fried criteria.[18](#_ENREF_18)

1. **METHODS**

**Participants:**

A total of 1402 outpatients who were admitted to a geriatric outpatient clinic for any health issue between February 2017-June 2018. Patients’ age, sex, education level, comorbidities, numbers of drugs used were recorded. All the patients underwent comprehensive geriatric assessment (CGA), including Mini Mental State Examination,[19](#_ENREF_19), Geriatric Depression Scale[20](#_ENREF_20) for neurocognitive evaluation, Basic and Instrumental Activities of Daily Living (BADL, IADL) for functionality evaluation[21](#_ENREF_21) Tinetti Performance-Oriented Mobility Assessment (POMA) for mobility evaluation[22](#_ENREF_22) and MNA-SF for nutritional evaluation.[23](#_ENREF_23)

Patients who did not complete CGA; patients who refused to participate; who had a history of severe illness that may impair general health status, such as acute renal failure, acute liver failure, acute cerebrovascular event, and sepsis; patients under 65 years of age were excluded. Dementia were diagnosed according to Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, criteria and patients with severe dementia, who classified as Clinical Dementia Rating 3, were also excluded as these individuals might not be able to accurately recall responses for questions of Fried and MNA-SF. Moreover, the reliability of hand grip strength is low for older patients with dementia.[24](#_ENREF_24),[25](#_ENREF_25) As a result of comprehensive geriatric assessment by a geriatrician, 1003 patients who did not have exclusion criteria, were included in this study. Informed consent was provided by each participant or a legal guardian before participating in the study.

**Mini-nutritional assessment-Short Form and Diagnosis of Frailty:**

The MNA-SF test consists of simple measurements and 6 questions that can be completed in less than 5 minutes: anthropometric measurements (BMI, weight loss); global assessment (mobility); Dietary questionnaire and subjective assessment (food intake, neuropsychological problems, acute disease). If the total score of MNA-SF was <8, 8-11, >11, it was accepted that there was malnutrition, risk of malnutrition, and no malnutrition, respectively.[23](#_ENREF_23),[26](#_ENREF_26)

Frailty status was defined, by Fried et al. in 2001, based on five dimensions of frailty phenotype. These criteria are: including shrinking, exhaustion, low levels of physical activity, weakness and slowness. People with 0 criteria were considered robust,1–2 pre-frail, and >3 frail, as suggested by Fried et al.[18](#_ENREF_18) Weakness, assessed by grip strength of the dominant hand with dynamometer, was accepted to be less than or equal to the cut-off points according to sex and BMI points which were determined by Fried et al. Shrinking: unintentional weight loss of 4.5 kg or >5% of baseline body weight within the past year. Low physical activity was accepted as positive in patients who had no physical activity, or rarely had short walks, or spent most of the time sitting in the past year.[18](#_ENREF_18),[27](#_ENREF_27) Gait speed was evaluated by 4-meter walking test, and it was regarded as slowness, if a time was recorded less than or equal to the cut-off points according to sex and height. 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.”[18](#_ENREF_18)

The investigation conformed to the Declaration of Helsinki. Written informed consent was received from the elderly subjects themselves or their proxy and ethical approval was given by Erciyes University Institutional Board (2017/405).

**Statistical Analyses:**

SPSS Statistics, Version 17.0. Chicago was used to perform the analysis. Nominal variables were assessed by Pearson Chi-Square test. Continuous variables with normal distribution were analyzed with One-way ANOVA followed by a post-hoc test, and The Kruskal Wallis test was used to assess the presence of non-normal distribution. Variances in more than 2 groups were assessed by post hoc Tukey tests. The area under the receiver operating characteristic (ROC) analysis curve was used to test the predictive accuracy to determine a suitable cut-off point. The retest was administered for two times (3 weeks interval) by another researcher. Internal consistency was analyzed with Cronbach alpha test. Cut-off scores were assessed by the receiver operating characteristics (ROC) curve. All analyses were conducted for both frail and pre-frail groups, separately. Sensitivity, specificity, and positive and negative predictive values (PPV and NPV) were calculated for different cut-off scores of MNA-SF to detect prefrail and frail older adults. For p <.05, results were considered statistically significant.

1. **RESULTS**

Of the 1003 outpatients, of whom the mean age was 74.2 ± 8.5 years, 73.5% were female.

313 participants (31.2%) were considered frail, 382 (38.1%) pre-frail and 308 (30.7%) non-frail. 6.8% of the patients were malnour­ished, 33.0% were at risk for malnutrition, and 60.2% had a normal nutritional status. Scores on the BADL, IADL, MMSE, POMA, MNA were lower, and scores on the GDS and TUG were higher in the frail group compared with both prefrail and robust group (for each, p<0.05). Descriptive characteristics of the participants are shown in Table 1.

All of the MNA-SF items that are in favor of malnutrition and total scores were significantly higher in frailty and prefrailty group than robust group (p<0.05).

Among frail patients and prefrail patients, 49.2 and 25.1% were at risk of malnutrition and 22.0% and 1.6% were malnourished, respectively (p<0.05) **(Table 2).**

Internal consistency of the MNA-SF had a Cronbach-alpha of 0.730. Interclass correlation coefficient for the test-retest reliability was 0.776. MNA-SF with a cut-off point of 11.0 had a sensitivity of 71.2% and a specificity of 92.8% to detect frail participants, and with a cut-off point of 13 had a sensitivity of 45.7% and a specificity of 78.3% to detect pre-frailty. The sensitivity, specificity, and PPV and NPV of the MNA-SF according to the Fried criteria are shown in **table 3**.

The area under the ROC of MNA-SF was 0.906 and 0.687 for the estimation of frailty and pre-frailty, respectively (**Figure 1**).

1. **DISCUSSION**

The present study found that frailty status is associated with the nutritional status, and MNA-SF shows strong correlation with Fried frailty criteria in older adults. Therefore, MNA-SF can be useful to identify frailty and pre-frailty against the Fried frailty phenotype as a reference standard.

Frailty is a common geriatric syndrome. In our study, the prevalence of frail and prefrail patients were found as 31.6%, and 36.2%. The high prevalence of frailty might be related to the low educational level and the low socioeconomic status of the Turkish community’s older patients because of poor dietary intake/compliance, and the study population consists of older adults admitted to geriatric center for any health issue, not whole community.[28-30](#_ENREF_28)

A number of scales have been validated to help determine frail subjects, but there is no consensus on both the assessment of frailty status and which frailty evaluation tool should be used. Many factors can lead to the development of frailty, but malnutrition has an important role in it.[3](#_ENREF_3) Mal­nutrition is characterized by deficiency of nutrient absorption or a decrease in nutrient intake, which can cause many negative outcomes and consequently lead to frailty, if it is not treated or treatment is delayed.[3](#_ENREF_3),[8](#_ENREF_8),[9](#_ENREF_9) Thus, the nutritional screening is very important for definition of frailty and frail older adults represent primary targets for nutritional therapy.[31](#_ENREF_31) Both MNA and MNA-SF are validated and effective tools for malnutrition screening, and when developing MNA, Vellas et al., different from previous scales, intended to screen risk of malnutrition and malnutrition for the frail older patients.[23](#_ENREF_23) Furthermore, in a study by Lilimand, MNA-SF was found to be an effective and valid screening scale to define malnutrition in frail older adults.[31](#_ENREF_31)

Until now, there have been few studies investigating associations between MNA-SF scores and frailty, these studies have found significant associations between nutritional status and frailty status.[3](#_ENREF_3),[24](#_ENREF_24),[32](#_ENREF_32) One of them carried out by Chang et al.[17](#_ENREF_17) showed that community-dwelling older people who were frail had a high risk of malnutrition when evaluated by MNA-SF. Another study, by Jürschik et al., consisted of 640 community-dwelling elders revealed that the higher the score of both MNA and MNA-SF, the higher was the frailty index score; thus it was suggested that both tests could be useful to determine frail older adults.[16](#_ENREF_16) Similar to these studies, we also found that frailty and pre-frailty were strongly associated with nutritional status evaluated by MNA-SF. However, we showed that there was a strong relationship between each of MNA-SF items and frailty status and MNA-SF had a high specificity and high sensitivity to detect not only malnutrition, but also frailty. This could be explained by several reasons. Firstly, even if MNA-SF is a screening tool for nutritional status, it also queries whether dementia or depression exist, which are strongly associated with frailty.[7](#_ENREF_7),[33](#_ENREF_33) Secondly, weight loss and decreased food intake, two items on the MNA-SF, can contribute to the development of both malnutrition and frailty, and an imbalance between energy intake and expenditure leads to muscle weakness which can be correlated with all of the frailty criteria including exhaustion, poor muscle strength, decreased functional activities, and slowness.[4](#_ENREF_4) Thirdly, assessment of suffering psychological stress or acute disease, another item of MNA-SF, may also be critical in the determination of frailty status owing to the fact that “mood and motivational frailty” is a part of physical and cognitive frailty, and frail patients usually tend to have acute diseases and hospitalization.[7](#_ENREF_7),[32](#_ENREF_32),[34](#_ENREF_34) Lastly, frailty increases age-related loss of muscle mass and muscle protein catabolism resulting in impaired mobility, which is assessed by MNA-SF.[23](#_ENREF_23),[35](#_ENREF_35) All these features of MNA-SF can explain why its specifity and sensitivity to detect frailty and prefrailty are high.

On the other hand, our study revealed that the best cut-off values for detection of frailty and pre-frailty was higher than those for detection of malnutrition and risk of malnutrition (11 and 13 versus and 7 versus 11 respectively). Therefore, frailty and pre-frailty should be evaluated even if an older person has still a good nutritional status.

The present study has some limitations. First of them is cross-sectional design. Second is that only physical frailty was evaluated, and cognitive frailty were not evaluated. Thirdly, patients with dementia were excluded, since the frailty phenotype has not been validated in subjects with major cognitive impairment. The strengths of our work, we can consider the large sample size.

In conclusion, MNA-SF is a fast, simple, and sensitive method in screening both frailty and malnutrition. Therefore, MNA-SF can easily be used for the older adults by clinicians to determine frailty status as well as nutritional status. Thus, two geriatric syndromes, frailty and malnutrition, can be identified by MNA-SF simultaneously in geriatrics practice.

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**Disclosure**

The authors report no conflicts of interest in this work.

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**FIGURE LEGEND**

**Figure 1. Receiver operating characteristic curve (ROC) analysis of the MNA-SF to detect prefrail and frail**

ROC curve for MNA to detect A) frailty, B) prefrailty

**Table 1. Descriptive characteristics of the participants**

|  |  |
| --- | --- |
| **Age (years)** | 74.2 ± 8.5 |
| **Gender % (female/male)** | 73.5 / 26.5 |
| **Education (years)** | 1.1 ± 1.3 |
| **Body mass index (kg/m2)** | 33.1 ± 42.0 |
| **Comorbidities (%)** | |
| * Hypertension | 65.5 |
| * Diabetes mellitus | 35.2 |
| * Congestive heart failure | 6.5 |
| * Coronary artery disease | 13.6 |
| * COPD | 17.6 |
| * Osteoarthritis | 18.0 |
| * Dementia | 7.1 |
| * Dysphagia | 5.2 |
| * Depression | 24.4 |
| **Geriatric Assessment** | |
| * MMSE | 24.3 ± 4.6 |
| * BADL | 89.5 ± 33.1 |
| * IADL | 17.3 ± 7.4 |
| * GDS | 4.8 ± 4.2 |
| * POMA | 27.4 ± 8.6 |
| * TUG (Second) | 14.1 ± 9.7 |

BADL: Basic Activity of Daily Living (0 [worst]–100 [best]); COPD: Chronic obstructive Pulmonary disease; GDS: Geriatric Depression Score (15 [worst]–0 [best]); IADL: Instrumental activity of daily living (0 [worst]–23 [best]); MMSE: Mini-Mental State Examination (0 [worst]–30 [best]); MNA-SF: Mini-Nutritional Assessment-Short Form (0 [worst]–14 [best]); POMA: Performance Oriented Mobility Assessment (0 [worst]–28 [best]); TUG: Timed up and go test

**Table 2. Relationship between Items of Mini Nutritional Assessment-Short Form and Frailty status**

**BMI:** Body Mass Index; **MNA**: Mini Nutritional Assessment; **MNA-SF**: MNA-Short Form Scores

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **MNA-Short Form Items** | **Robust**  **(29.8%)** | **Pre-Frail**  **(38.1%)** | **Frail**  **(32.1%)** | **P value** |
| **Malnutrition parameters** | | | | |
| MNA-Short Form Scores | 13.4±1.0 | 12.3±1.8 | 9.6±2.7 | < 0.001 |
| Risk of Malnutrition (%) | 7.1 | 25.1 | 49.2 | < 0.001 |
| Malnutrition (%) | 0 | 1.6 | 22.0 | < 0.001 |
| **MNA-SF parameters** | | | | |
| Decrease in food intake (%) | | | | |
| Severe decrease | 1.3 | 1.8 | 14.1 | < 0.001 |
| Moderate decrease | 9.1 | 16.2 | 42.8 |
| No decrease | 89.6 | 81.9 | 43.1 |
| Weight loss (%) | | | | |
| Weight loss greater than 3 kg | 2.3 | 8.4 | 29.7 | < 0.001 |
| Does not know | 1.6 | 5.0 | 10.5 |
| Weight loss between 1 and 3 kg | 3.6 | 5.5 | 10.5 |
| No weight loss | 92.5 | 81.2 | 44.4 |
| Mobility (%) | | | | |
| Bed or chair bound | 0 | 0 | 4.5 | < 0.001 |
| Able to get out of bed / chair but does not go out | 0.3 | 5.5 | 30.4 |
| Goes out | 99.7 | 94.5 | 65.2 |
| Suffered psychological stress or acute disease (%) | | | | |
| Yes | 9.1 | 11.5 | 24.6 | < 0.001 |
| No | 90.9 | 88.5 | 75.4 |
| Neuropsychological problems (%) | | | | |
| Severe dementia or depression | 3.9 | 30.1 | 49.2 | < 0.001 |
| Mild dementia | 2.9 | 11.5 | 18.8 |
| No psychological problems | 93.2 | 58.4 | 32.0 |
| Body Mass Index (BMI) (%) | | | | |
| BMI less than 19 | 0.3 | 0.3 | 3.5 | < 0.001 |
| BMI 19 to less than 21 | 0.7 | 2.1 | 7.0 |
| BMI 21 to less than 23 | 0.3 | 2.9 | 7.0 |
| BMI 23 or greater | 98.7 | 94.7 | 82.5 |

**Table 3. The sensitivity, specificity, negative and positive predictive values of MNA-Short Form**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Cut-Off** | **Diagnosis** | **Sensitivity (%)** | **Specificity (%)** | **PPV (%)** | **NPV (%)** |
| **MNA-SF** | 13.0 | Pre-frail | 45.71  (39.77-51.75) | 78.32  (73.09-82.96) | 67.37  (61.55-72.0) | 59.57  (56.57-62.51) |
| 11.0 | Frail | 71.25  (65.89-76.20) | 92.86  (89.39-95.47) | 91.02  (87.07-93.85) | 76.06  (72.69-79.14) |

**MNA-SF**: MNA-Short Form Scores; **PPV**: Positive predictive value; **NPV:** Negative predictive value