USE OF THE MINI NUTRITIONAL ASSESSMENT TO DETECT FRAILTY IN HOSPITALISED OLDER PEOPLE

E. DENT, R. VISVANATHAN, C. PIANTADOSI, I. CHAPMAN

Abstract: Objectives: The aims of this study were to: (1) determine the prevalence of undernutrition and frailty in hospitalised elderly patients and (2) evaluate the efficacy of both the Mini-Nutritional Assessment (MNA) screening tool and the MNA short form (MNA-SF) in identifying frailty. Setting and Participants: A convenient sample of 100 consecutive patients (75.0 % female) admitted to the Geriatric Evaluation and Management Unit (GEMU) at The Queen Elizabeth Hospital in South Australia. Measurements: Frailty status was determined using Fried’s frailty criteria and nutritional status by the MNA and MNA-SF. Optimal cut-off scores to predict frailty were determined by Youden’s Index, Receiver Operator Curves (ROC) and area under curve (AUC). Results: Undernutrition was common. Using the MNA, 40.0 % of patients were malnourished and 44.0 % were at risk of malnutrition. By Fried’s classification, 66.0 % were frail, 30.0 % were pre-frail and 4.0 % robust. The MNA had a specificity of 0.912 and a sensitivity of 0.516 in predicting frailty using the recommended cut-off for malnourishment (< 17). The optimal MNA cut-off for frailty screening was < 17.5 with a specificity of 0.912 and sensitivity of 0.591. The MNA-SF predicted frailty with specificity and sensitivity values of 0.794 and 0.636 respectively, using the standard cut-off of < 8. The optimal MNA-SF cut-off score for frailty was < 9, with specificity and sensitivity values of 0.765 and 0.803 respectively and was better than the optimum MNA cut-off in predicting frailty (Youden Index 0.568 vs. 0.503). Conclusion: The quickly and easily administered MNA-SF appears to be a good tool for predicting both under-nutrition and frailty in elderly hospitalised people. Further studies would show whether the MNA-SF could also detect frailty in other populations of older people.

Key words: Aged, frail elderly, undernutrition, screening, predictive value of tests.

Introduction

Undernutrition, with its manifestation of weight loss is common in older populations. This problem is worse in hospitals, with as many as 50 % of hospitalised elderly people undernourished (1, 2). The Mini-Nutritional Assessment (MNA) is a common nutritional screening tool used to assess nutritional status in elderly people (3). It takes approximately 10-15 minutes to administer (2) and measures 18 items in 4 components, assessed by asking questions and measuring body mass index (BMI), calf and mid-arm circumference. Older people identified as malnourished by the MNA have an increased risk of in-hospital mortality (4, 5), delayed post-operative wound healing (6), an increased likelihood of nursing home admission (5) and longer lengths of hospital stay (5).

Recently a more easily administered short form (SF) of the MNA, the MNA-SF, has been introduced (7, 8). It comprises BMI measurement and the assessment of the first six of the 18 MNA items, using questions related to food intake, weight loss, mobility, psychological problems and dementia. It takes approximately 4-5 minutes to administer. Its diagnostic accuracy in detecting malnourishment is similar to that of the full MNA (7).

Frailty is also a substantial problem in older people. It is characterised by a general lack of strength and increased susceptibility to disease (9), and is associated with increased mortality (10) and morbidity (11, 12). Frailty is also associated with an increased risk of adverse events occurring during hospitalization (13) and functional decline post-hospitalization (12, 14, 15). Identification of frailty in hospitalised elderly people allows for optimisation of a multidisciplinary subjective global assessment (SGA) to manage frailty and its associated problems both in hospital and post-hospitalisation (16). The Fried’s frailty score is often used to identify frailty (10, 12, 17).

While frailty and undernutrition are not the same, older people who are undernourished are more likely to be frail (17), and there is overlap between these conditions, particularly in hospitalised patients (18). The use of one screening tool for these two common conditions would be of benefit for time-pressured acute care clinicians. The MNA nutritional screening tool has recently been proposed as a possible screening tool for frailty (3, 14) but has not yet been assessed for this use.

In this study, results from an ongoing study of hospitalised elderly patients were used to (1) determine the prevalence of undernutrition and frailty in hospitalised elderly patients, and (2) assess whether the MNA and the MNA-SF can be used to identify frailty.

Methods

Consecutive patients (or their proxy where applicable) were approached within 72 hours of admission to the geriatric evaluation and management unit (GEMU) at The Queen Elizabeth Hospital (TQEH) in Adelaide, Australia. The GEMU
generally admits patients a few days after admission for an acute illness. Study exclusion criteria were: unable to comply with the study protocol, a lack of understanding of the consent forms without a proxy, aged <70 years and not wishing to be part of the study. Study participants were recruited as part of a larger study. The study had ethics approval from TQEH Human Research Ethics Committee.

Frailty, MNA and MNA-SF assessments were performed in all subjects by the same investigator (ED). Weight (kg) was measured using a calibrated weigh chair (FVCS-150) to two decimal points. Height was measured to the nearest centimetre using a stadiometer for patients who were able to stand. For other patients, self-reported height was used. Circumference measures were performed using standard anthropometric procedures (19).

Frailty was diagnosed using a modified Fried’s frailty criteria, assessing five frailty components – shrinking, weakness, exhaustion, slowness and low physical activity levels (20). Shrinking and exhaustion were defined as per Fried’s original study (20), with shrinking being unintentional weight loss of 4.5kg or more in the last year and exhaustion established by responses to the questions “I felt that everything I did was an effort” and “I could not get going in the last week”. Weakness was defined as a grip strength <30kg for males and <18 kg for females as per the frailty intervention trial (FIT) (12). Low physical activity was defined as per FIT criteria, which was a “yes” response to all three of “did not perform and weight bearing physical activity”, “spent more than 3 hours per day sitting” and “went for a short walk once per month or less”. Slow walking speed was defined as > 30s to complete 6m or unable to complete 6m as defined by the Elderly Mobility Scale (21). Frailty was defined as the presence of three or more of the five frailty components; pre-frailty as one or two components; and robust as the absence of all frailty components.

Nutritional Status was determined using the MNA (2, 3) and the MNA-SF (7). MNA scores < 17 out of 30 were classified as “malnourished”, scores 17 – 23.5 as “at risk of malnourishment” and scores > 23.5 as “well nourished” (3). By the MNA, inadequate nutritional health was present in 84 (84.0%) patients, with malnourishment (score<17) in 40 (40.0%) and risk of malnutrition (score 17-23.5) in 44 (44.0%). The MNA and MNA-SF scores were both normally distributed. Using Fried’s criteria, 66 (66.0%) patients were frail, 30 (30.0%) as pre-frail and 4 (4.0%) as robust. Table 1 shows patient characteristics.

**Results**

Figure 1 shows patient recruitment. One hundred consecutive patients were included. Mean (SD) age of patients was 85.2 (6.1) years (range 72 – 98). 75 (75.0%) of the patients were female. 31 (31.0%) patients had a proxy assist with data collection. Height was self-reported in 28 (28.0 %). By the MNA, inadequate nutritional health was present in 84 (84.0%) patients, with malnourishment (score<17) in 40 (40.0%) and risk of malnutrition (score 17-23.5) in 44 (44.0%). The MNA and MNA-SF scores were both normally distributed. Using Fried’s criteria, 66 (66.0%) patients were frail, 30 (30.0%) as pre-frail and 4 (4.0%) as robust. Table 1 shows patient characteristics.

**Flow Diagram of Patient Recruitment from the GEMU (Geriatric Evaluation and Management Unit)**

Fried’s frailty classification was negatively associated with calculating MNA’s sensitivity, specificity, positive prediction value (PPV) and negative prediction value (NPV) for each MNA cut-off point. The maximum Youden Index (YI) (sensitivity + specificity – 1), was computed to determine the most accurate MNA cut-off score to reflect frailty.

Statistical analysis was carried out using PASW Statistics 18 (IBM SPSS Statistics; Chicago, IL) and Microsoft Office Excel 2007 (Microsoft Software, Washington), with statistical significance set at P < 0.05.

**Table 1**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malnourishment (score&lt;17)</td>
<td>40 (40.0%)</td>
</tr>
<tr>
<td>Risk of malnutrition (score 17-23.5)</td>
<td>44 (44.0%)</td>
</tr>
<tr>
<td>Adequate nutritional health</td>
<td>84 (84.0%)</td>
</tr>
<tr>
<td>Frail (66.0%)</td>
<td>66 (66.0%)</td>
</tr>
<tr>
<td>Pre-frail (30.0%)</td>
<td>30 (30.0%)</td>
</tr>
<tr>
<td>Robust (4.0%)</td>
<td>4 (4.0%)</td>
</tr>
</tbody>
</table>

Statistical Analysis

Normality of data was assessed using both Kolmogorov-Smirnov tests and histograms. Associations between MNA scores and frailty classifications were determined by Spearman’s correlations. The accuracy of MNA and MNA-SF scores in identifying frailty was assessed by Receiver Operator Curves (ROCs) and area under curve (AUC) using sensitivity and specificity values for each MNA cut-off point.

The ability of malnourishment classification by MNA and MNA-SF to detect frailty (>3 criteria) was analysed by...
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Characteristics of Patients for each Classification by Fried’s Frailty Criteria. Data are Expressed as Mean ± SD

<table>
<thead>
<tr>
<th>Overall</th>
<th>Fried Frailty Classification</th>
<th>Pre-Frail</th>
<th>Robust</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=100)</td>
<td>Frail (n=66)</td>
<td>Pre-Frail (n=30)</td>
<td>(n=4)</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>85.2 ± 6.1</td>
<td>86 ± 5.9</td>
<td>84.0 ± 6.6</td>
<td>82.5 ± 4.5</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.8 ± 6.1</td>
<td>25.9 ± 7.2</td>
<td>25.4 ± 5.5</td>
<td>25.5 ± 3.0</td>
</tr>
<tr>
<td>Days in hospital before GEMU</td>
<td>6.0 ± 8.2</td>
<td>6.6 ± 9.6</td>
<td>4.7 ± 4.0</td>
<td>4.3 ± 3.0</td>
</tr>
<tr>
<td>Days in GEMU</td>
<td>14.8 ± 7.9</td>
<td>15.2 ± 12.7</td>
<td>15.0 ± 14.5</td>
<td>7.7 ± 1.5</td>
</tr>
<tr>
<td>Gender (%)</td>
<td>75% (75)</td>
<td>53% (80.3%)</td>
<td>19% (63.3%)</td>
<td>3% (75%)</td>
</tr>
<tr>
<td>(25M (25%))</td>
<td>13M (19.7%)</td>
<td>11M (17.7%)</td>
<td>1M (12.5%)</td>
<td>1M (25%)</td>
</tr>
<tr>
<td>Grip Strength (kg)</td>
<td>14.9 ± 6.4</td>
<td>12.9 ± 5.6</td>
<td>18.2 ± 6.1</td>
<td>23.8 ± 4.7</td>
</tr>
<tr>
<td>Calf Circumference (cm)</td>
<td>31.8 ± 4.9</td>
<td>31.4 ± 5.0</td>
<td>32.0 ± 4.4</td>
<td>34.5 ± 5.0</td>
</tr>
<tr>
<td>Arm Circumference (cm)</td>
<td>26.4 ± 6.0</td>
<td>26.2 ± 5.1</td>
<td>26.6 ± 3.3</td>
<td>27.4 ± 4.5</td>
</tr>
<tr>
<td>MNA</td>
<td>18.3 ± 5.0</td>
<td>16.7 ± 5.0</td>
<td>21.1 ± 3.4</td>
<td>23.1 ± 3.3</td>
</tr>
<tr>
<td>MNA-SF</td>
<td>7.8 ± 2.8</td>
<td>6.8 ± 2.6</td>
<td>9.4 ± 2.2</td>
<td>11.5 ± 1.7</td>
</tr>
</tbody>
</table>

* Significant differences between groups occur between (i) the Frail and Robust Group and (ii) the Frail and Pre-Frail Group. No significant differences occurred between the pre-frail and robust group; † n (%) for all such values

**Table 2**

Receiver Operator Curves for the identification of frailty by the (A) Mini-Nutritional Assessment (MNA) total score and (B) MNA-SF total score using Fried’s frailty criteria to classify frailty. Total Area under Curve (AUC) = 0.780 (P<0.001) for the MNA and 0.802 (P<0.001) for the MNA-SF. Data labels show optimal MNA and MNA cut-off scores.

For the MNA, the standard malnourishment cut-off score (<8) had a specificity of 0.591 and sensitivity of 0.636. The optimal MNA cut-off score to identify frailty based on the YI was <9, with a sensitivity of 0.803 and specificity of 0.765. This optimal MNA-SF had a higher sensitivity than that of the optimal MNA cut-off (0.803 vs. 0.591) and was also a better predictor of frailty as indicated by a higher YI (0.568 vs. 0.503).

Table 2

### Efficacy values of Malnutrition against Frailty Classification by Fried’s Criteria using the MNA and the MNA-SF for Malnourishment Classification (n=100)

<table>
<thead>
<tr>
<th>MNA Cut-off Scores</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6.5 &lt;17.0 &lt;17.5 &lt;18.0 &lt;18.5 &lt;19 &lt;19.5</td>
<td>0.515 0.561 0.591 0.591 0.621 0.652 0.682</td>
<td>0.912 0.912 0.912 0.882 0.824 0.765 0.706</td>
<td>0.919 0.925 0.929 0.907 0.972 0.872 0.843 0.818</td>
<td>0.492 0.517 0.534 0.526 0.528 0.531 0.533</td>
</tr>
<tr>
<td>MNA-SF Cut-off Scores</td>
<td>Sensitivity</td>
<td>Specificity</td>
<td>PPV</td>
<td>NPV</td>
</tr>
<tr>
<td>&lt;6 &lt;7 &lt;8 &lt;9 &lt;10 &lt;11 &lt;12</td>
<td>0.333 0.515 0.636 0.803 0.879 0.909 0.924</td>
<td>0.971 0.912 0.794 0.765 0.500 0.412 0.235</td>
<td>0.957 0.919 0.857 0.869 0.773 0.750 0.701</td>
<td>0.429 0.492 0.529 0.607 0.680 0.700 0.615</td>
</tr>
<tr>
<td>Youden Index</td>
<td>0.304 0.427 0.430 0.568 0.379 0.321 0.160</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PPV, Positive Prediction Value (the proportion of patients with positive test results that are correctly identified); NPV, Negative Prediction Value (the proportion of subjects with a negative test result that are correctly identified)

### Discussion

The rate of inadequate nutritional health, as assessed by the MNA, was high in our study (84.0%, with 40.0% malnourished and 44.0% at risk of malnourishment). Frailty, as determined by Fried’s criteria was also common (66.0%). The high rates of both conditions is probably not surprising, given the high age of the subjects, the contribution of both frailty (12) and undernutrition (22) to increased risk of hospitalisation in older people and reported substantial rates for both conditions in healthier groups of older people (23, 24).

Our study also found malnourishment, identified by MNA, was significantly associated with frailty status identified by Fried’s frailty criteria. Although this finding is probably not surprising, as undernutrition and frailty can contribute to each other, as far as we know this is the first time the link has been reported using validated screening tools for these conditions. Using either the standard cut-off score for malnourishment of <17 or the optimal cut-off of <17.5 identified in this study, the MNA score had a high specificity (>90%) but lower sensitivity (<60%) in detecting frailty. This high specificity is good as it indicates few false positive results with its associated burdens, including increased costs of further assessments and unnecessary patient stress. Nonetheless, sensitivity should also be high in a good screening tool (fewer false negatives), and this could limit the use of the MNA as a screening tool for frailty.

In contrast, the MNA-SF score had a higher sensitivity than the MNA score: 0.636 at the standard cut-off (<8) and an even higher sensitivity of 0.803 at the optimal identified cut-off score (<9), with a specificity of 0.765 at this cut-off. Based on these values, as well as its higher YI and AUC, the MNA-SF outperforms the MNA score in detecting frailty and appears to be suitable for identifying undernutrition and frailty. It has the added advantage of being quicker and easier to perform compared to the full MNA.

Our results suggest that the MNA-SF, with a cut-off of <9
References