# Prognostics of recovery in hip fracture patients

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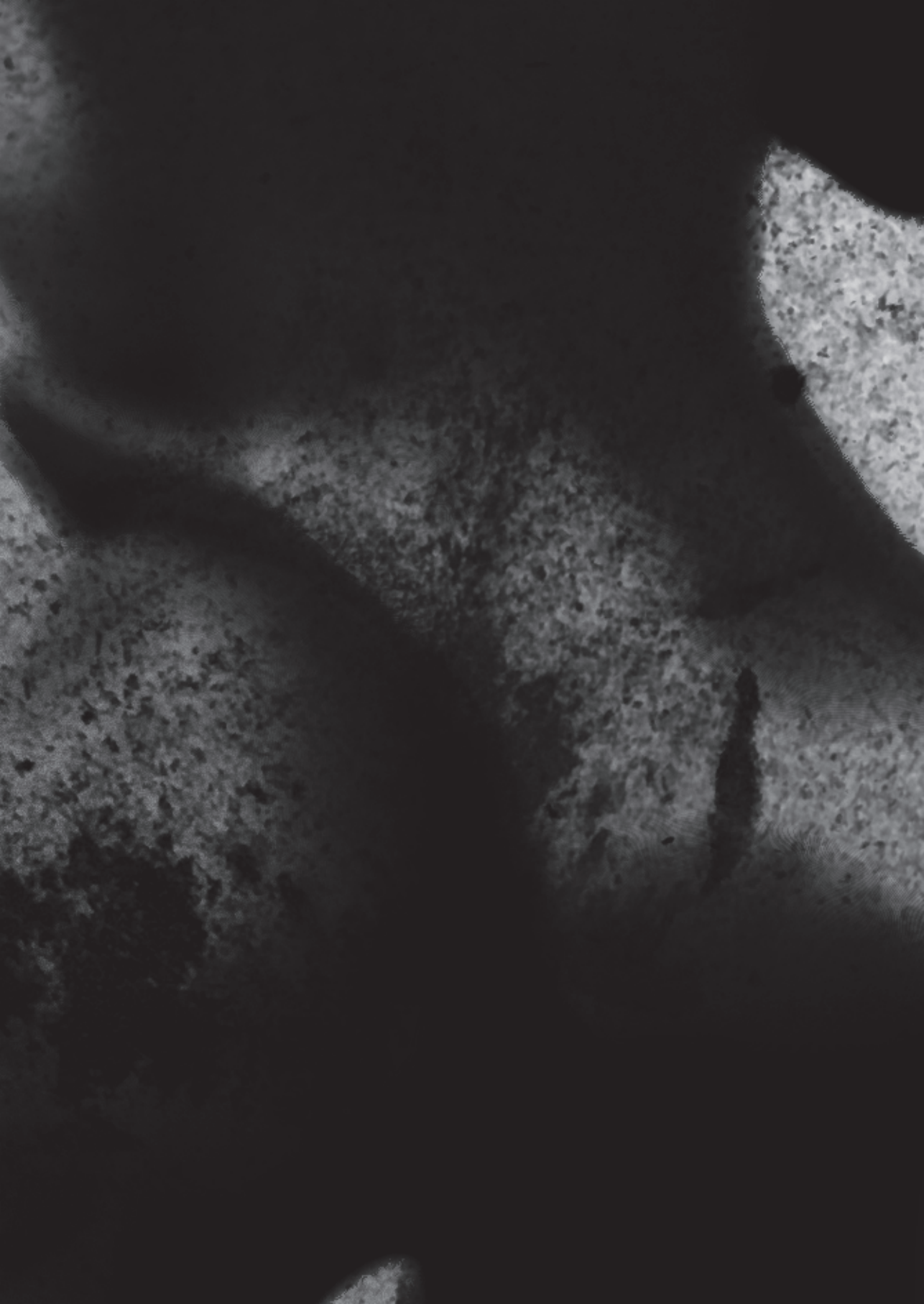
# Part II

## Prognostic factors of functional recovery



# Chapter 4

## Screening methods for malnutrition

van der Sijp M.P.L., van Eijk M., Krijnen P., Schipper I.B., Achterberg W.P., Niggebrugge A.H.P. Screening methods for malnutrition in Patients Admitted to the Hospital with A Proximal Femoral Fracture. *Injury. 2018 Dec;49(12):2239-2243*.

## Abstract

**Introduction:** The prevalence of malnutrition in patients admitted with a proximal femoral fracture is considered high and the negative effects on health are well-studied. The SNAQ and the MNA-SF are two screening tools routinely used during admission of acute medical patients. The aim of this study is to compare the screening capacity of the SNAQ score and the MNA-SF, and to evaluate their predictive values for malnutrition using the ESPEN criteria.

**Materials and methods:** A single-centre study with data routinely collected prospectively from the original patient records was performed in the Haaglanden Medical Centre Bronovo in the Netherlands. All patients with a proximal femoral fracture consecutively admitted between December 19th 2016 and December 21st 2017 were included. The Intraclass Correlation Coefficient was used to assess the agreement between the malnutrition screening tools and the predictive values were calculated to compare the SNAQ with the MNA-SF using the ESPEN diagnostic criteria as the reference standard.

**Results:** Data was available from 437 patients. Of all patients admitted with a proximal femoral fracture 16.9% was diagnosed as malnourished by the ESPEN criteria. When screened, 20.1% (SNAQ score) to 47.8% (MNA-SF) of all patients were classified as either at risk for malnutrition or as malnourished. A moderate agreement was found between the MNA-SF and the SNAQ ($\kappa$ = 0.68). The sensitivity, specificity, PPV and NPV of the SNAQ score were 71.6%, 90.4%, 60% and 94% respectively, compared to 100%, 62.8%, 35.4% and 100% for the MNA-SF.

**Discussion:** The SNAQ has been proven to be a very specific screening tool and the positive predictive value tends to be higher than that of the MNA-SF. However, 28.4% of all malnourished patients with a proximal femoral fracture had a negative screening test when using the SNAQ score.

**Conclusions:** No benefits were observed for the SNAQ over the MNA-SF as a screening tool for malnutrition in admitted patients with a proximal femoral fracture. Missing a significant portion of malnourished patients or those at risk and consequent under treatment of fragile older patients should be avoided. The well-validated MNA-SF seems more preferable as a screening tool for this patient population.

## Introduction

Malnutrition can be defined as a lack of nutrition leading to diminished physical and mental function and impaired clinical outcome.[1] These negative effects of malnutrition on health are well-studied.[2] Malnutrition has been associated with delayed wound healing, increased hospital length of stay, increased risk of complications, readmissions and mortality.[2-4] Additionally, malnutrition is associated with poor functional and rehabilitation outcomes due to these impaired physical and mental capacities.[2] The prevalence of malnutrition in patients admitted with a proximal femoral fracture is considered high, but ranges widely from 6-78%, which reflects the lack of universal consensus on a definition and the diagnostic methods5. The mean age of patients with a proximal femoral fracture is above 80 years.[6] Older patients are particularly at risk of malnutrition due to the physical and metabolic changes associated with aging and morbidity, which affect long-term nutritional intake.[7] These age-related physiological changes also lead to an increased vulnerability. Many of the risk factors for malnutrition are correlated with the risk of sustaining a proximal femoral fracture.[8] In addition, hospital admission and concurrent surgical treatment of patients with a proximal femoral fracture further increases the risk of malnutrition as their regular diet is disturbed. Pre-operative fasting combined with delayed surgery can lead to deterioration of the nutritional status.[3] Postoperatively the incidence of malnutrition increases due to the patients' loss of functionality, independency and institutionalization.[7] Treatment of hospitalized patients who are malnourished or at risk for malnutrition with diets and supplements has shown to have positive effects on the complication rates, mortality and quality of life.[9-11] To improve outcome of care in the older patient with a proximal femoral fracture, early recognition and treatment of malnourishment is mandatory. Numerous screening tools are available for early detection of malnutrition.

The SNAQ (Short Nutritional Assessment Questionnaire) is the most commonly used screening tool for malnutrition during hospital admission in the Netherlands.[12] Although the effectiveness of the SNAQ as a screening tool for malnutrition in patients admitted with a proximal femoral fracture has never been validated, its use is recommended in the national treatment guidelines for the proximal femoral fracture in the older patient (2016) by the Dutch Trauma Surgery Association (NVT) and is a quality indicator for hip fracture care in the nationwide Dutch Hip Fracture Audit (DHFA).[13] In contrast, the Dutch Steering Committee 'Malnutrition' advocates the MNA-SF for older patients as part of the geriatric assessment.[14] The Mini Nutritional Assessment Short-Form (MNA-SF) is one of the most studied screening tools for both older patients and patients with a proximal femoral fracture.[5] It has been recognized by the European Society of Clinical Nutrition and Metabolism (ESPEN) as a risk screening tool to be used in combination with additional diagnostic criteria for the diagnosis of malnutrition.[1] Its use is validated for in-hospital, elderly care and community settings.[1, 15] As such it is a scientifically substantiated malnutrition screening tool for older patients[16], nonagenarians[7], acute medical patients[17] and multi-morbid patients with a proximal femoral fracture[5]. Its use has been evaluated in populations both with and without dementia.[18]

The aim of this study is to compare the screening outcomes of the SNAQ score and the MNA-SF, and to evaluate their predictive values for malnutrition using the ESPEN criteria.

## Materials and methods

A single-centre cross-sectional study was performed with data that were routinely and prospectively registered simultaneously in an external database with the clinical registrations during admission and outpatient follow-ups as part of the 'Hip Fracture Centre' of the Haaglanden Medical Centre Bronovo in The Hague, the Netherlands.[19] All consecutive patients with a proximal femoral fracture (AO-classification 31A-C) admitted between December 19th 2016 and December 21st 2017 were included.

Height and weight registered on admission were used to calculate body mass index (BMI; weight (kg) / height $(m)^2$). Cognitive, functional and nutritional status were assessed by a trained nurse using Dutch versions of the Six-item Cognitive Impairment Test (6CIT), Katz Index of Independence in Activities of Daily Living (Katz-ADL), the MNA-SF and the SNAQ score. The patients' pre-fracture living situation was documented and the American Society of Anaesthesiologists (ASA) classification was used to assess comorbidity as part of the standard preoperative workup. Patients were considered 'cognitively impaired' if they had a known history of cognitive impairment such as dementia, if they had a 6-CIT score ≥ 11 points on admission, or if a collateral history from relatives or caregivers was necessary for adequate malnutrition assessments.

All admitted patients with a proximal femoral fracture are routinely discussed twice weekly in a multidisciplinary meeting attended by a dietician. Patients with abnormal scores or a strong clinical suspicion for malnutrition are notified to the dietician, clinically assessed and treated. Treatment or preventative measures for malnutrition with dietary strategies or nutritional supplements are only initiated when indicated.

### Nutritional screening

The SNAQ score consists of three questions concerning weight loss, appetite and the use of dietary supplements (appendix A). Patients with a SNAQ score of 0 or 1 are considered 'well-nourished' and not at risk for malnourishment. Patients scoring 2 points are considered 'moderately malnourished' and patients scoring 3 points or more are considered 'severely malnourished'.[20] The MNA-SF combines five questions concerning food intake, weight loss, mobility, psychological stress or acute disease and neuropsychological problems with the BMI or (if the BMI is unavailable the) calf circumference (appendix B). Patients with a MNA-SF score of 12-14 points are considered normal, patients with 8-11 points are considered 'at risk of malnutrition' and patients with 7 points or less are considered 'malnourished'.[21]

A discrepancy in the three categories of the SNAQ and the MNA-SF, reflecting different parts of the nutritional spectrum is likely to exist. The common denominator of both tools, however, is the cut-off point between the normal nutritional status and an elevated risk of malnutrition (defined as ≥11 points for the MNA-SF and ≤2 points for the SNAQ); These patients, classified as having the lowest risk of malnutrition in both tools, do not require further nutritional assessments or interventions according to the specific instructions of each screening tool.[20, 21] Thus, to calculate the predictive values, the latter two high-risk groups of each tool were combined to produce binomial outcomes. For simplicity the scores above and below the aforementioned cut-off points are referred to as 'normal' and 'malnourished'. To assess the predictive values of the screening tools, the diagnostic criteria defined by ESPEN (Fig. 1) were used as the reference standard for the diagnosis malnutrition[1].

**Figure 1.** The ESPEN diagnostic criteria for malnutrition.

Alternative 1:
- BMI <18.5 kg/m$^2$

Alternative 2:
- Weight loss (unintentional) >10% indefinitely of time, or >5% over the last 3 months combined with:
  - BMI <20 kg/m$^2$ if <70 years of age, or <22 kg/m$^2$ if ≥70 years of age
  - FFMI <15 and 17 kg/m$^2$ in women and men, respectively.

BMI body mass index, FFMI fat free mass index.

Unintentional weight loss (>10% indefinitely of time or >5% over the last 3 months) was assessed using the corresponding parameter from the MNA-SF and the SNAQ score screening tools. The fat-free mass index (FFMI) was not routinely assessed and excluded from the diagnostic criteria for our study purposes.[22]

All data were handled in agreement with the 'Code of Conduct for Health Research' of the Council of the Federation of Medical Scientific Societies. Personal data was handled according to the Dutch Personal Data Protection Act. The study was approved by the institutional Medical Research Ethics Committee (METC Southwest Holland; protocol number 18-001) without the need of individual patient consent due to the observational nature of the study.

**Statistical analyses**

All statistical analyses were performed using IBM SPSS statistics software for Windows version 23.0. Patients without assessments of both screening tools were excluded from the analyses. Patient characteristics were described as mean and standard deviation, or number and percentage and compared using the independent sample t-test or Pearson Chi-squared test. Cross-tabulations were used to analyse the discriminative power of the screening tools, including the sensitivity,

specificity, positive predictive value (PPV) and negative predictive value (NPV). The Spearman correlation coefficient (ρ) was used to assess the concurrent validity and the kappa statistic (κ) or the Intraclass Correlation Coefficient (ICC) was used to assess the agreement between the tools, interpreted as follows: 0–0.1, virtually none; 0.11–0.4, slight; 0.41–0.6, fair; 0.61–0.8, moderate; and 0.81–1, substantial.[23] P-values below 0.05 ($p < 0.05$) were considered statistically significant.

## Results

A total of 485 patients with a proximal femoral fracture were admitted to the study-hospital between 19th December 2016 and 21st December 2017. Sufficient data of 437 patients (90.1%) was available. The patient characteristics are presented in Table 1. The mean age of the study population was 79.2 years (SD ±12.8) and the majority was female (69%). The mean BMI was 23.2 kg/m$^2$ (SD ±3.9). Cognitive impairment was present in 137 patients (31.4%). According to the ESPEN diagnostic criteria, 74 patients (16.9%) were classified as malnourished. Higher age, ASA classification and Katz-ADL score as well as cognitive impairment and living independently before the fracture were all significantly correlated with malnutrition.

**Table 1.** Patient characteristics of all patients and malnourished[a] patients.

| **Characteristics** | | **Total N=437 (%)** | **Malnourished (ESPEN) N=74 (16.9%)** | **Normal (ESPEN) N=363 (83.1%)** | **p-value** |
|---|---|---|---|---|---|
| Age (mean, ±SD) | | 79.2 (±12.8) | 82.0 (±12.2) | 78.6 (±12.8) | *0.037* |
| Gender (f) | | 300 (68.6) | 57 (77.0) | 243 (66.9) | 0.088 |
| Cognitively impaired | | 137 (31.4) | 40 (54.1) | 97 (26.7) | *<0.001* |
| ASA classification | I | 27 (6.4) | 1 (3.7) | 26 (7.2) | *<0.001* |
| | II | 188 (44.2) | 20 (10.6) | 168 (46.3) | |
| | III | 188 (44.2) | 42 (22.3) | 146 (40.22) | |
| | IV | 21 (4.9) | 7 (33.3) | 14 (3.9) | |
| | V | 1 (0.2) | 1 (2.1) | 0 (0.0) | |
| Katz-ADL | 0-1 | 298 (68.2) | 33 (44.6) | 265 (73.0) | *<0.001* |
| | 2-5 | 112 (25.6) | 27 (36.5) | 85 (23.4) | |
| | 6 | 27 (6.2) | 14 (18.9) | 13 (3.6) | |
| Living situation | Home (independent) | 263 (60.2) | 31 (41.9) | 232 (63.9) | *0.001* |
| | Homecare | 62 (14.2) | 10 (13.5) | 52 (14.3) | |
| | Nursing home | 96 (22.0) | 28 (37.8) | 68 (18.7) | |
| | Other | 16 (3.7) | 5 (6.8) | 11 (3.0) | |
| BMI (mean) | | 23.2 (±3.9) | 18.2 (±2.2) | 24.3 (±3.3) | *<0.001* |
| SNAQ score | ≥2 | 88 (20.1) | 53 (71.6) | 35 (9.6) | *<0.001* |
| MNA-SF | ≤11 | 209 (47.8) | 74 (100) | 135 (37.2) | *<0.001* |

[a] according to the ESPEN diagnostic criteria, f Female, y Years

According to the SNAQ score 349 patients (79.9%) were classified as normal and 88 patients (20.1%) were considered malnourished; 17 (3.9%) moderately and 71 (16.2%) severely. Using to the MNA-SF, 228 of all patients (52.2%) were classified as normally nourished, 154 patients (35.2%) were at risk and 55 patients (12.6%) were malnourished (Table 2). A significant correlation was found between the SNAQ and the MNA-SF scores ($\rho$ = -0.632, $p<0.001$). Agreement between the tools on classifying patients as normal and malnourished, was found for 72.4% of all patients with $\kappa$=0.68.

**Table 2.** Nutritional status of all femoral neck fracture patients according to the MNA-SF and SNAQ score.

| MNA-SF<br>SNAQ | Normal<br>(14-12) | At risk<br>(11-8) | malnourished<br>(≤7) | Total |
|---|---|---|---|---|
| **Well-nourished** (0-1) | 228 (52.2) | 109 (24.9) | 12 (2.7) | 349 (79.9) |
| **Moderately malnourished** (2) | 0 (0) | 11 (2.5) | 6 (1.4) | 17 (3.9) |
| **Severely malnourished** (≥3) | 0 (0) | 34 (7.8) | 37 (8.5) | 71 (16.2) |
| **Total** | 228 (52.2) | 154 (35.2) | 55 (12.6) | 437 (100) |

No patients were classified as malnourished by the SNAQ score and simultaneously scored as normal by the MNA-SF. Of all patients classified as normal by the SNAQ (n=349), 34.6% were classified as either at risk (n=109, 24.9%) or as malnourished (n=12, 2.7%) by the MNA-SF (Table 2). Of these 349 patients, 21 patients (6.0%) were diagnosed as malnourished using the ESPEN criteria. Of the 154 patients categorized as 'at risk' by the MNA-SF, 32 patients (20.1%) were diagnosed as malnourished using the ESPEN criteria. The PPV and NPV of the SNAQ score were 60% and 94% respectively, compared to 35.4% and 100% for the MNA-SF (Table 3).

**Table 3.** Predictive values of the SNAQ and MNA-SF.

| | Sens | Spec | PPV | NPV |
|---|---|---|---|---|
| **SNAQ** | 71.6 | 90.4 | 60.2 | 94.0 |
| **MNA-SF** | 100 | 62.8 | 35.4 | 100 |

Sens sensitivity, Spec specificity, PPV positive predictive value, NPV negative predictive value

## Discussion

In our study, 16.9% of all patients admitted with a proximal femoral fracture were actually malnourished according to the ESPEN criteria. When screened, 20.1% (SNAQ score) to 47.8% (MNA-SF) of all patients were classified as either at risk for malnutrition or as malnourished. These findings are

similar to those found in recent literature.[3, 24] Malnutrition was associated with age, comorbidity, cognition and reduced independence in activities of daily living and living situation.

Significant differences were observed in the prevalence of malnutrition when screening with the MNA-SF or SNAQ. Only a moderate agreement was found in the classification for malnutrition between the screening tools.

The SNAQ has been proven to be a very specific screening tool and the positive predictive value tends to be higher than that of the MNA-SF.[25] However, 28.4% of all malnourished patients with a proximal femoral fracture had a negative screening test when using the SNAQ score. The MNA-SF is a very sensitive tool, but with a poor positive predictive value. The instruments' instructions, additional criteria (such as the ESPEN criteria) or nutritional assessments by a dietician are necessary to avoid overtreatment of patients. The MNA-SF, however, seems the more appropriate tool to avoid false negative screening outcomes.[21] Treating those *at risk* of malnutrition as well as treating all older patients with a proximal femoral fracture regardless of their nutritional status has previously proven health benefits.[26] Overtreatment with non-invasive and low-cost dietary supplements seems preferable to undertreatment of the malnourished in this frail older patient population, as some studies indicate significant benefits of treating all hip fracture patients with nutritional supplements, regardless of their national status.[27]

Both screening tools assess weight loss, but the other questions of each screening tool focus on different risk factors for malnutrition. The SNAQ score is a purely anamnestic screening tool (meaning its data is obtained solely by questioning the patient), lacking objective measurements such as the BMI or FFMI. This makes it susceptible for bias when hetero anamnestic information is required in severely cognitive impaired patients, which constitutes 31.4% of this study population. In addition, age-related metabolic and behavioural changes are often associated with chronic weight loss and malnutrition, rather than acute weight loss due to recent and acute onset of disease.[28] The weight-loss questions of both the MNA-SF and the SNAQ score focus on the latter. As such, for older patients the BMI and FFMI seem more valid than anamnestic recent weight loss for the detection of malnutrition. Variations on the SNAQ score such as the 'SNAQ 65+' and 'SNAQrc' have been developed for community-dwelling older people and residential care, which respectively include the upper arm circumference and BMI as a factor.[29, 30] However, these tools are not routinely used and have not been extensively validated for hospitalized patients.

The Dutch healthcare system is advancing towards more autonomy and prolonged homestay with homecare for older people to avoid permanent institutionalization and the associated costs. This may increase the risk for malnutrition in patients with decreased self-dependence and it calls for increased awareness of healthcare professionals, adequate screening and effective treatment.

**Strengths and limitations**

Our study includes a large cohort of patients treated in a recent time period. Complete data were available for more than 90% of patients. Therefore, we assume the study population to be an accurate representation of patients with proximal femoral fractures.

For study purposes, we grouped the screening scores into dichotomous outcomes. As described in the results section, differences in the screening outcomes between the two tools may be attributed to the tools' inherent group discrepancies. The SNAQ score seem to make no distinction between patients are not malnourished and those who are at risk of malnourishment. The MNA-SF does, which might explain the relative overdiagnosis for malnutrition by the MNA-SF, and its poorer specificity compared to the SNAQ score.

No universal definition for malnutrition exists and many proposed definitions require labour-intensive assessments or clinical outcomes, which renders them unfit as screening tools. In this study the ESPEN diagnostic criteria were chosen as the reference standard. Use of alternative definitions and reference standards for malnutrition may give varying results when studying the effectiveness of screening tools. Future studies comparing other tools or reference standards such as the FFMI may provide additional insights into the nutritional status of this frail older patient population.

## Conclusions

Based on our results, we discourage the routine use of the SNAQ score as a screening tool for older patients with a proximal femur fracture, in order to avoid missing a significant portion of malnourished patients or those at risk and consequently avoid under treatment of fragile older patients. The well-validated MNA-SF seems more preferable as a screening tool for this patient population.

# Appendices

## Appendix A

The SNAQ score.

| **Did you lose weight unintentionally?** | **points** |
|---|---|
| More than 6kg in the last 6 months | 3 |
| More than 3kg in the last month | 2 |
| **Did you experience a decreased appetite over the last month?** | 1 |
| **Did you use supplemental drinks or tube feeding over the last month?** | 1 |

## Appendix B

The MNA-SF score.

**A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?**
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake

**B Weight loss during the last 3 months**
0 = weight loss greater than 3kg
1 = does not know
2 = weight loss between 1 and 3kg
3 = no weight loss

**C Mobility**
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out

**D Has suffered psychological stress or acute disease in the past 3 months?**
0 = yes
2 = no

**E Neuropsychological problems**
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems

**F1 Body Mass Index (BMI)**
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater

If BMI is not available, replace question F1 with question F2. Do not answer question F2 if question F1 is already completed.

**F2 Calf circumference in cm**
0 = calf circumference less than 31
3 = calf circumference 31 or greater

## Reference list


1. Cederholm T, Bosaeus I, Barazzoni R, et al. Diagnostic criteria for malnutrition - An ESPEN Consensus Statement. Clin Nutr. 2015; 34: 335-40.
2. Yaxley A, Crotty M and Miller M. Identifying Malnutrition in an Elderly Ambulatory Rehabilitation Population: Agreement between Mini Nutritional Assessment and Validated Screening Tools. Healthcare (Basel). 2015; 3: 822-9.
3. Koren-Hakim T, Weiss A, Hershkovitz A, et al. The relationship between nutritional status of hip fracture operated elderly patients and their functioning, comorbidity and outcome. Clin Nutr. 2012; 31: 917-21.
4. Isenring E, Capra S and Bauer J. Nutrition support, quality of life and clinical outcomes. J Hum Nutr Diet. 2012; 25: 505-6; author reply 7-8.
5. Bell JJ, Bauer JD, Capra S and Pulle RC. Concurrent and predictive evaluation of malnutrition diagnostic measures in hip fracture inpatients: a diagnostic accuracy study. Eur J Clin Nutr. 2014; 68: 358-62.
6. Parker M and Johansen A. Hip fracture. BMJ. 2006; 333: 27-30.
7. Vandewoude M and Van Gossum A. Nutritional screening strategy in nonagenarians: the value of the MNA-SF (mini nutritional assessment short form) in NutriAction. J Nutr Health Aging. 2013; 17: 310-4.
8. Lauritzen JB, McNair PA and Lund B. Risk factors for hip fractures. A review. Dan Med Bull. 1993; 40: 479-85.
9. Neelemaat F, Kruizenga HM, de Vet HC, Seidell JC, Butterman M and van Bokhorst-de van der Schueren MA. Screening malnutrition in hospital outpatients. Can the SNAQ malnutrition screening tool also be applied to this population? Clin Nutr. 2008; 27: 439-46.
10. Norman K, Kirchner H, Freudenreich M, Ockenga J, Lochs H and Pirlich M. Three month intervention with protein and energy rich supplements improve muscle function and quality of life in malnourished patients with non-neoplastic gastrointestinal disease--a randomized controlled trial. Clin Nutr. 2008; 27: 48-56.
11. Hedstrom M, Ljungqvist O and Cederholm T. Metabolism and catabolism in hip fracture patients: nutritional and anabolic intervention--a review. Acta Orthop. 2006; 77: 741-7.
12. Kruizenga HM, de Jonge P, Seidell JC, et al. Are malnourished patients complex patients? Health status and care complexity of malnourished patients detected by the Short Nutritional Assessment Questionnaire (SNAQ). Eur J Intern Med. 2006; 17: 189-94.
13. DICA. Dutch Hip Fracture Audit DHFA. 2016. Available at: https://dica.nl/dhfa/home. Accessed Januari 23, 2018.
14. Stuurgroep ondervoeding. Screening. 2018. Available at http://www.stuurgroepondervoeding.nl/toolkits/screeningsinstrumenten-kliniek. Accessed Januari 23, 2018.
15. Kondrup J, Allison SP, Elia M, et al. ESPEN guidelines for nutrition screening 2002. Clin Nutr. 2003; 22: 415-21.
16. Young AM, Kidston S, Banks MD, Mudge AM and Isenring EA. Malnutrition screening tools: comparison against two validated nutrition assessment methods in older medical inpatients. Nutrition. 2013; 29: 101-6.
17. Ranhoff AH, Gjoen AU and Mowe M. Screening for malnutrition in elderly acute medical patients: the usefulness of MNA-SF. J Nutr Health Aging. 2005; 9: 221-5.
18. Volkert D, Chourdakis M, Faxen-Irving G, et al. ESPEN guidelines on nutrition in dementia. Clin Nutr. 2015; 34: 1052-73.
19. van der Sijp MPL, Schipper IB, Keizer SB, Krijnen P and Niggebrugge AHP. Prospective comparison of the anterior and lateral approach in hemiarthroplasty for hip fractures: a study protocol. BMC Musculoskelet Disord. 2017; 18: 361.

20. Kruizenga HM, Seidell JC, de Vet HC, Wierdsma NJ and van Bokhorst-de van der Schueren MA. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). Clin Nutr. 2005; 24: 75-82.

21. Rubenstein LZ, Harker JO, Salva A, Guigoz Y and 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.

22. Henriksen C, Gjelstad IM, Nilssen H and Blomhoff R. A low proportion of malnourished patients receive nutrition treatment - results from nutritionDay. Food Nutr Res. 2017; 61: 1391667.

23. Shrout PE. Measurement reliability and agreement in psychiatry. Stat Methods Med Res. 1998; 7: 301-17.

24. Koren-Hakim T, Weiss A, Hershkovitz A, et al. Comparing the adequacy of the MNA-SF, NRS-2002 and MUST nutritional tools in assessing malnutrition in hip fracture operated elderly patients. Clin Nutr. 2016; 35: 1053-8.

25. Neelemaat F, Meijers J, Kruizenga H, van Ballegooijen H and van Bokhorst-de van der Schueren M. Comparison of five malnutrition screening tools in one hospital inpatient sample. J Clin Nurs. 2011; 20: 2144-52.

26. Malafarina V, Uriz-Otano F, Malafarina C, Martinez JA and Zulet MA. Effectiveness of nutritional supplementation on sarcopenia and recovery in hip fracture patients. A multi-centre randomized trial. Maturitas. 2017; 101: 42-50.

27. Avenell A and Handoll HH. Nutritional supplementation for hip fracture aftercare in the elderly. Cochrane Database Syst Rev. 2000: CD001880.

28. Stajkovic S, Aitken EM and Holroyd-Leduc J. Unintentional weight loss in older adults. CMAJ. 2011; 183: 443-9.

29. Wijnhoven HA, Schilp J, van Bokhorst-de van der Schueren MA, et al. Development and validation of criteria for determining undernutrition in community-dwelling older men and women: The Short Nutritional Assessment Questionnaire 65+. Clin Nutr. 2012; 31: 351-8.

30. Kruizenga HM, de Vet HC, Van Marissing CM, et al. The SNAQ(RC), an easy traffic light system as a first step in the recognition of undernutrition in residential care. J Nutr Health Aging. 2010; 14: 83-9.