Clinical Nutrition (2008) **27**, 439–446

available at www.sciencedirect.com

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ORIGINAL ARTICLE

# Screening malnutrition in hospital outpatients. Can the SNAQ malnutrition screening tool also be applied to this population?

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Received 21 October 2007; accepted 4 February 2008

**KEYWORDS**
Malnutrition;
Screening;
Outpatients;
Diagnostic accuracy;
SNAQ

**Summary**
*Background & aims:* It is known from earlier studies that only 15% of the malnourished hospital outpatient population is recognized and receives nutritional treatment. To increase this number, a quick and easy malnutrition screening tool would be helpful. Because such a tool is lacking, we developed one by using the SNAQ (Short Nutritional Assessment Questionnaire) as a basis. The aim of this study was to develop a quick and easy malnutrition screening tool and to measure its diagnostic accuracy in malnourished hospital outpatients.
*Methods:* First, an optimal set of questions was selected for the preoperative outpatient population. Secondly, the diagnostic accuracy for the preoperative outpatients was determined (979 patients) and finally, the diagnostic accuracy for general hospital outpatients was established (705 patients).
*Results:* The three original SNAQ questions proved to be the best set of questions for the outpatient population as well. In the preoperative and general outpatient population the diagnostic accuracy resulted respectively in a sensitivity of 53% and 67%, a specificity of 97% and 98%, a positive predictive value of 69% and 72% and a negative predictive value of 94% and 97%.

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0261-5614/$ - see front matter 
doi:10.1016/j.clnu.2008.02.002

*Conclusions:* With an acceptable diagnostic accuracy it may be concluded that the original SNAQ malnutrition screening tool is valid for the hospital outpatient population.


## Introduction

Disease-related malnutrition is a widespread problem in nearly all health care settings. Prevalence of disease-related malnutrition is reported to vary from 25–40% in hospital inpatients to 15–25% in home care units and 20–25% in nursing homes.[1–7] To the best of our knowledge, very little data is available on the prevalence of disease-related malnutrition in a general hospital outpatient population. Wilson found a malnutrition prevalence of 7–11%, depending on age.[8] A recent study on the prevalence of disease-related malnutrition (based on Body Mass Index (BMI) and percentage of unintentional weight loss) in our own general outpatient population revealed a malnutrition percentage of 7% (VU University Medical Centre in Amsterdam, The Netherlands).[9]

Disease-related malnutrition may be harmful to patients. Studies have reported increased postoperative complications,[10–12] decreased quality of life,[13] decreased wound healing[14] and increased mortality and morbidity.[15] These harmful effects lead to an increased length of hospital stay and so higher hospital costs.[16–20]

In order to diminish the negative consequences of disease-related malnutrition it is of paramount importance to recognize malnourished patients at an early stage of their medical treatment. The time available to set out an optimal nutritional treatment plan during hospital stay is limited because the length of hospital stays decreases. Patients will optimally benefit from nutritional treatment if this has already been initiated in the outpatient setting. Therefore, early recognition of malnutrition in the outpatient clinic is essential.[15]

Several studies have pointed out that medical and nursing staff recognizing of disease-related malnutrition is often inadequate.[16,21] Also in our own general outpatient population only 15% of the malnourished patients received nutritional treatment.[9] These findings emphasize the need for an appropriate screening tool for the early detection of malnourished patients. Although without any doubt screening tools are already being used in the outpatient setting, diagnostic accuracies for these tools have not been reported.

A malnutrition screening tool for the hospital outpatients in clinical practice should be quick, easy and ready to apply and to interpret. An example of such a tool is the Short Nutritional Assessment Questionnaire (SNAQ). The SNAQ (Fig. 1), consisting of three questions, has been validated for the hospital inpatient population against low BMI and/or unintentionally weight loss. The SNAQ has been proven to be a valid and reproducible screening tool for determining the risk of malnutrition of hospitalized patients.[22] The recognition of disease-related malnutrition may improve from 50% to 80% by using this malnutrition screening tool. Implementation of this screening tool, accompanied by a treatment plan, has been proven to be both effective and cost effective.[16]

Diagnostic accuracies of the SNAQ for the hospital outpatient population are missing. Therefore, the first objective of this study was to determine whether the three SNAQ questions most predictive of malnutrition in the hospital inpatient setting were also most predictive of malnutrition in the hospital outpatient setting. The second objective was to measure the diagnostic accuracy of this SNAQ malnutrition screening tool in the outpatient population.

## Patients and methods

This study was performed in three steps. First, the development of the SNAQ outpatient malnutrition screening tool was performed by selecting the optimal set of questions most predictive of malnutrition in a preoperative outpatient population. Second, the diagnostic accuracy of this screening tool was calculated in the same preoperative population. Finally, the diagnostic accuracy of this screening tool was calculated in a general outpatient population.

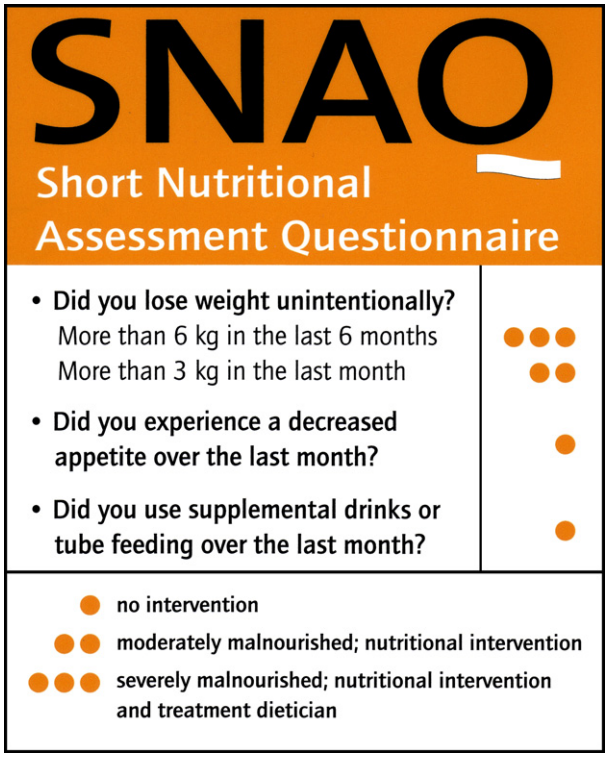


**Figure 1** Short Nutritional Assessment Questionnaire (SNAQ), a screening tool for malnutrition developed for the hospital inpatient population.

The study design was in accordance with the Declaration of Helsinki and the study itself was approved by the medical ethical committee of the VU University medical centre.

## Development SNAQ in the preoperative population

### Patients

All patients visiting the preoperative outpatient clinic of the VU University medical centre in the period of May 2004 to August 2004 were included in the study. These patients were listed for elective surgery, varying from extensive surgery (such as oesophagus resection or aorta reconstruction), to relatively minor operations (such as knee operation). Patients were excluded from the study when they were under the age of 18 years, were pregnant, suffered from senile dementia, could not understand the Dutch language, or were not able to or willing to give informed consent.

### Nutritional status

All patients were weighed (wearing indoor clothes and shoes) by nurses of the preoperative outpatient clinic on the same calibrated scales (SECA 880 in kg to the nearest decimal) and were asked for their height. When patients did not know their height, it was then measured (SECA 220 in cm to the nearest decimal).

Within five working days of their visit to the outpatient clinic, the principal investigator (F.N.) contacted the participating patients (see next section) and inquired after unintentional weight loss. Based on measured weight, and recalled or measured height and unintentional weight loss, the investigator determined the nutritional status. Patients were defined as severely malnourished when one or more of the following conditions were present: a BMI $< 18.5$ kg/m$^2$, unintentional weight loss of more than 5% in the last month or more than 10% in the last 6 months. Patients were defined as moderately malnourished with 5–10% unintentional weight loss in the last 6 months, independent of the BMI.[22–26]

### Procedure of development of SNAQ

The SNAQ malnutrition screening tool has earlier been developed in a hospital inpatient population by selecting the questions most predictive of malnutrition by using logistic regression analysis.[22] Since the disease status and prevalence of disease-related malnutrition in the outpatient population differs from the hospital inpatient population, it is possible that the questions that were most predictive would be different for the outpatient population.

The investigator interviewed the patients by telephone after their visit to the preoperative outpatient clinic. Fifteen nutritional questions (Table 1) which were significantly related to malnutrition in the hospital inpatient population were asked.[22] In addition the principal investigator obtained supplementary information (e.g. physician, date of surgery, oncological disease) from the medical charts in the electronic hospital database.

### Selecting the optimal SNAQ questions

For selecting the optimal set of SNAQ questions, logistic regression was performed with either presence or absence of moderate and severe malnutrition (as defined by low BMI and unintentional weight loss) as dependent variable, and the questions of Table 1 as independent variables. The backward stepwise Waldtest was used. For developing a practical screening tool, the score was achieved by making round numbers of the beta coefficients which can then be added up to obtain an aggregate score.

**Table 1** Questions which were significantly related to malnutrition (BMI $< 18.5$ and recent unintentional weight loss) in the hospital inpatient and outpatient population[a]

| Questions | OR (CI) Inpatients[22] | OR (CI) Outpatients |
|---|---|---|
| Did you lose weight unintentionally, more than 6 kg in the last six months? | 256.1 (34.3–1907.0) | 32.3 (17.4–60.2) |
| Did you lose weight unintentionally, more than 3 kg in the last month? | 19.5 (9.4–40.7) | 15.1 (7.9–28.8) |
| Did you experience a decreased appetite? | 5.1 (2.9–9.2) | 6.3 (3.9–10.0) |
| Did you use supplemental drinks or tube feeding? | 5.4 (2.6–11.1) | 20.0 (19.2–43.4) |
| Did you eat less than normal? | 7.4 (3.9–14.1) | 2.8 (1.9–4.2) |
| Did you experience pain while eating? | 2.4 (1.3–4.6) | 5.0 (3.3–7.6) |
| Did you experience nausea? | 2.5 (1.4–4.3) | 3.0 (2.0–4.5) |
| Did you vomit? | 2.0 (1.1–3.6) | 3.2 (2.0–5.1) |
| Did you experience difficulty when eating? | 4.5 (2.5–8.1) | 5.0 (3.3–7.6) |
| Did you skip a meal occasionally? | 2.5 (1.4–4.3) | 1.5 (1.0- 2.2) |
| Do you have false teeth? | 2.1 (1.2–3.7) | 2.0 (1.3–2.9) |
| Did you experience difficulty chewing? | 3.5 (1.7–7.2) | 2.4 (1.4–3.9) |
| Did you experience difficulty swallowing? | 2.4 (1.3–4.4) | 2.4 (1.5–3.9) |
| Did you have diarrhoea? | 1.9 (1.1–3.3) | 1.6 (1.0–2.4) |
| Did you experience feelings of fatigue or weakness? | 4.6 (2.0–10.6) | 1.7 (1.2–2.6) |

[a] All questions, except the first one, concern the period of the last month.

## Diagnostic accuracy in the preoperative hospital outpatient population

The diagnostic accuracy of the SNAQ in the preoperative population was determined by comparing the SNAQ score with the objective definition of malnutrition as described in the nutritional status section.

The study population was categorized into three groups, based on the definition of malnutrition: well nourished, moderately malnourished and severely malnourished.

Diagnostic accuracy was assessed at a cut-off value of two points, comparing the severely malnourished plus moderately malnourished patients with the well-nourished patients and at a cut-off value of three points or more, comparing the severely malnourished patients with the moderately malnourished plus well nourished patients.

The diagnostic accuracy of the SNAQ was expressed as sensitivity, specificity, positive predictive value and negative predictive value. The sensitivity represents the probability (0–100%) that the SNAQ score is two points or more for moderately malnourished patients and three points or more for severely malnourished patients. The specificity represents the probability (0–100%) that the SNAQ score is less than two points for well nourished patients. The positive predictive value (0–100%) represents the probability that a patient with a score of two points is moderately malnourished and with three points or more is severely malnourished. The negative predictive value (0–100%) represents the probability that a patient with a score of less than two points is well nourished.

The area under the receiver operating characteristic (ROC) curve represents the diagnostic accuracy of the SNAQ score compared to the objective criteria of malnutrition (BMI $<$ 18.5 and unintentional weight loss). A greater area under the curve indicates a better accuracy of the SNAQ. The score varies between 0.5 when the SNAQ test is worthless, because just as many true as false positives were detected, and 1.0, when the sensitivity and specificity are superb.

*p*-Values were based on two-sided tests and the 95% confidence interval was used to express statistical significance.

Differences in patient characteristics between the three groups were tested by the Kruskal–Wallis test on continuous variables, and with ANOVA on binary variables.

Statistical analyses were performed using the SPSS system for Windows, version 12.0 (SPSS, Chicago, IL, USA).

### Diagnostic accuracy in the general hospital outpatient population

On 5 April 2005, a cross sectional screening on disease-related malnutrition was performed in all patients visiting the outpatient clinic (including a new sample of the preoperative population as described before). Patients were excluded from participation when they were under the age of 18, pregnant, suffered from senile dementia, failed in their competence of the Dutch language or did not give informed consent. Determining weight, height and classifying nutritional status was carried out as described in the preoperative population.

Trained interviewers ($n = 15$) asked patients the three SNAQ questions, age, questions on nutritional status, medical condition, dietetic therapy, elective surgery and existence of several diseases as described earlier.[22]

Statistics were performed as described in the previous subheading.

## Results

### Development of the SNAQ in the preoperative population

In this sub-study 1107 patients were included. One hundred and nine patients (10%) were excluded because of the following reasons: the investigator did not succeed to contact the patient by telephone within a period of five working days ($n = 50$), the telephone number could not be traced ($n = 31$), the patient did not consent to participate ($n = 25$) or the patient was unable to speak due to oral or throat related conditions ($n = 3$). Another 19 patients (2%) were excluded (after inclusion), in whom no definition of nutritional status could be determined because of incomplete data. As far as data were complete for these 19 patients, sex, age, SNAQ score etc. were not different from included patients. Finally the data of 979 patients were analysed.

#### Patients

The characteristics of this preoperative population are presented in Table 2. Age varied from 18 to 93 with a mean of 49 ($\pm$ 17) years of age. The percentage of women in this study population was 58%. The most common specialisms referring to the preoperative outpatient clinic were otolaryngology (21%), gynaecology (19%), orthopaedics (9%), surgical oncology (7%), plastic surgery (7%) and neurosurgery (7%). Of all included patients 21% visited the preoperative outpatient clinic because of an oncological disease. According to the definition of nutritional status 5% ($n = 49$) was moderately malnourished and 7% ($n = 67$) was severely malnourished.

#### Development of the SNAQ

Determining the optimal set of questions for screening disease-related malnutrition regarding the outpatient population resulted in the following three questions:

**Table 2** Characteristics of the preoperative population in well nourished, moderately malnourished and severely malnourished patients

| | Well nourished | Moderately malnourished | Severely malnourished | *p*-Value (ANOVA[†]/Kruskal–Wallis[‡]) |
|---|---|---|---|---|
| *N* (%) | 863 (88.2%) | 49 (5.0%) | 67 (6.8%) | – |
| Sex, % women | 58.1% | 57.1% | 62.7% | 0.749[‡] |
| Age in years ($\pm$ SD) | 49 (16.5) | 55 (16.4) | 51 (17.1) | 0.024[†] |
| BMI in kg/m$^2$ ($\pm$ SD) | 25.8 (4.6) | 23.9 (4.5) | 21.0 (4.2) | $<$0.001[†] |
| Oncologic disease (%) | 18.2% | 34.0% | 39.1% | $<$0.001[‡] |

1. ''Did you lose weight unintentionally (more than six kilograms in the last six months and/or more than three kilograms in the last month)?'',
2. ''Did you use supplemental drinks or tube feeding over the last month?'',
3. ''Did you experience difficulties when eating and drinking over the last month?''

The question ''Did you experience difficulties when eating and drinking over the last month?'' and ''Did you experience a decreased appetite?'' were highly correlated and had an almost identical contribution to the logistic regression model (an OR of 2.7 (95% CI 1.6—4.5) and an OR of 2.2 (95% CI 1.2—4.2) respectively), and were therefore exchangeable.

We followed the procedure as described in our previous study to make the SNAQ an easy-to-use tool.[22] In short this implies that scores were achieved by making round numbers of the beta coefficients (Table 3) of the logistic regression model. Since the beta coefficients of the logistic model of the outpatient population differed from the beta coefficients of the logistic model of the hospital population,[22] new scoring systems with new cut-off values were tested. After having changed the scores and cut-off values, the combination of sensitivity, specificity, positive predictive value and negative predictive value did not improve. Therefore the decision was made to use the original set of SNAQ questions with the same scoring system (Fig. 1).

## Diagnostic accuracy of the SNAQ in the preoperative population

Nine per cent ($n = 89$) of the patients had a SNAQ malnutrition score of two points or more and 8% ($n = 78$) of the patients had a score of three points or more. According to the objective definition of malnutrition, 5% of patients were moderately malnourished and 7% severely malnourished.

The diagnostic accuracy of the SNAQ for the cut-off values two and three is presented in Table 4. The ROC curve of the SNAQ for these patients shows an area under the curve (AUC) of 0.74 (95% CI 0.66—0.81) and 0.78 (95% CI 0.72—0.83) respectively.

**Table 3** Logistic regression model of the set of questions with the optimal predictive value of malnutrition

| Questionnaire | OR (CI) | β |
|---|---|---|
| | Outpatients | Outpatients |
| Did you lose weight unintentionally, more than 6 kg in the last six months? | 16.5 (8.4—32.4) | 2.8 |
| Did you lose weight unintentionally, more than 3 kg in the last month? | 4.1 (1.8—9.4) | 1.4 |
| Did you use supplemental drinks or tube feeding? | 4.6 (1.7—12.4) | 1.5 |
| Did you experience a decreased appetite? | 2.2 (1.2—4.2) | 0.8 |

## Diagnostic accuracy in the general hospital outpatient population

In this one-day cross sectional study 705 general hospital outpatients were included. The characteristics of this population are presented in Table 5. Age varied from 19 to 88 with a mean of 54 (± 17) years of age. The percentage of women in this study population was 56%.

The subgroups with the highest prevalence of malnutrition were surgery (13%), pulmonology (12%), radiotherapy (9%) and gastroenterology (9%). Out of all included patients 20% had an oncological disease.

Seven per cent ($n = 47$) of the patients had a SNAQ malnutrition score of two points or more and 5% ($n = 32$) of the patients had a score of three points or more. According to the objective criteria of malnutrition 2% of patients were moderately malnourished and 6% severely malnourished.

The diagnostic accuracy for the cut-off values two and three is presented in Table 4. The ROC curve of the SNAQ for these patients shows an AUC of 0.87 (95% CI 0.80—0.94) and 0.85 (95% CI 0.77—0.93) respectively.

## Diagnostic accuracy in the high malnutrition risk departments

In a post-hoc analysis the diagnostic accuracy of the SNAQ was measured in high malnutrition risk departments. High risk departments were defined as departments with a prevalence of malnutrition of 8% or higher. For the preoperative outpatient population these departments were: surgical oncology, dermatology, plastic surgery, oral maxillofacial surgery, nephrology, gastroenterology, ophthalmology and pulmonology ($n = 264$). For the general outpatient population these departments were: surgery, pulmonology, radiotherapy, gastroenterology, oncology, internal medicine, haematology and gynaecology ($n = 278$). The diagnostic accuracy of the high malnutrition risk for both populations is presented in Table 6.

## Discussion

The SNAQ malnutrition screening tool was found to be a reliable tool for malnutrition risk screening in a general outpatient population. In preoperative patients the prevalence of moderate malnutrition was 9% and the prevalence of severe malnutrition was 8%. In the general outpatient population, 7% was moderately malnourished and 5% was severely malnourished. The diagnostic accuracy of the SNAQ malnutrition screening tool in these outpatient populations was determined: sensitivity was 53—67% and specificity was 94—97%.

We checked whether questions that were most predictive for malnutrition in hospital inpatients would also be most predictive in hospital outpatients. Two models, containing three questions, were equally predictive for inpatients and outpatients. One model was exactly the same as the original SNAQ for hospital inpatients. Therefore, we concluded that the original SNAQ malnutrition screening tool, developed for the hospital inpatient population, can also be used in the outpatient population.

**Table 4** Diagnostic accuracy for the preoperative outpatient population and the general outpatient population

| | Sensitivity (95% CI) | Specificity (95% CI) | Positive predictive value (95% CI) | Negative predictive value (95% CI) |
|---|---|---|---|---|
| *Preoperative outpatient population* | | | | |
| Cut-off value 2 points or more | 53% (43–62) | 97% (95–98) | 69% (58–78) | 94% (92–95) |
| Cut-off value 3 points or more | 45% (33–57) | 95% (93–96) | 38% (28–50) | 96% (94–97) |
| *General hospital outpatient population* | | | | |
| Cut-off value 2 points or more | 67% (52–79) | 98% (97–99) | 72% (57–84) | 97% (96–98) |
| Cut-off value 3 points or more | 63% (46–77) | 99% (98–100) | 78% (60–91) | 98% (96–99) |

Detection of malnourished patients by nursing and medical staff, before adopting the SNAQ malnutrition screening tool, was only 15%. Possible explanations for this may be the high workload of nursing and medical staff in the outpatient clinics, and a lack of malnutrition guidelines.[9]

Introduction of a malnutrition screening tool for hospital outpatient populations can be expected to improve detection of disease-related malnutrition. The SNAQ malnutrition screening tool is not time-consuming, does not need trained interviewers or any special device. Of course, weighing all patients, calculating the BMI as well as the percentage of unintentional weight loss is the preferred way of assessing nutritional status. However, implementation of the SNAQ malnutrition screening tool in the routine care in the hospital outpatient setting could be feasible because of the short time it will take. Implementation of the SNAQ in the hospital outpatient setting may therefore improve recognition and treatment of outpatients at risk of malnutrition from 15% to 53–67% and even up to 71% in the high risk departments (Table 4). One should, however, realize the potential disadvantage of 'quick and easy' assessment tools to determine malnutrition (such as SNAQ) and identify patients at risk of malnutrition. Additionally, patients qualified as malnourished by these instruments require further nutritional assessment to diagnose malnutrition definitely.

A critical reader of this study will possibly criticize the methodology of measuring weights and heights. Weights were measured with both shoes and light clothing, heights were asked for and measured if patients did not know their height. We did so because this reflects daily practice in the outpatient department where approximately 1000 patients are being seen every day.

Correcting for, for example, weight with one kilo for shoes, does in our opinion create false accuracy. Currently we do not know as yet many other factors that may have influenced the results, such as weighing six months ago, calibration of scales at home, fasted or non-fasted measurements of weights, seasonal influences, the time of day, etc. Creating false accuracy by correcting weight only, yet ignoring the other factors, is not correct in our opinion. Therefore, we have performed this study with the weights and heights as they are usually obtained in the outpatient department.

Moreover, one should realize that, when doing it the way we did, we showed the best-case scenario. Should we have corrected for, for example weight, which could have possibly led to a few more patients with BMI below the cut-off point (one kilo weight difference does not lead to extreme changes in BMI), more patients would have been identified as malnourished. One should realize therefore that weighing and measuring in conformity with usual care only identifies the smallest number of malnourished patients. Doing so more accurately, which we strongly advise but in this large patient group do not think feasible, would probably lead to a higher percentage of malnourished patients. Again, these considerations underline our point of view that patients, appointed malnourished by a quick and easy screening tool, require further assessment to definitely diagnose them as malnourished.

The diagnostic accuracy of the SNAQ for moderately plus severely malnourished patients (cut-off value two points or more) was better in the hospital inpatient population (sensitivity 79%, specificity 83%, positive predictive value 70% and negative predictive value 89%) than in the hospital outpatient population (sensitivity 53–67%, specificity 97–98%, positive predictive value 69–72% and negative predictive value of 94–97%). This may be explained by the

**Table 5** Characteristics of the general hospital outpatient population in well nourished, moderately malnourished and severely malnourished patients

| | Well nourished | Moderately malnourished | Severely malnourished | *p*-Value (ANOVA[†]/Kruskal–Wallis[‡]) |
|---|---|---|---|---|
| *N* (%) | 654 (92.8%) | 11 (1.6%) | 40 (5.7%) | – |
| Sex, % women | 56.2% | 45.5% | 52.5% | 0.858[‡] |
| Age in years (± SD) | 54 (16.5) | 57 (8.0) | 53 (17.3) | 0.279[†] |
| BMI in kg/m$^2$ (± SD) | 26.3 (4.6) | 25.1 (5.5) | 20.0 (3.6) | <0.001[†] |
| Oncologic disease (%) | 18.7% | 72.7% | 37.5% | <0.001[‡] |

**Table 6** Diagnostic accuracy for the high malnutrition risk departments in the preoperative outpatient population and the general outpatient population

| | Sensitivity (95% CI) | Specificity (95% CI) | Positive predictive value (95% CI) | Negative predictive value (95% CI) |
|---|---|---|---|---|
| *Preoperative high risk outpatient population* | | | | |
| Cut-off value 2 points or more | 59% (42—72) | 94% (90—97) | 73% (58—85) | 89% (85—93) |
| Cut-off value 3 points or more | 57% (39—74) | 90% (86—94) | 48% (32—64) | 93% (89—96) |
| *General high risk hospital outpatient population* | | | | |
| Cut-off value 2 points or more | 71% (54—85) | 100% (98—100) | 100% (86—100) | 96% (93—98) |
| Cut-off value 3 points or more | 69% (48—86) | 98% (96—100) | 82% (60—95) | 97% (94—99) |

lower prevalence of disease-related malnutrition in the outpatient population and by the differences between both populations. For example, the severity of disease is expected to be higher in the hospital population, the outpatient population was younger and the percentage of malnourished patients with a BMI $< 18.5$ was higher in the outpatient group than in the hospital group (41% versus 25%).

Post-hoc analysis in high malnutrition risk departments showed a considerable improvement in the diagnostic accuracy, which may plead for a further selection of departments that should implement malnutrition risk screening (haematology, pulmonology, radiotherapy, gastroenterology, oncology, internal medicine and gynaecology).

A discussion point in every study on disease-related malnutrition is the absence of a gold standard.[24] In this diagnostic accuracy study, we applied a commonly used and accepted definition of disease-related malnutrition by using both percentage unintentional weight loss and BMI.

In the general outpatient population, patients who did not participate in the cross-sectional screening were not registered. We expect this to be a limited number of patients, because all patients received a questionnaire and researchers were present in the outpatient clinic all day long to collect the questionnaires and to measure the patients' weight.

A treatment protocol, based on the SNAQ score, has now been developed to guarantee optimal care in the preoperative period. All patients with a SNAQ score of two points or more (moderately/severely malnourished) will receive written advice (a brochure) or group education. Patients with a SNAQ score of at least three points (severely malnourished) will receive dietetic treatment. This protocol treatment is expected to improve the nutritional status on admission to the hospital. Whether this treatment plan is indeed effective, and also cost effective, needs to be investigated.

## Conclusion

The SNAQ malnutrition screening tool in its original form can be applied for the general hospital outpatient population as well. The recognition and treatment of malnourished patients may improve from 15% before screening to 53—67% after implementing the SNAQ malnutrition screening tool. Deciding to screen only in high malnutrition risk departments may improve recognition up to even 71%.

Since calculating BMI and percent unintentional weight loss of each patient is no daily routine, the SNAQ malnutrition screening tool is a useful instrument to assess patients' nutritional status in a quick, easy and valid way.

It should be studied whether a per protocol nutritional treatment plan based on the SNAQ score improves the nutritional status in the preoperative period and decreases the prevalence of disease-related malnutrition on admission to the hospital.

## Conflict of interest statement

This project was financially supported equally by both Abbott BV and Nutricia Nederland BV. There was no conflict of interest.

## Acknowledgements

The authors of this article would like to thank the nursing and medical staff on the preoperative outpatient clinic for handing out SNAQ questionnaires. We also would like to thank Esther van 't Riet en Annemarie Brummelman, students, for their help with the practical part of this study. F.N. and H.M.K. were responsible for the study design, data collection, analysis, and writing the manuscript (guarantor). H.C.W.dV., J.C.S. and M.A.E.vB. participated in developing the study design, the analysis and writing the manuscript. M.B. participated in the inclusion of the patients and the data collection.

## References

1. Bruun LI, Bosaeus I, Bergstad I, Nygaard K. Prevalence of malnutrition in surgical patients: evaluation of nutritional support and documentation. *Clinical Nutrition* 1999;**18**:141—7.
2. Corish CA, Kennedy NP. Undernutrition in hospitals. *British Journal of Nutrition* 2001;**85**:509—10.
3. Edington J, Boorman J, Durrant E, et al. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. *Clinical Nutrition* 2000;**19**:191—5.
4. Green CJ. Existence, causes and consequences of disease related malnutrition in the hospital and the community, and clinical and financial benefits of nutritional intervention. *Clinical Nutrition* 1999;**18**:3—28.
5. Kelly IE, Tessier S, Cahill A, et al. Still hungry in hospital: identifying malnutrition in acute hospital admissions. *QJM* 2000;**93**:93—8.

6. Kyle UG, Pirlich M, Schuetz T, Luebke HJ, Lochs H, Pichard C. Prevalence of malnutrition in 1760 patients at hospital admission: a controlled population study of body composition. *Clinical Nutrition* 2003;**22**:473—81.
7. Waitzberg DL, Caiaffa WT, Correia ITD. Hospital malnutrition: the Brazilian National Survey (IBRANUTRI): A study of 4000 patients. *Nutrition* 2001;**17**:573—80.
8. Wilson M, Vaswani S, Liu D, Morley J, Miller D. Prevalence and causes of undernutrition in medical outpatients. *American Journal of Medicine* 1998;**104**:56—63.
9. Kruizenga HM, Neelemaat F, Seidell JC, Weijs PJM, Verkleij B, van Bokhorst-de van der Schueren MA. Undernutrition and overnutrition in hospital outpatients. Eur J Clin Nutr, submitted for publication.
10. Klidjian AM, Foster KJ, Kammerling RM, Cooper A, Karran SJ. Relation of anthropometric and dynamometric variables to serious postoperative complications. *British Medical Journal* 1980;**281**:899—901.
11. van Bokhorst-de van der Schueren MA, van Leeuwen PA, Sauerwein HP, Kuik DJ, Snow GB, Quak JJ. Assessment of malnutrition parameters in head and neck cancer and their relation to postoperative complications. *Head and Neck* 1997; **19**:419—25.
12. Hunt DR, Rowlands BJ, Johnston D. Hand grip strength—a simple prognostic indicator in surgical patients. *Journal of Parenteral and Enteral Nutrition* 1985;**1985**:701—4.
13. Larsson J, Akerlind I, Permerth J, Hornqvist JO. The relation between nutritional state and quality of life in surgical patients. *European Journal of Surgery* 1994;**160**:329—34.
14. Clark MA, Plank LD, Hill GL. Wound healing associated with severe surgical illness. *World Journal of Surgery* 2000;**24**:648—54.
15. Stratton RJ, Green CJ, Elia M. Consequences of disease-related malnutrition. In: *Disease related malnutrition: an evidence-based approach to treatment*. Cambridge: CABI Publishing; 2003. p. 113—55.
16. Kruizenga HM, Van Tulder MW, Seidell JC, Thijs A. Van Bokhorst-de van der Schueren MAE. Effectiveness and cost-effectiveness of early screening and treatment of malnourished patients. *American Journal of Clinical Nutrition* 2005; **82**:1082—9.
17. Pichard C, Kyle UG, Morabia A, Perrier A, Vermeulen B, Unger P. Nutritional assessment: lean body mass depletion at hospital admission is associated with an increased length of stay. *American Journal of Clinical Nutrition* 2004;**79**:613—8.
18. Naber TH. Lean body mass depletion is associated with an increased length of hospital stay. *American Journal of Clinical Nutrition* 2004;**79**:527—8.
19. Tucker HN, Miguel SG. Cost containment through nutrition intervention. *Nutrition Reviews* 1996;**54**:111—21.
20. Rypkema G, Adang E, Naber THJ, et al. Cost effectiveness of an interdisciplinary intervention in geriatric inpatients to prevent malnutrition. *Journal of Nutrition, Health and Aging* 2003;**2**: 122—7.
21. Stratton RJ, Green CJ, Elia M. Causes of disease-related malnutrition. In: *Disease related malnutrition: an evidence-based approach to treatment*. Cambridge: CABI Publishing; 2003. p. 93—112.
22. Kruizenga HM, Seidell JC, de Vet HC, Wierdsma NJ. van Bokhorst-de van der Schueren MA. Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). *Clinical Nutrition* 2005;**24**:75—82.
23. Kruizenga HM, Wierdsma NJ, Van Bokhorst-de van der Schueren MAE, et al. Screening of nutritional status in The Netherlands. *Clinical Nutrition* 2003;**22**:147—52.
24. Stratton RJ, Green CJ, Elia M. Scientific criteria for defining malnutrition. In: *Disease related malnutrition: an evidence-based approach to treatment*. Cambridge: CABI Publishing; 2003. p. 1—34.
25. FAO/WHO/UNU. *Energy and protein requirements*. Technical Report Series no. 724. Geneva: WHO; 1985.
26. Detsky AS, Smalley PS, Chang J. The rational clinical examination. Is this patient malnourished? *Journal of the American Medical Association* 1994;**271**:54—8.