Screening and treatment of malnourished hospital patients

Hinke Kruizenga

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CHAPTER 1

General Introduction

Disease related malnutrition

The problem of nutrition and disease was recognized as long ago as the 4th century BC by Hippocrates, in his regimen on acute disease. He described a diet of barley gruel with honey and water to drink. Unfortunately, the theory of the four humors, initiated by Hippocrates and promoted later by Galen in the 2nd century led to the policy of starving a fever and feeding a cold, a policy that continued until the mid-19th century, when Dr Robert Graves of Dublin decided that perhaps the high mortality from typhus fever had something to do with the treatment of bleeding, starving and purging, and reversed the policy. Instead he gave his patients food and drink, with a consequent reduction in mortality rates. To those who sought the reason for this he said: ''You are not to permit your patient to encounter the terrible consequences of starvation because he does not ask for nutriment. Gentlemen, these results are due to good feeding. When I am gone, you may be at a loss for an epitaph for me; I give it to you in these words: He fed fever'.' A few years later, Florence Nightingale, writing from the Crimea in her Notes on Nursing, said: ''Every careful observer of the sick will agree in this, that thousands of patients are annually starved in the midst of plenty from want of attention to the ways which alone make it possible for them to take food. I would say to the nurse, have a rule of thought about your patient's diet ... consider, remember how much he has had and how much he ought to have today.'' The modern, high-tech medicine tends to forget the ordinary but important role of adequate nutritional care in the total medical care, particularly the elderly and chronically ill who may stay in hospital or institutions longer than most, and who have a higher prevalence of malnutrition on admission.

What is disease related malnutrition?

Malnutrition can be subdivided in undernutrition, which is due to a deficiency of nutrients and overnutrition, which is due to an excess of nutrients. However, the term malnutrition is commonly used to refer to undernutrition rather than overnutrition, and it is in this sense that malnutrition is used in this thesis.

Disease related malnutrition exists in a high proportion of hospitalised patients and is caused by reduced food intake, malabsorption and /or catabolism.[1] Although there is no universally accepted definition of disease related malnutrition, the following components will form the definition:

- Disease in any form and severity
- Deficiency or imbalance of energy protein and other nutrients
- Decreasing amount body mass, especially fat free body mass

The body Mass Index (BMI) (kg/m2) and unintentional weight loss are part of most definitions of malnutrition. The BMI-mortality curves suggest that, in the general population, a BMI of 18.5 – 25 kg/m2 is preferable, since it is associated with the lowest mortality. Mortality is increased when the BMI is lower than 18,5 kg/m (underweight) or when the BMI is higher than 25 kg/m (overweight).[2] Whereas a low BMI may indicate chronic malnutrition, recent unintentional weight loss indicates a more acute deterioration of the nutritional status.[3-6] Second, nutritional variables combined with biochemical parameters are associated with severity of illness (such as low serum albumin) in so-called nutritional indices.[7] These indices predict surgical risk and should therefore be termed health risk indices rather than nutritional indices. Severe malnutrition is easily recognized but, in highly complex patients, in whom malnutrition is part of an impaired health status, malnutrition tends to be recognized only in a late stage of the treatment.[8]

Adverse consequences of disease related malnutrition

Disease related malnutrition has extensive adverse consequences such as impaired immune function,[9;10] reduced respiratory functioning,[11] reduced overall muscle strength and fatigue,[12] impaired thermoregulation,[13] impaired wound healing,[14] apathy, depression, impaired social interactions and self neglect.[15] Both malnutrition and disease severity can have independent negative effects on the prognosis of patients. In combination these factors may create a vicious circle that can only be broken by a combination of treatment of the underlying disease and nutritional support.

Because of these adverse consequences, malnutrition is associated with postoperative complications, increased length of hospital stay and even death.[16-18] It is clear that the adverse impact of disease related malnutrition on patient outcome and recovery results in increased healthcare utilization and associated costs.[19-21] Prospective studies on the amount of money that could be saved if appropriate screening and nutritional support are provided are lacking.

Prevalence of disease related malnutrition in different health care settings

The prevalence of disease related malnutrition is dependent on age, severity of disease and health care setting and is approximately 10% in the general hospital outpatient population and 25 - 40% in the hospital inpatient population on hospital admission.[22;23] Despite this high prevalence and overall understanding that malnutrition increases complications, costs and length of hospital stay,[19-21] still 50% of all hospitalised undernourished patients remain unrecognised by medical and nursing staff, and therefore untreated.[24] Data suggest that recognition of malnutrition in the outpatient clinic is even worse: Wilson et al [22] describes a recognition of malnutrition in 43% of the elderly malnourished patients, and in only 12% of the young adult, malnourished patients.

To resolve this problem, ideally, in all in- and outpatients the nutritional status should be assessed by physicians or nurses, to determine whether the patient is undernourished and a nutritional intervention should be started. However, this 'ideal', comprehensive diagnostic assessment in all patients is not applicable in the current clinical practice. Since it is considered time-consuming, requiring a specialist, it is thus expensive, and an unnecessary burden for those patients which turn out to be well nourished. There has been a strong resistance to nutritional screening for two main reasons. First, nutritional screening is only one of the large and increasing number of procedures that health professionals are asked to perform during their busy schedules. Second, the clinical and economical benefits of nutritional screening do not appear to have been convincingly demonstrated for a range of conditions in different care settings using the criteria demanded by evidence based medicine.

For these reasons it is desirable to have a quick-and-easy, non-invasive and cost-effective screening method before comprehensive diagnostic assessment takes place.

Before a screening tool is considered for implementation, it is, next to practical applicability, important to determine its diagnostic test performance. In screening, the true positive rate (sensitivity) of the tool is the most important part of the diagnostic test performance.[25] The higher the sensitivity (e.g. the lower the false negative rate), the more effective the screening method is in identifying those patients who benefit from further assessment and nutritional intervention. The available malnutrition screening tools have one or more of the following limitations: 1) they use nutrition parameters that are not routinely or immediately available; 2) they may be complicated, time intensive and invasive; 3) they were developed in specific patient populations; 4) dieticians are often required to collect the data, which are therefore too specialized for implementation on a hospital-wide basis by nursing or administrating staff; 5) no practical information how to implement them has been provided; and 6) their effectiveness in terms of sensitivity, specificity, validity, reliability and cost-effectiveness have not been well established.

A malnutrition screening tool for the hospital setting should be:
1. Practical
   a. easy and quick to complete
   b. easy to understand
   c. acceptable to patients and health care workers
   d. can be used on all adult patients
2. Reliable and valid
3. Linked to a care plan

Outline of the thesis

The overall goals of the work presented in this thesis are:
1. to determine the prevalence and recognition of disease related malnutrition in all health care settings, especially in the hospital inpatient and outpatient population
2. to develop a screening tool which is practical, reliable and valid in a hospital setting and is linked to a care plan
3. to analyse the effectiveness and cost-effectiveness of the screening and protocolled nutritional care plan in the hospital setting

Chapter 2 describes a screening on malnutrition in 7606 patients in all health care settings. The main conclusion of this screening was that the prevalence of disease related malnutrition is high but the recognition of malnutrition by the physician or nurse is low. A valid, quick and easy screening tool needed to be developed.
Chapter 3 describes the development and validation of the Short Nutritional Assessment Questionnaire (SNAQ) and **chapter 4** describes the effectiveness and cost effectiveness of screening and early protocolled treatment.
Chapter 5 reports on the complexity of the patients that are identified as malnourished by the SNAQ.
Chapter 6 describes the prevalence of malnutrition in the hospital outpatient population. Given the fact that overweight and obesity are a more extensive problem than undernutrition in the hospital outpatient group, prevalences of undernutrition and overnutrition are reported in this chapter.
Chapter 7 reports on the diagnostic value of the SNAQ in a general outpatient population and in a preoperative outpatient population.
In the **concluding chapter** of this thesis the main outcomes of the studies are discussed. Since the SNAQ is not the only malnutrition screening tool available, the quality of the SNAQ will be compared to other tools. Furthermore, suggestions will be made on optimisation of the nutritional care for malnourished patients.

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CHAPTER

2

Screening of Nutritional status in the Netherlands

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Abstract

Background and aims

In 2001 the Dutch Dietetic Association conducted a national screening on malnutrition. The goal of this screening was to determine the prevalence of disease related malnutrition in The Netherlands in all fields of medical care and to investigate the involvement of the dietician in the treatment of malnutrition.

Methods

Eight thousand five hundred and twenty nine patients were screened of which data of 7606 patients could be analysed. Eighty-one percent (6150) of the patients were hospital patients. Eleven percent (808) of the patients lived in a nursing home. Seven percent (533) of the patients were home care patients who were measured at home or at the general practitioner's office. The origin of 115 patients (2%) was not registered. Age, height, weight, unintentional weight loss, kind of illness and intervention by a dietician were registered. Malnutrition was defined as >10% unintentional weight loss during the past 6 months and risk of malnutrition was defined as 5-10% unintentional weight loss during the past 6 months.

Results

Twelve percent (884) of all patients appeared to be malnourished. Thirteen percent (962) were at risk of malnutrition and 75% (5760) were well nourished. Fifty-four percent of the malnourished patients were referred to a dietician.

Oncological disease was more associated with malnutrition than non-oncological disease (in particular in the head and neck, lung and intestinal areas). Also, non-oncological gastro-intestinal and lung disease patients were often categorised as malnourished. Elderly patients (>75 years) were more at risk of malnutrition. BMI and unintentional weight loss did not correlate well.

Conclusion

In this national survey conducted by dieticians, including a convenience sample of mainly institutionalised patients, approximately 25% of patients in all medical fields were categorised as moderately or severely malnourished. About half of these patients were seen by a dietician.

Introduction

Although malnutrition is usually associated with developing countries, it occurs in Western Hemisphere as well. It is considered to be only a minor problem compared to that of overweight. In medical care however, there is growing awareness that malnutrition (i.e. unintentional weight loss, loss of lean body mass or depletion of fat mass) plays an important role in the course of the treatment of patients. Malnutrition is associated with decreased muscle function and immune function, impaired quality of life, impaired wound healing and even with increased length of hospital stay, mortality and costs of health care.[1-3]

The pathogenesis of disease related malnutrition is multifactorial, but reduced food intake due to loss of appetite, episodes of fasting, pain on eating, swallowing difficulties and inability to eat independently play an important role. Moreover, there is a disturbance in energy balance depending on a number of regulatory substances such as cytokines and glucocorticoids.[4]

Nutritional status can be defined in different ways. In clinical practice malnutrition is most often defined as unintentional weight loss during the past 6 months, with weight loss >10% categorised as severe malnutrition.[5] Beside involuntary weight loss, also body mass index (BMI: weight (kg) / height (m)2) is often used as a parameter of nutritional status. BMI <18.5 is generally accepted as underweight, BMI 18.5-25 as normal weight and BMI>25 as overweight.[6] Both weight loss and BMI are generally accepted parameters of nutritional status. However, when describing disease related malnutrition, most authors prefer to use unintentional weight loss over BMI because unintentional weight loss is caused by inadequate energy balance accompanied by insufficient nutrient intake and this holds for all classes of BMI.[2;7]

In 2000, the Dutch Dietetic Association conducted a national campaign to draw attention to disease-related malnutrition in society and among health care professionals. Their slogan was: Eat well to get well. The campaigns targets were to create awareness in society that disease-related malnutrition delays recovery and increases the incidence of complications. Furthermore to convince health care professionals of the fact that early detection and treatment of malnutrition should be integrated in medical diagnostics and treatment.

In 2001 a national screening on malnutrition followed this campaign. The goal of this screening was to determine the prevalence of disease-related malnutrition in The Netherlands in all fields of medical care and to investigate the involvement of the die titian in the treatment of malnutrition.

Patients and methods

In September and October 2001, 91 teams of dieticians in all fields participated in this national screening on malnutrition. Patients were excluded from the study when they were <18 years of age, could not be weighed, or were not able to give informed consent. 8529 Patients were screened. All patients gave written informed consent. 923 (11%) Patients were excluded afterwards because data were incomplete. 7606 Patients remained in the study. The number of patients who did not participate in the screening was not registered.

Table 1 gives information about the origin of the included patients. 81% (6150) of the screened patients were hospital patients. 41% of all Dutch hospitals participated in this survey. 11% (808) of the patients lived in a nursing home. 7% (533) of the patients were home care patients who were measured at home or at the general practitioner's office. In 2% (115) of the patients the origin was unregistered.

Table 1 Distribution of the included patients by field of medical care

	N (%)	Number of locations	Age (mean ± SD)
Hospital	6150 (81%)	56	63.2 ± 16.2
Home care	533 (7%)	22	59.3 ± 20.2
Nursing home	808 (11%)	16	80.1 ± 10.6
Unregistered	115 (2%)	unknown	49.1 ± 20.1
Total	7606	94	64.5 ± 17.0

In this survey we chose to define nutritional status by involuntary weight loss. Dieticians recorded age and height and measured actual weight. The patients were asked whether they had had unintentional weight loss during the past 6 months. Patients who did not have unintentional weight loss or who had lost <5% of their weight were characterised as "well nourished". Patients who had unintentionally lost 5-10% of their weight were characterised as "at risk of malnutrition" and patients who had lost unintentionally more than 10% of their weight were characterised as "malnourished". [5] BMI was derived from weight and height and associations between weight loss and BMI were calculated. [2] Supplementary information (e.g. kind of illness, surgery, oncological and non-oncological illnesses) was obtained from their medical records. Intervention by a dietician with respect to malnutrition was also registered.

Statistical analyses

The study population was categorised into 3 groups based on percentage weight loss. Statistical analyses were performed using the SPSS-system for Windows, SPSS Inc., Chicago. Descriptive statistical methods were used to express means, standard deviations, percentages, frequencies, correlations and the χ^2 tests. The associations between risk factors and malnutrition were expressed as odds ratios (OR) with OR >1 indicating elevated risk and OR<1 indicating reduced risk. P-values were based on two-sided tests and the cut-off point for statistical significance was 0.05.

Results

Twelve percent (884) of all patients were malnourished. Thirteen percent (962) were at risk of malnutrition and 75% (5760) were well nourished. In the malnourished group 54% of the patients were referred to a dietician for nutritional support. *Table 2* shows the characteristics of all patients who participated in the screening. The percentage malnourished patients were highest in hospital setting (13%). The percentage of malnourished patients who were treated by a dietician was highest in nursing homes (60%). The group of home care patients had the lowest percentage of malnourished patients (5%) and the highest percentage of patients with a BMI>25 (51%) (data not shown).

Type of illness

15.6% (1186) of all patients had an oncological disease. 21% of these cancer patients were malnourished, 19% were at risk of malnutrition and 60% were well nourished. *Figure 1* shows that cancer patients were more at risk of malnutrition than other patients (p<0.001, OR malnourished – other =

Figure 1 The percentage of oncological and non-oncological patients, categorised by percentage of weight loss

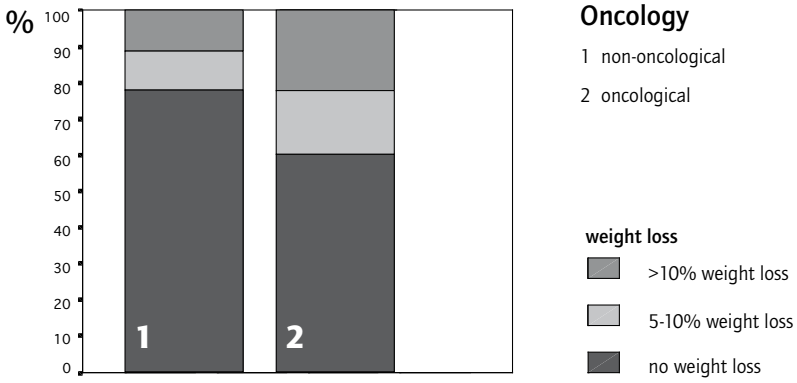
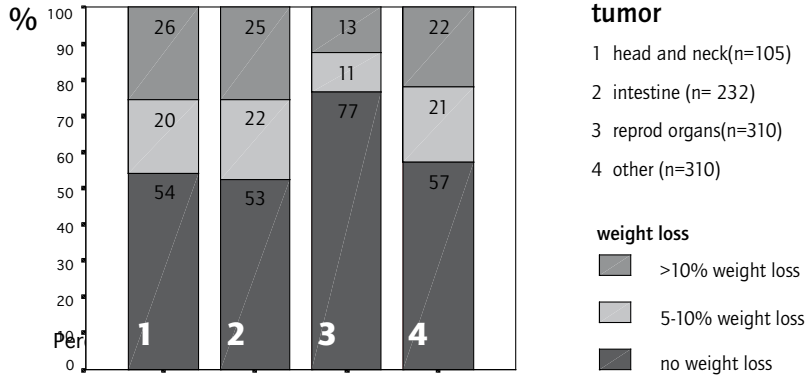
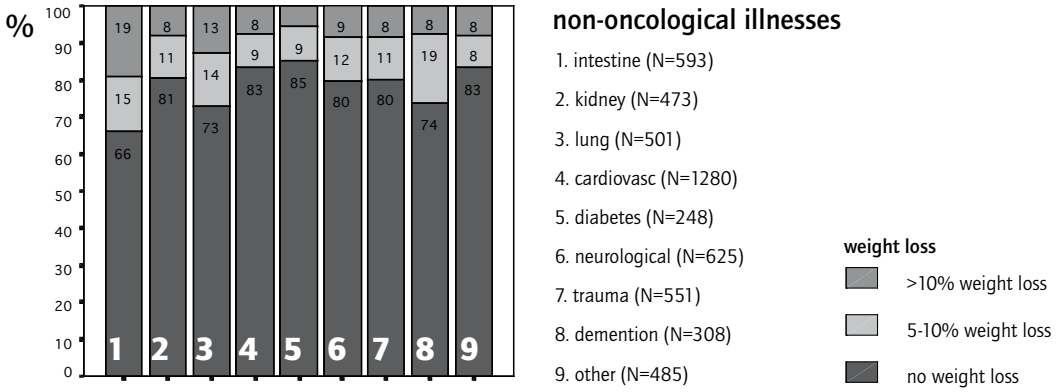


Figure 2 Oncological patients categorised by tumor localisation and percentage of weight loss



2.41 (95% CI: 2.06-2.83)). *Figure 2* shows the prevalence of malnutrition in the largest oncological subgroups. Malnutrition occurred most frequently in head and neck cancer patients and in patients with intestinal tumours. The group 'other' contains patients with lung tumours and haematological tumours who were also often at risk of malnutrition.
Figure 3 shows the prevalence of malnutrition in the largest non-oncological subgroups. The groups of patients with intestinal diseases and lung diseases contained relatively the most malnourished patients. The group of patients with diabetes and cardiovascular diseases contained relatively the least malnourished patients.

Figure 3 non-oncological diseases categorised by percentage of weight loss



30% (2312) of the total group were surgical patients (mixed surgery). 14% of these surgical patients were malnourished, 12% were at risk of malnutrition and 74% were well nourished. The percentage of surgical patients was not different between the three groups of patients categorised by percentage weight loss (p =0.15). The odds ratio of surgical patients is only slightly elevated, (OR malnourished – other = 1.24 (95% CI: 1.07-1.43)) i.e. surgical patients were only at slightly higher risk of malnutrition than others.

Body mass index

BMI <18.5 is generally accepted as underweight, BMI 18.5-25 as normal weight and BMI >25 as overweight (6). The mean BMI of all patients was 25.2 ± 4.9, which is within the reference values of 18.5 - 25. In the well nourished group BMI was 26.1 ± 4.8, in the groups with patients at risk this was 23.3 ± 4.2 and even in malnourished patients mean BMI was within normal limits: 21.8 ± 4.2 (p <0.001 between malnourished and well nourished). The BMI's of well nourished patients, in the total group as well as in all subgroups, indicate that most well nourished patients suffered from overweight. *Figure 4* shows the three groups of patients categorised by BMI and involuntary weight loss.
Patients with BMI <18.5 were more at risk of malnutrition than others (OR = 6.01 (95% CI: 4.92 –7.33)) and patients with BMI >25 were less at risk of malnutrition (OR = 0.15 (95% CI: 0.12-0.18)). *Figure 5a* and *5b* illustrate the distribution of BMI in the 3 groups, categorised by nutritional status based on weight loss.
Malnutrition can be defined by amount of unintentional weight loss or by BMI <18.5 (6). In this survey the correlation between percentage weight loss and BMI was low (Pearson's r = 0.22). Using unintentional weight loss as the standard, the sensitivity of BMI as predictor of malnutrition was 0.21 and de specificity was 0.95. In other words: Only 21% of the patients with >10% weight loss had a BMI <18.5 and 95% of the patients with <10% weight loss had a BMI >18.5.
The predictive value of a positive test was low (0.41). Therefore it is not correct to assume that a patient with a BMI <18.5 is malnourished. The predictive value of a negative test was high (0.90).

Figure 4 BMI and weight loss in hospital patients, home care patients and nursing home patients

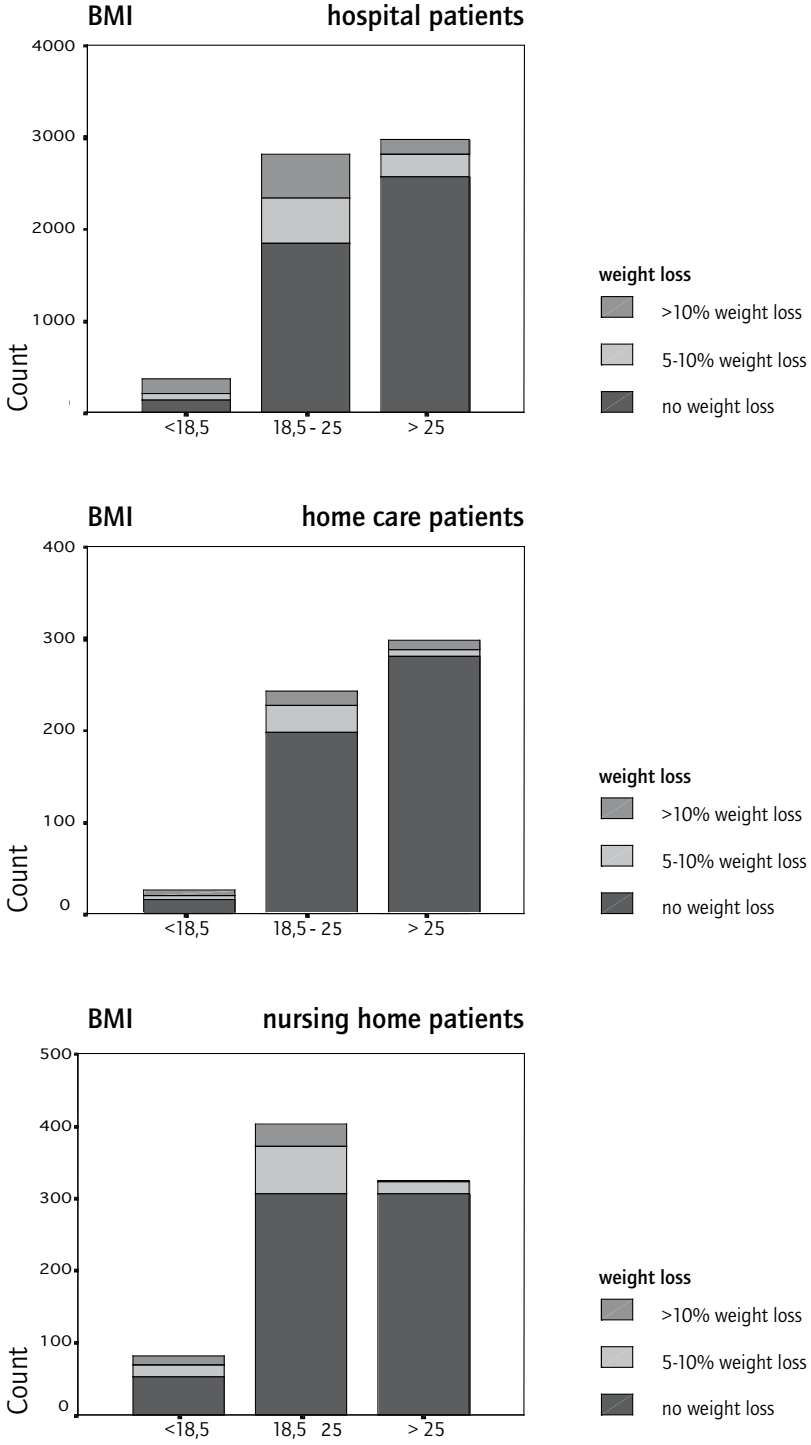


Figure 5a Distribution curves of body mass index categorised by weight loss

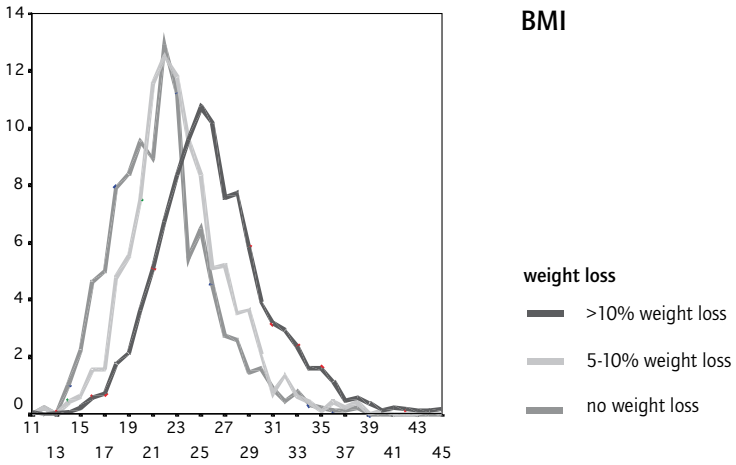
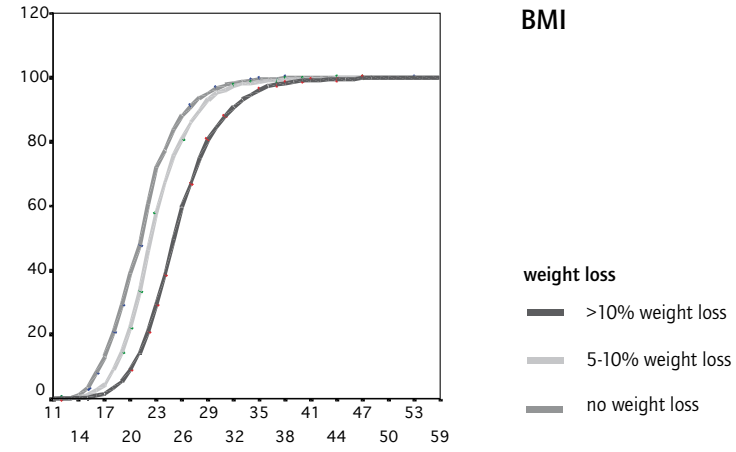


Figure 5b Cumulative curve of body mass index categorised by weight loss



Age

The mean age of the total group of patients was 64.5 ± 17.0 years and varied between 18 and 102 years (table 1). Malnourished patients were older than well nourished patients in all subgroups (total group $p<0.001$, hospital patients $p<0.001$, home care patients $p=0.003$, nursing home patients $p=0.01$). Elderly patients were more at risk of malnutrition than others (OR = 1.36 (95% CI: 1.17-1.57)).

Discussion

The purpose of this survey was to gain insight in the prevalence of disease-related malnutrition in the Dutch population and how often this led to referral to a dietician.
12% (884) of all patients appeared to have lost >10% of their weight. 13% (962) had lost 5-10% of their weight and 75% (5760) did not lose weight. 54% of the patients with more than 10% weight loss were referred to a dietician.
This survey shows that oncological disease, in particular in the head and neck, lung and intestinal area was associated with unintentional weight loss. Patients with non-oncological diseases were less at risk of weight loss but nevertheless gastrointestinal problems and lung diseases were often associated with nutritional problems. BMI and percentage weight loss did not correlate. Still, patients with low body weights (BMI <18.5) were more at risk of unintentional weight loss. Elderly patients were more at risk of malnutrition than others.

The discrepancy between the definition of malnutrition based on BMI and on unintentional weight loss illustrates the complexity of the definition of nutritional status. Patients with unintentional weight loss and BMI >25 are usually not recognised as malnourished. Still, 19% of the patients with weight loss >10% had a BMI >25. On the other hand screening on malnutrition by registering only unintentional weight loss leaves out the patients with dangerously low body weights with no recent weight loss. Based on the results of this screening, unintentional weight loss seems to be a better indicator of disease related malnutrition than a low BMI, since unintentional weight loss reflects insufficient energy and nutrient availability due to impaired food intake or absorption, or elevated needs.

One of the shortcomings of this study is that a large number of patients were excluded from the study and that no record was kept of these patients. In addition to the standard research protocol, 1 hospital (450 patients) recorded how many patients were excluded. About 30% of the patients in this hospital were excluded because they could not be weighed, were too ill, were admitted to the intensive care unit or were not able to give informed consent because of e.g. dementia. This group of excluded patients is probably at even higher risk of weight loss than the included patients. Therefore, the data of this study probably only reveal the tip of the iceberg. Malnutrition may be a far more severe problem than described here, which is confirmed by earlier studies, which have reported malnutrition to occur in 25-40% of patients on admission to hospital and to increase to over 60% during admission. [1;8;9]
The same hospital also studied the relation between nutritional status and treatment outcome. Malnourished patients had a longer hospital stay than others ($p < 0.001$). These data confirm data from the literature, stating that malnutrition increases costs of health care.[1;10;11]

More shortcomings of this national screening involve the recording of the sex of the patients and their weights. The researchers failed to register the sex of the patients. Due to this neglect it was not possible to interpret the results for men and women separately.
Actual weight was weighed with different scales. Possibly not all scales were calibrated. Moreover, the weight at 6 months previously had not been recorded, therefore a recall weight was used. It is possible that patients did not report this accurately due to forgetfulness, faults in weighing scales or other reasons.

54% of the malnourished patients were seen by a dietician for advice. These data suggest that referral of malnourished patients to dieticians could be improved in the Netherlands. On the other hand, it was

not recorded whether or not patients had had dietary advice through other channels (e.g. their doctors) or whether they were not referred for dietary advice, for example because there were in the terminal stage of illness.
This screening shows the importance of consensus on criteria of malnutrition. Although both weight loss and BMI are well known parameters of nutritional status, for this national survey weight loss seemed to be a better indicator of disease related malnutrition, given the loss of appetite and episodes of fasting often accompanying disease. In English-speaking countries nutrition assessment screening instruments such as the Subjective Global Assessment (screening of hospital patients) and the Mini Nutritional Assessment (screening of elderly) are in use to define patients' individual nutritional status (12-14). These assessment tools, however, have not been developed for the screening of large groups of patients and are not convenient for daily routine use (i.e. they are time consuming and need a lot of experience). This national Dutch screening indicated that disease related malnutrition is indeed a severe problem, and that a quick and easy assessment tool to detect malnutrition may be useful in determining patients at risk. For Dutch speaking countries, no such tool is available yet.

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CHAPTER

3

Development and validation of a hospital screening tool for malnutrition: The Short Nutritional Assessment Questionnaire (SNAQ)

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Abstract

Objective

For the early detection and treatment of malnourished hospital patients no valid screening instrument for the Dutch language exists. Calculation of percentage weight loss and BMI by the nurse at admission to the hospital appeared to be not feasible. Therefore the SNAQ (Short Nutritional Assessment Questionnaire) was developed.

Research, design and methods

291 patients on the mixed internal and surgery / oncology wards of the VU University medical center were screened on nutritional status and classified as well nourished (< 5% weight loss in the last six months and BMI>18,5), moderately malnourished (5-10% weight loss in the last six months and BMI>18,5) or severely malnourished (>10% weight loss in the last six months or >5% in the last month or BMI<18,5).

All patients were asked 26 questions related to eating and drinking difficulties, defecation, condition and pain. Odds ratio, binary and multinomial logistic regression were used to determine the set of questions that best predicts the nutritional status. Based on the regression coefficient a score was composed to detect moderately (≥ 2 points) and severely (≥ 3 points) malnourished patients.

The validity, the nurse – nurse reproducibility and nurse - dietician reproducibility was tested in another but similar population of 297 patients.

Results

The questions 'Did you lose weight unintentionally?'; 'Did you experience a decreased appetite over the last month?' and 'Did you use supplemental drinks or tube feeding over the last month?' were most predictive of malnutrition. The instrument proved to be valid and reproducible.

Conclusion

SNAQ is an easy, short, valid and reproducible questionnaire for early detection of hospital malnutrition.

Introduction

Malnutrition is a state of nutrition in which a deficiency or excess or imbalance of energy, protein and other nutrients, causes measurable adverse effects on tissue or body form (body shape, size and composition), function, and clinical outcome. [1] This broad definition implies that malnutrition may arise from a wide range of conditions that differ in severity and cause. In Western countries, undernutrition is considered to be only a minor problem compared with that of overweight.
In hospital settings however, there is growing awareness that undernutrition may play an important role in the course of the treatment of patients. The body mass index (BMI) (weight/length^2) can be used to provide an approximate guide to the probability of chronic undernutrition. One of the most commonly used cut-off values to define this kind of malnutrition is a BMI<18,5 [1-4]. This index does, however, usually not give information about the unintentional recent weight change that is often accompanying underlying disease. Several clinical studies have demonstrated that recent involuntary weight loss >10% in 6 months is a good indicator of more acute undernutrition [1;5-8].

In 2001, the Dutch Dietetic Association conducted a national screening on disease related malnutrition in 6150 hospital patients at 56 different locations. Based on the generally acceptable definitions of malnutrition, disease related malnutrition was defined as >10% involuntary weight loss [1;5-7;9] or BMI <18,5 [1-3]. In this study, about 25% of the hospital patients appeared to be malnourished. Only 50% of the malnourished patients were recognised by the nursing and medical staff [10].

In an ideal situation the physician or the nurse calculates the BMI and the percentage of involuntary weight loss over the last months at the first day of patients' admission to the hospital. With this information the physician and/or the nurse can decide which patients are malnourished and should be referred to a dietician. In practice nurses or physicians do not have time to calculate indices of nutritional status. Thus, hospital malnutrition often remains unidentified. Therefore, our team developed a short questionnaire that can be integrated in the nurses' intake of the patient at admission to the hospital and costs less than 5 minutes time. This questionnaire divides hospital patients into three groups: well nourished, moderately malnourished and severely malnourished. Using this questionnaire, malnourished patients are recognised at admission and referred to dietician in an early stage.
This article describes the process of the development of the so called Short Nutritional Assessment Questionnaire (SNAQ). In addition, it reports the results of the diagnostic value and reproducibility of the SNAQ.

Research design and methods

The development of the SNAQ is based on the results of nutritional status data and characteristics of 291 patients (population A). The validity of the SNAQ is tested in a similar population (population B) (cross validation). The reproducibility of the SNAQ is also tested in population B.

Questionnaire development study (population A)

Subjects

291 patients, admitted to a mixed internal ward (internal medicine, gastroenterology, dermatology, nephrology) and a mixed surgical ward (general surgery and surgical oncology) of the VU university medical center in the period of April until October 2002, were included in the study. Patients who were not able to give informed consent, could not be weighed or were younger than 18 years of age were excluded from the study. The medical ethical commission of the VU University medical center approved the study-design.

Nutritional status

On the day of the admission to the hospital, all patients were weighed on the same calibrated scale (SECA 880) and their height was asked for. When patients did not know their height, it was measured (SECA 220). Patients were asked whether they had lost weight unintentionally over the last month and the last 6 months. Patients were considered severely malnourished if one or more of the following conditions were present: a BMI <18,5 (1-4), unintentional weight loss of more than 5% in the last month or more than 10% in the last 6 months. Patients were considered moderately malnourished when they had lost 5-10% of their weight unintentionally in the last 6 months [1;5-8]. Based on the most commonly accepted standards from the literature, this definition of nutritional status was used as the "objective standard of malnutrition" against which the questions from the questionnaire were validated.

Questionnaire

On the day of admission to the hospital, all patients completed a detailed questionnaire on symptoms and risk factors of malnutrition. The questionnaire consisted of twenty-six nutrition-related questions *(table 2)* adopted from the quality of life questionnaires EORTC-C30 and EORTC H&N 35 [11], and from complex screening instruments which are too complex and time-consuming for the daily hospital situation (Nutricia Nutritional Screening List, Mini Nutritional Assessment [12], Subjective Global Assessment [13]). The questionnaire was completed with questions of experts (dieticians, nutritionists) who also unanimously approved the questionnaire.

Analysis

To select symptoms and risk factors that could be used to identify subjects with malnutrition, selection of questions predictive of malnutrition was performed in three phases to finally make up a short and simple questionnaire, the SNAQ.

First, the odds ratio was calculated for each question of the questionnaire with the presence or absence of malnutrition as dependent variable. All questions with a statistically significant odds ratio ($p<0.05$) were included in the next phase.

Second, logistic regression was carried out with the presence or absence of malnutrition as dependent variable and with questions with a significant odds ratio as independent variables. The questions

associated with malnutrition at a significance level of $p<0.05$ in a backward stepwise procedure were selected for the next phase of the analysis.
Third, multinomial logistic regression was carried out with severe malnutrition, moderate malnutrition and no malnutrition as the dependent variable and the questions from phase two as the independent variables using $p<0.05$ as selection criterion. This model contained all the finally selected items together. The probability of a patient being malnourished can be predicted by the following regression equation, in which the categorization is based on a continuous function of P between 0 and 1:
$P(\text{malnourished}) = [1 + e^{-(a+b_1x_1+ b_2x_2 + b_3x_3 + b_xx_x)}]^{-1}$ where P(malnourished) represents the probability of being malnourished, a is the constant and b_1, b_2, b_3 and bx represent the regression coefficients of the questions x_1, x_2, x_3 and x_x.
To make the new questionnaire to a screening tool which is practical, the regression coefficients associated with the questions were transformed into a simple score that can be added up to obtain an aggregate score (in this case: the coefficients of the model are multiplied by 4/7 and rounded to the nearest integer, resulting in a score, ranging from 0 to 7 (*table 3*). The cut-off points for the scores belonging to 'moderately malnourished' and 'severely malnourished' were determined by reading the optimal cut-off point in the ROC-curve. All analyses were performed with the SPSS software package, version 9.0.

Questionnaire validation study (population B)

For the validation study a new group of 297 patients, admitted to the same wards of the VU university medical center in the period of February until June 2003, was included. Patients who were not able to give informed consent, could not be weighed or were younger than 18 years of age were excluded from the study. Upon admission to the hospital the nurse filled out the newly developed screening tool, the SNAQ, for every patient. Patients who were classified as moderately or severely malnourished following the SNAQ-score (≥ 2 points) received energy- and protein-enriched meals and twice a day a nutritious snack. Patients who were classified as severely malnourished (≥ 3 points) received, besides the energy- and protein-enriched meals and snacks, treatment by a dietician (who was not involved in the study). The dietician scored the referrals based on the SNAQ-score as 'very necessary', 'moderately necessary' or 'not necessary'. The measurements and the definition of the nutritional status were identical to the procedure of the first phase of the study.

The validity of the SNAQ in population B is expressed in the sensitivity, specificity and the negative and positive predictive value. To measure the cross-validity of the SNAQ a receiver-operator characteristic (ROC) curve was constructed to present the relationship of the SNAQ-score with the definition of malnutrition. ROC curves characterise that relationship between the true positive rate (sensitivity) and the false positive rate (1-specificity). The specificity of a test is the probability (0-100%) that the SNAQ score is <2 points for well nourished patients. The sensitivity is the probability (0-100%) that the SNAQ score is ≥2 points for moderately malnourished patients and ≥3 points for severely malnourished patients. The area under the curve (AUC) quantifies the validity of the SNAQ: the greater the area under the curve, the better the performance of the SNAQ. It varies between 0.5, when the SNAQ is no better than the chance in correctly categorising the two groups, and 1.0, when its sensitivity and specificity are perfect.

To measure the inter observer agreement of the SNAQ, it was filled out for 47 patient by two nurses and for another 47 patients by a nurse and a dietician. The inter observer agreement was tested with the kappa (κ) and the 95% confidence interval ($\kappa \pm 1{,}96$ SE). [14]

Results

Questionnaire development study (population A)

Subjects

Of the 291 patients that participated in this study, 76 patients (26%) were severely malnourished and 17 patients (6%) were moderately malnourished, according to the previously described definition of malnutrition. The characteristics of population A and B, including parameters of nutritional status are presented in *table 1*.

Table 1 Characteristics of the well nourished and the moderately / severely malnourished patients of population A and B

	Population A			Population B		
	Moderately /severely malnourished	Well nourished	Whole group	Moderately /severely malnourished	Well nourished	Whole group
N (%)	93 (32%)	198 (68%)	291	98 (33%)	199 (67%)	297
Internal ward / surgical and oncological ward (N) (% internal)	62 / 31 (67%)	99 / 99 (50%)	161 / 130 (55%)	63 / 35 (64%)	79 / 120 (40%)	144 / 155 (49%)
Sex (men / women) (% men)	38 / 55 (41%)	80 / 118 (40%)	118 / 173 (41%)	36 / 62 (37%)	81 / 118 (41%)	117 / 180 (39%)
Age (years)	56.6 ± 18.0	62.2 ± 18.3	58.4 ± 18.3	62.2 ± 19.0	60.0 ± 16.5	60.6 ± 17.3
BMI (kg/m2)	22.1 ± 4.7	26.3 ± 5.1	25.0 ± 5.4	22.4 ± 5.0	25.8 ± 4.1	24.7 ± 4.6

Selection of the questions for the SNAQ

The selection of the SNAQ-questions is described in *table 2*. In the first phase of the selection 17 questions showed statistically significant odds ratios. From these, 7 remained in the binary logistic regression analyses of the second phase. The third and last phase of multinomial logistic regression, based on a significant Wald-test, resulted in the final selection of the four questions for the SNAQ *(table 3)*. These were "Did you lose weight unintentionally? More than 6 kg in the last 6 months (3 points) or more than 3 kg in the last month" (2 points), "Did you experience a decreased appetite over the last month?" (1 point), and "Did you use supplemental drinks or tube feeding over the last month?" (1 point).
Patients with < 2 points were classified as well nourished. Patients with 2 points were classified as moderately malnourished and patients with ≥ 3 points were classified as severely malnourished.

Table 2 selection of the SNAQ-questions

Over the last month:		OR phase 1 (95% CI)	phase 2 (p-value)	phase 3 (p-value)
1.	Did you experience difficulty while eating?	4,50 (2,50-8,07)	0,05	
2.	Did you eat less than normal?	7,36 (3,85-14,07)	0,33	
3.	Did you experience a decreased appetite?	5,12 (2,86-9,17)	0,02	0,005
4.	Did the food taste differently?	1,17 (0,61-2,22)		
5.	Did you experience nausea?	2,48 (1,44-4,28)	0,38	
6.	Did you vomit?	1,96 (1,07-3,56)	0,85	
7.	Did you experience pain while eating?	2,42 (1,27-4,62)	0,92	
8.	Did you need help with eating and drinking?	4,60 (1,96-10,77)	0,81	
9.	Did you skip a meal occasionally?	2,45 (1,41-4,27)	0,99	
10.	Did you often eat alone?	1,48 (0,86-2,54)		
11.	Do you have false teeth?	2,13 (1,23-3,68)	0,56	
12.	Did you experience difficulty chewing?	3,47 (1,67-7,18)	0,14	
13.	Did you experience difficulty swallowing?	2,36 (1,25-4,43)	0,15	
14.	Did you have diarrhea?	1,93 (1,12-3,33)	0,34	
15.	Did you have constipation?	1,74 (1,00-3,05)		
16.	Did you have loss of blood?	1,36 (0,67-2,75)		
17.	Did you experience burping?	1,18 (0,67-2,09)		
18.	Do you suffer from a food allergy or are you food intolerant?	0,44 (0,12-1,54)		
19.	Did you have to eat an adjusted diet?	1,18 (0,56-2,47)		
20.	Did you use supplemental drinks or tube feeding?	5,38 (2,62-11,07)	0,03	0,01
21.	Did you experience feelings of fatigue or weakness?	4,60 (2,00-10,60)	0,04	
22.	How often have you been admitted to a hospital during the last year?	0,98 (0,57-1,68)		
23.	Did you lose weight unintentionally?	24,73 (10,67-57,33)	<0,001	
24.	More than 3 kg in the last month?	379 (50 – 2859)	<0,001	<0,001
25.	More than 6 kg in the last 6 months?	43 (19-97)	<0,001	<0,001
26.	Do you have an oncological disease	0,13 (0,88 – 2,79)		

Table 3 Final selection of the questions for the SNAQ

	Regression coefficient	Regression coefficient x 4/7	Score*	OR (95% CI)
Constant	-4.07			
Did you lose weight unintentionally? More than 6 kg in the last 6 months More than 3 kg in the last month	 5.59 3.63	 3.19 2.07	 3 2	267.0 (30.0-2376.2) 37.7 (12.5-113.6)
Did you experience a decreased appetite over the last month?	1.42	0.81	1	4.2 (1.5-11.4)
Did you use supplemental drinks or tube feeding over the last month?	1.47	0.84	1	4.3 (1.4-13.9)

** To get round numbers for the SNAQ-scores, the B-coeficients of the logistic regression analyses are multiplied with 4/7 and rounded of to the nearest integer.*

Questionnaire validation study (population B)

Following the objective criteria of malnutrition (reference standard) in population B (n=297) 78 patients (26%) were severely malnourished and 19 patients (6%) were moderately malnourished Demographic data were similar in population A and B *(table 1)*.

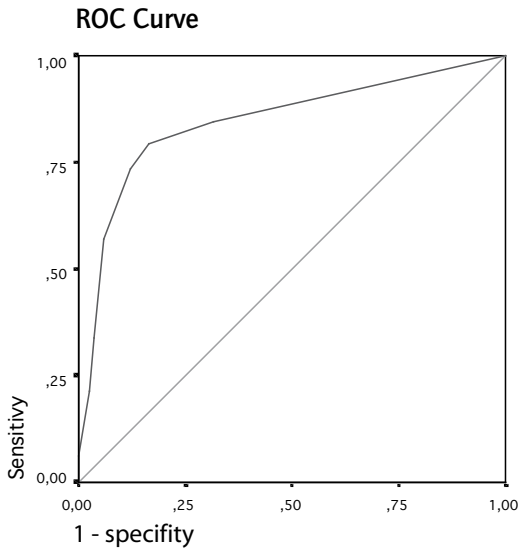
Validity and cross-validity of the SNAQ

The validity and the cross-validity of the SNAQ are shown in *table 4* for the two cut-off points. In population B, both sensitivity and specificity proved to be more than 75% for both cut-off points.
The ROC-curve (figure 1a) of the moderately and severely malnourished patients (cut-off point ≥2) shows an area under the curve of 0.85 (95% CI 0.79-0.90; p<0.0001). The area under the curve for the severely malnourished patients (cut-off point ≥3) (figure 1b) was similar (AUC= 0.85; 95% CI 0.79-0.90; p<0.0001).

Table 4 Validity of the SNAQ in population A and the cross-validity of the SNAQ in population B

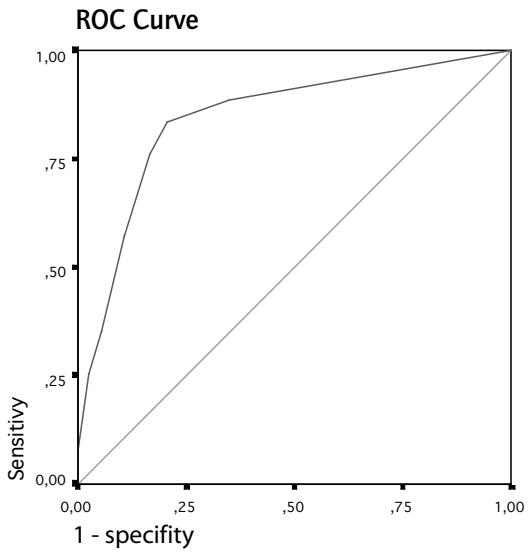
	≥ 2 points (moderately and severely malnourished patients)		≥ 3 points (severely malnourished patients)	
	Population A	Population B	Population A	Population B
Sensitivity	86%	79%	88%	76%
Specificity	89%	83%	91%	83%
Positive predictive value	79%	70%	78%	62%
Negative predictive value	93%	89%	96%	91%

Figure 1a ROC curve of the SNAQ score in the moderately and severely malnourished patients against the objective standard of malnutrition for population B



Area under the curve = 0.85 (95% CI 0.79-0.90)

Figure 1b ROC curve of the SNAQ score in the severely malnourished patients against the objective standard of malnutrition for population B



Area under the curve = 0.85 (95% CI 0.79-0.90)

Dietary intervention based on the SNAQ-score

111 Patients had a SNAQ-score ≥ 2 points. They received enriched meals and two nutritious snacks per day, by which their daily intake during the hospital stay was increased with approximately 600 kcal and 10-12 grams of protein. 95 Patients had a SNAQ-score ≥ 3 points and were sent to an independent dietician for further consultation. 6 of these patients did not receive additional dietary advice because they were too ill or had gone home before the dietician was able to see the patient. 89 Patients were treated by a dietician based on the SNAQ-score. In 89% of the cases (79 patients) the dietician scored the consultation as very necessary, in 7% (6 patients) as moderately necessary and in 4% (4 patients) as not necessary. All patients scored by the dietician as 'not necessary' were indeed well nourished following the objective criteria.

Reproducibility of the SNAQ

The kappa (κ) of the SNAQ-score, an indicator for the nurse-nurse reproducibility in 47 patients, was 0.69 (95% CI: 0.45-0.94). The κ of the SNAQ-score in 47 patients by a nurse and a dietician was 0.91 (95% CI:0.80 – 1.03). From the 47 patients in whom the nurse-nurse reproducibility was tested, 7 patients (15%) were classified in different categories. In the group of patients in whom the nurse-dietician reproducibility was tested, 3 patients (6%) were classified differently.

Discussion

In August 2003, Kondrup et al. published the ESPEN guidelines for nutritional screening.[15] One of their conclusions was that existing screening tools are published with insufficient details regarding their intended use and method of derivation, validation, and with an inadequate assessment of their effectiveness. The development of SNAQ does correspond to these requirements. The derivation and validation have been described in this article, its effectiveness (clinical outcome) will be reported on in a separate article.

The questions with regard to involuntary weight loss, loss of appetite and recent use of supplemental drinks or tube feeding appeared to be the best indicators for malnutrition. These items can be easily scored by the nurse at admission of the patient to the hospital. Based on the impact of the three items on the nutritional status, reflected by the value of the regression coefficient, a score was assigned to each item. Based on this score the treatment plan was developed.

By using two populations, population A for the development of the SNAQ and population B for the cross-validation of the SNAQ we have provided insight into the performance of the questionnaire in clinical practice. Both population A and B contained approximately the same number of severely and moderately malnourished patients. The patients were recruited on the same medical wards, but recruited in different seasons. Nevertheless, both populations were very comparable.

The validity and cross-validity of the SNAQ were good. Of course, the validity of the SNAQ in population A was more impressive than the cross-validity in population B because the logistic regression model was built on population A. However the results of the cross validation in population B are more meaningful, as they reflect the value of the SNAQ in clinical practice. The area under the curve in population B for both cut-off points is 0.85. The positive predictive value of the severely malnourished patients (≥ 3 points) was 62%. This indicates that 38% patients, who were referred to the dietician based on the SNAQ-score, were not severely malnourished, which adds to the workload of the dietician. On the other hand, the dieticians scored 89% of the referrals based on the SNAQ-score as very necessary. Besides on BMI and weight loss, the dietitian valuates (subjectively) whether the patient is at risk of becoming malnourished.

The sensitivity was 76% in the severely malnourished patients. 6 Of the patients 19 who were "missed" still scored 2 points and did receive the enriched meals and the snacks and the extra attention of the nutritional assistant on the ward. They lacked the consultation by the dietitian.
Although the sensitivity and the positive predictive value were not as high in population B as in population A, these results are an improvement to the current clinical situation in which only half of the malnourished patients is being recognized, mostly not at admission to the hospital but in a later stage of hospitalization.
The reproducibility of the SNAQ was also good. Training of the nursing staff on the impact of malnutrition in hospital patients and the need of nutritional screening could result in even better nurse-nurse reproducibility.

The SNAQ was validated in a population of mixed internal, surgical and oncological patients. This group of patients is a good reflection of the nutritionally relevant population of a general hospital. The

results of this study are applicable to most wards in Dutch hospitals. The SNAQ has not been validated for an outpatient population. This will be subject of further study.

For a more complete insight in the nutritional status of the study population, body composition was measured at admission to the hospital with bioelectrical impedance analyses and upper arm muscle circumference. The hand grip strength was measured with handgripdynamometry. Because these measurements do not contribute to the definition of malnutrition that was used to validate the SNAQ, the results of these measurements are not reported in this article.

The true validity of a screening tool can only be discussed when its impact on clinical outcome has been proven. To do so, length of hospital stay, care complexity, weight change during hospital stay and costs during hospital stay were recorded to determine whether the use of the SNAQ and its treatment plan were cost-effective. Preliminary results are promising; we do expect improvement in clinical outcome parameters. However, we have chosen to publish these results in a later stage.

The SNAQ and other short screening instruments

Other short screening instruments for hospital setting are the NRS-2002,[16] the MUST,[17] the MST [18] and the NNSF.[19] All instruments are valid and suitable for the screening of hospital patients on malnutrition. Our goals in developing the SNAQ (costs less than 5 minutes of the nurses time, needs no calculating, includes a treatment plan based on the screening score) are only met by the MST.
The NNSF is too time-consuming and complicated, the MUST needs calculating of the BMI and the percentage of recent weight loss and the NRS-2002 needs calculating of the BMI. Both the MST and the SNAQ are suitable for screening of hospital patients at admission to the hospital. In both cases patients at risk are being referred to a dietitian for further assessment. Besides, the SNAQ also provides with a treatment plan (standard enrichment of meals and extra in-between meals, both for moderately and severely malnourished patients).
The impact of the SNAQ and its linked treatment plan with respect to clinical outcome is currently under study. The value of the SNAQ in comparison with other screening and treatment instruments can only be determined after publication of these results.

Conclusion

The SNAQ proves to be a valid and reproducible instrument to detect and treat malnourished hospital patients in an early stage of hospitalisation without the need to calculate percentage weight loss or BMI. The SNAQ and its linked treatment plan is, therefore, a very practical instrument that can easily be used in all Dutch hospitals and on all medical wards with adult patients, even if nurses are not focussed on inquiring specific details of nutritional status.

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CHAPTER

4

Effectiveness and cost-effectiveness of early screening and treatment of malnourished patients

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Abstract

Objective

This paper reports on the (cost) effectiveness of the early recognition and treatment of malnourished hospital patients using the Short Nutritional Assessment Questionnaire (SNAQ).

Patients and outcome measures

The intervention group consisted of a group of 297 patients on two mixed medical - surgical wards, receiving screening on malnutrition at admission and standardized nutritional care. The control group (comparable group of 291 patients) received usual clinical care. Outcome measures were weight change, use of supplemental drinks, tube feeding, parenteral nutrition and in-between meals, number of consultations by the dietician and length of hospital stay.

Results

The recognition of malnutrition improved from 50% to 80%. The standardized nutritional care protocol added approximately 600 kcal and 12 grams of protein to the daily intake of the malnourished. Early screening and treatment of malnourished patients reduced the length of hospital stay in malnourished patients with low handgrip strength (frail patients). To shorten the mean length of hospital stay with one day in the total malnourished group, a mean investment of EUR 76 (63 USD) in nutritional screening and treatment was needed. In the total group and in the sub-group of malnourished patients with low handgrip strength the incremental costs were comparably low.

Conclusion

Application of the SNAQ screening and early, standardized nutritional care improves the recognition of malnourished patients and gives the opportunity to start treatment at an early stage of hospitalization. The additional costs of early nutritional care were low, especially in a sub-group of frail malnourished patients.

Introduction

Disease related malnutrition is a major health care problem resulting in a reduced ability to prevent, fight and recover from disease. Malnutrition is associated with postoperative complications, increased length of hospital stay and even death.[1-3] It is clear that the adverse impact of disease-related malnutrition on patient outcome and recovery results in increased healthcare utilization and associated costs. Prospective studies on the amount of money that could be saved if appropriate screening and nutritional support are provided are lacking.

In 2001, the Dutch Dietetic Association conducted a national screening on disease related malnutrition in 6150 hospital patients at 56 different locations. Approximately 25% of the hospital patients appeared to be malnourished. Only 47% of the malnourished patients were identified by the nursing and medical staff.[4] To increase early recognition and awareness of malnutrition, we developed a screening tool, the SNAQ: Short Nutritional Assessment Questionnaire (*figure 1*). This screening tool takes less than five minutes and can easily be integrated in the nurses' intake of the patient at admission to the hospital. The SNAQ has been proven to be valid and reliable.[5]

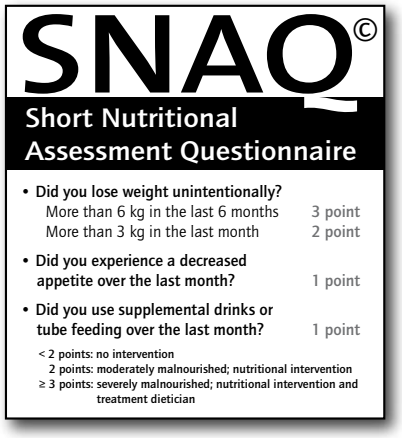

figure 1

The present paper reports on the analyses of the effectiveness and cost effectiveness of the early recognition and treatment of malnourished hospital patients using the SNAQ compared with usual nutritional care without the SNAQ with respect to length of hospital stay, weight change, use of nutritional supplements and quality of nutritional care.

Methods

Study design

A controlled trial with a historical control group was performed. Randomization of the intervention was not feasible because the availability of a screening instrument would influence the nutritional attitude of the nursing staff. This would have resulted in more attention to the recognition and early treatment of malnutrition in the control group.

In the intervention group the nurse filled out the SNAQ upon admission to the hospital for every

patient. Patients who were classified as moderately malnourished following the SNAQ-score (≥ 2 points) received energy- and protein-enriched meals and two in-between meals per day, accounting for an additional 600 kcal and 12 grams of protein per day. Patients who were classified as severely malnourished (≥ 3 points) received, in addition, treatment by a dietician. Patients of the control group received usual nutritional care. They were not routinely screened in a standardized on nutritional status at admission to the hospital and referral to a dietician occurred only by indication.

Patients

The intervention group consisted of a group of 297 patients, admitted to a mixed internal ward (general internal medicine, gastroenterology, dermatology, rheumatology, nephrology) and a mixed surgical ward (general surgery and surgical oncology) of the VU university medical center in the period of February to June 2003. The control group consisted of a group of 291 comparable patients, admitted to the same wards in the period of April to October 2002. Patients who were not able to give informed consent, could not be weighed or were younger than 18 years of age were excluded from the study. The study-design was in accordance to the Declaration of Helsinki and approved by the institutional review board of the VU university medical center.

Outcome measures

Outcome measures were weight change during hospital stay, use of supplemental drinks, tube feeding, parenteral nutrition and in-between meals, number of consultations by the dietician and length of hospital stay. Patients who died during the hospital stay were not included in the analyses (table 1). Use of tube feeding, parenteral feeding and supplemental drinks were recorded out of the medical chart by the researcher in both the intervention and the control group. In the intervention group the number of consumed in-between meals was recorded by the nutritional assistant who handed out the in-between meals (in-between meals were not routinely provided in the control group). In both control and intervention groups the number of consultations per patient and the total number of dietetic consultations was recorded out of the dietetic chart and the consult registration files by the researcher. Also, the number of days of hospitalization before consultation with a dietician was recorded.

Nutritional Status

Patients were characterized as severely malnourished when one or more of the following conditions were present: a BMI <18.5, unintentional weight loss of more than 5% in the last month or more than 10% in the last 6 months and as moderately malnourished with 5-10% unintentional weight loss in the last 6 months.[6-11] All analyses were performed by comparing the (severely and moderately) malnourished patients with the well-nourished patients.

On the day of admission to the hospital, a trained researcher weighed all patients on the same calibrated scale (SECA 880) and asked patients for their height. When patients did not know their height, it was measured (SECA 220). Patients were asked whether they had lost weight unintentionally over the last month and the last 6 months. The handgrip strength was measured in the non-dominant hand as the better of two readings on a mechanical dynamometer (Baseline, Smith & Nephew, USA). The measurement was performed as recommended by the American Society of Hand Therapists[12] and the standards of Mathiowetz et al. were used.[13] Care complexity was objectified by INTERMED scores. INTERMED is an observer-rated instrument to assess care complexity. It has been validated in several medical inpatient populations.[14;15] Information from four domains (biological, psychological, social and health care) is integrated and assessed in the context of time (history, current state and prognosis).

Of each of the four domains, five variables are rated 0 to 3 according to a manual with clinical anchor points, resulting in a potential range of 0 to 60. Scoring is based on a patient interview and a review of the medical chart. A cut off-score of more than 20 points was found to be optimal in detecting patients at risk of longer length of hospital stay and poor quality of life at discharge.[16]

Statistics

Since the patients were not randomized, the results may be subject to bias. Propensity scores were used to reduce this bias.[17] These scores are the predicted probability of receiving the treatment (being part of the treatment group). Predictors were age, sex, INTERMED-score and medical specialism. Since the length of hospital stay was skewed to the right, natural logarithmic transformation was applied to distribute the data more symmetrically.
All analyses were carried out in the total group with nutritional status (malnourished and well nourished) and treatment (intervention and control) as factors. When effect modification occurred, analyses were carried out for subgroups. The effectiveness of the screening and the use of the treatment plan were assessed through linear regression analyses with natural logarithm of the length of hospital stay (ln-LOS) as dependent variable and age, care complexity (INTERMED) and group as independent variables. The change of weight during hospital stay was analyzed through analysis of covariance with weight and BMI (first and last day of the hospital stay) as dependent variables with intervention/control group as factor. Co-variables were sex, length of hospital stay and handgrip strength.
Differences in use of supplemental drinks, tube feeding, parenteral nutrition and in-between meals and the number of consultations by the dietician in the intervention and the control group were tested with the chi-square test and the t-test. Numbers are reported as mean and standard deviation (SD) or standard error (SE).

Economic evaluation

The economic evaluation was performed from a societal perspective. All relevant direct costs were prospectively recorded by the researcher, such as costs of SNAQ screening and dietetic treatment and hospitalization. In effectiveness part of the cost effectiveness analyses, length of hospital stay was outcome measure.
Because the costs were skewed to the right, bootstrapping was used for pair-wise comparison of the mean differences in costs between the intervention group and the control group and to calculate the cost effectiveness ratio. Confidence intervals were obtained by bias corrected and accelerated (BCa) bootstrapping, choosing 2000 as the number of replications. An incremental cost effectiveness ratio was calculated by dividing the difference between the mean costs in the intervention and control group by the difference in the mean length of hospital stay (Ln-transformated) in both groups. This ratio expresses the incremental costs per day of hospitalization reduced. The cost-effectiveness ratio was also calculated for the subgroup of malnourished patients. Bootstrapped cost effectiveness ratios were plotted on a cost effectiveness plane.[18] Because of the skewness of the data on length of hospital stay, a sensitivity analyses was performed in the total malnourished group in which the patients with a length of hospital stay >40 days were excluded. Costs are defined in Euros(EUR) and the cost effectiveness ratios in Euros and US Dollars (USD) (rate 1 EUR = 1,21 USD).

Results

In both intervention and control group 26% of the patients were severely and six percent moderately malnourished. The baseline characteristics of the intervention group and the control group are presented in *table 1*. Groups were not different regarding age, sex, BMI, handgrip strength and INTERMED score, also when classified by nutritional status.

Table 1 The characteristics of the intervention group and the control group

	Intervention group		Control group	
	Well nourished (mean (SE))	Malnourished (mean (SE))	Well nourished (mean (SE))	Malnourished (mean (SE))
N	199	98	198	93
Age (years)	60.0 (1.16)	62.0 (1.91)	56.6 (1.28)	62.2 (1.90)
Sex (M/F)	41% / 59%	37% / 63%	40% / 60%	41% / 59%
BMI (kg/m2)	25.8 (0.29)	22.4 (0.49)	26.3 (0.36)	22.1 (0.49)
Hand grip strength (kg)	29.8 (1.03)	23.7 (1.23)	32.5 (1.09)	28.5 (1.83)
INTERMED score (0-60)	11.0 (0.46)	15.7 (0.87)	13.0 (0.48)	17.9 (0.91)
Mortality	6 (3%)	7 (7%)	4 (2%)	4 (4%)
Specialism				
• Oncological surgery	45%	22%	34%	22%
• Gastrointestinal surgery	17%	15%	14%	14%
• General Internal Medicine	19%	35%	24%	32%
• Gastroenterology	6%	17%	12%	17%
• Rheumatology	7%	5%	9%	8%
• Dermatology	3%	4%	4%	7%
• Nephrology	3%	2%	3%	0%

Characteristics of respectively the malnourished patients and the well nourished patients were not different in the intervention and the control group.

Consultation of dietician and nutritional care

In the malnourished patients of the intervention group referral to a dietician was statistically significantly higher and the use of supplemental drinks was statistically significantly lower. In the intervention group, 76% of the malnourished patients were referred to a dietician on the basis of the SNAQ score. In the control group, the nurse or the physician referred 46% of the malnourished patients to the dietician. The use of supplemental drinks was 28% in the malnourished intervention group vs. 37% in the malnourished control group. The use of tube feeding and parenteral feeding was not statistically significantly different in the intervention and the control group. In the intervention group 79% of the malnourished patients received extra nutritional care (two in-between meals and enriched breakfast, lunch and dinner). In malnourished patients there were no differences in the mean number of consultations from the dietician in the intervention group (mean 2.1; SD 2.6) and in the control group (mean 2.0; SD 3.6). The mean number of hospital days before the first consultation of a dietician was lower in the intervention group (mean 2.6; SD 2.1) than in the control group (mean 5.8; SD 6.7) ($p<0.001$).

Length of hospital stay

In the well-nourished group the length of hospital stay was on average 9.6 (SD 7.6) in the intervention group and 10.0 days (SD 10.0) in the control group. In the malnourished group, the uncorrected mean length of hospital stay in the intervention group was 11.5 days (SD 8.0) and in the control group 14.1 days (SD 13.3). In the total group no effect of the nutritional intervention on the length of hospital stay was found (p=0.13).

Handgrip strength appeared to be an effect modifier for length of hospital stay in the malnourished group (interaction intervention group x handgrip strength (lower than standard); p=0.012). Analyses of effect of screening and nutritional intervention on the length of hospital stay were, therefore, stratified for handgrip strength (lower or higher than the standard). No other interactions were present. Malnourished patients with low handgrip strength in the intervention group (n=59) had a shorter length of hospital stay than the malnourished patients with low handgrip strength in the control group (n=35). None of the variables from table 1 was confounder for this effect. Since age and INTERMED score had a significant effect on the length of hospital stay in the malnourished group as a whole, these parameters were added to the regression model. With the INTERMED score the model is corrected for care complexity. Table 2 gives the results of the linear regression analyses of the ln-transformed length of hospital stay.

Table 2 Linear regression analyses of ln-LOS in malnourished patients with low hand grip strength (n= 94) (R2 = 15%)

	Coefficient	Significance (p-value)
constant	2.025	<0.001
Age (years)	0.00417	0.2
INTERMED score (0-60)	0.01633	0.08
Control group / intervention group (0/1)	-0.311	0.03

ln-LOS = 2.025 + 0.00417 x age + 0.01633 x INTERMED score − 0.311 x intervention group
Taking the outcome of the whole regression equation as the exponent (x) in the formula y=ex (back transformation), the difference in length of stay in the intervention group and the control group become interpretable.

Application of this regression equation with back-transformation showed that a malnourished patient with low handgrip strength in the control group of 62 years of age (mean age in the malnourished group) with an INTERMED score of 17 (mean INTERMED score in the malnourished group) would have a length of stay of 13 days. The same patient in the intervention group would stay 9.5 days in hospital (p=0.02). Analyses without the high values (83 and 73 days) in the control group showed similar results.

Weight change during hospital stay

Weight change during hospital stay was not statistically significantly different in the intervention and control group (p=0.6). The mean weight change in the intervention group was −0.1% (SD 7.9%) against −0.3% (SD 5.9%) in the control group. Forty-three percent of the malnourished patients in the intervention group compared with 45% the control group gained weight during their hospital stay.

Cost effectiveness analysis

The costs of the SNAQ screening and treatment are described in table 3. The costs of SNAQ screening by the nurse at admission to the hospital were EUR 2 per patient. The costs of the SNAQ treatment consisted of the in-between meals, the distribution of the in-between meals in a cooled cart (the SNAQ-cart), personnel costs of the nutritional assistants (2 hours per round, 4 hours per day) and dietician (first consultation EUR 73.53 and following consultations EUR 49). The cost effectiveness of the SNAQ screening was analyzed for all patients that were screened at admission to the hospital. In addition, a subgroup analysis was conducted for the malnourished patients only, because in the intervention group these patients received nutritional treatment.

Table 3 Mean costs in all patients and in the malnourished patients

All patients (n = 588)	Intervention group	Control group
Number of in-between meals (mean) at 51 Eurocent (mean ±SD)	887 (9.9)	0
SNAQ-cart (€)	2083	0
Extra costs of nutritional assistant (€)	4800	0
Dietician (mean number of consultations and mean costs (€)) (mean ± SD)	1.1 ± 2.0 (60.3 ± 103.4)	1.0 ± 2.4 (56 ± 123)
Length of hospital stay (days) (mean ± SD)	10.4 ± 8.4	12.0 ± 13.5
Malnourished patients (n = 191)		
Dietician (mean consultations and mean costs (€)) (mean ±SD)	2.1 ± 2.6 (120 ± 134)	2.0 ± 3.6 (109 ± 184)
Length of hospital stay (days) (mean ± SD)	11.5 ± 8.0	14.0 ± 13.3

Table 4 Endpoints in the cost-effectiveness analyses (mean ± SD) in the subgroup of malnourished patients in the control group (n= 291) and the intervention group (n= 297)

	Intervention group	Control group
Costs		
In-between meals (€)	18.4 ± 12.9	0
Nutritional assistent(€)	54 ± 51	0
Dietician (€)	118.2 ± 136.3	104.7 ± 174.7
Effects		
Length of stay (days)	11.5 ± 8.0	14.0 ± 13.3
Weight change (%)	-0.1 ± 7.9	-0.3 ± 5.9
>3% increase of weight during hospitalisation (%)	18%	16%

Table 4 gives an overview of the costs and effects included in the cost-effectiveness analysis. For each patient the total amount of consumed in-between meals was recorded and multiplied by the costs.

These were calculated by dividing the costs of the SNAQ-cart by the amount of in-between meals and adding this number to the costs of one in-between meal.
Table 5 and *figure 2* report on the results of the cost-effectiveness analyses of the SNAQ screening on malnutrition in all hospital patients at admission to the hospital and the application of the SNAQ treatment plan in malnourished patients.

Table 5 Incremental costs, effects and cost-effectiveness ratio (ICER) of the entire population and the subgroup of malnourished patients

	Δ costs (€) (95% CI)	Δ effects (95% CI)	ICER
Entire population (n=588)			
Costs SNAQ screening and treatment plan / length of stay (days)	36.8 (15.1 – 58.4)	-1.04 (-1.16 – 1.07)	-35.4 (-1239.2 – 109.4)
Malnourished patients (n= 191)			
Costs SNAQ screening and treatment plan / length of stay (days)	86.0 (33.7 – 138.3)	-1.13 (-1.36 – 1.07)	-76.1 (-478.2 – 218.0)
Malnourished patients with a low hand grip strength (n= 94)			
Costs SNAQ screening and treatment plan / length of stay (days)	68.6 (-11.6 – 40.9)	-1.36 (-1.82 – 1.02)	-50.4 (-195.7 – 2.8)

The mean costs of the screening and the treatment plan were EUR 36.77 higher in the intervention group than in the control group. The cost-effectiveness ratio indicates that the additional costs of SNAQ screening and treatment to reduce the mean length of hospital stay by one day is EUR 35.4 (29.2 USD). Figure 2 shows that 73% of the bootstrapped ratios lay in the northwest quadrant. This indicates higher costs and shorter length of hospital stay. Twenty-seven percent of the bootstrapped ratios lie in the northeast quadrant, indicating higher costs and longer length of hospital stay.

The results of the cost-effectiveness analyses of the SNAQ-screening and treatment in the malnourished group are presented in table 5 and figures 3 and 4. The costs of the SNAQ-treatment and the consultation of the dietician were EUR 86 higher (95% CI: 33.7 to 138.3) in the intervention group than in the control group. The mean length of hospital stay (with ln-transformation) was 1.13 days shorter (95% CI −1.36 to 1.07) in the intervention group. Figure 3 shows that 88% of the bootstrapped cost effectiveness ratios are in the northwest quadrant of higher costs and reduced length of hospital stay. The incremental costs of SNAQ treatment were EUR 76.10 (62.8 USD) to reduce the length of hospital stay by one day. In the sub-group of patients with low handgrip strength the incremental costs were only EUR 50.40 (41.6 USD) to reduce the length of hospital stay with 1 day. In this sub-group the costs of the SNAQ-treatment and consultation of the dietician were EUR 69 higher in the intervention group than in the control group. The mean length of hospital stay (with ln-transformation) was 1.36 days shorter in the intervention group. Ninety-three percent of the bootstrapped cost-effectiveness ratios are in the northwest quadrant of higher costs and reduced length of hospital stay (figure 4).
A sensitivity analysis was performed in the total malnourished group in which the patients with a length of hospital stay>40 days were excluded. The mean costs of the SNAQ-treatment and the consultation of the dietician were higher (EUR 100; 95% CI: 57.3 to 143.8) in the intervention group than in the control group. The mean length of hospital stay was 1.08 days shorter (95% CI: −1.3 to 1.1) in the intervention group.

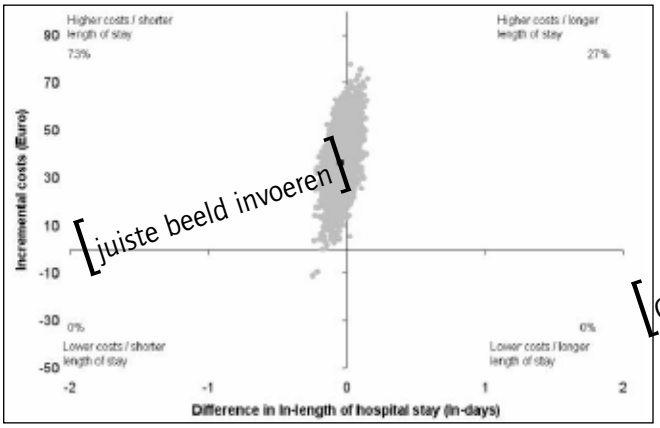

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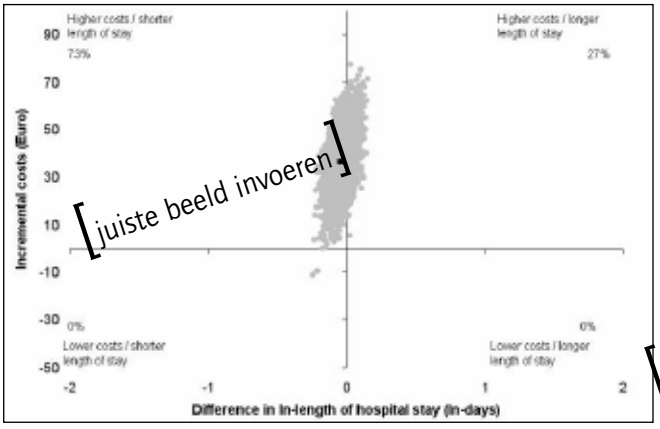
Figure 1 Henibh et wis dit, sed minisse magna faccum vulputat nostincin vulpute dunt autate vulla acincipsum zzriustie faccummolore digna alit, quat augiat.



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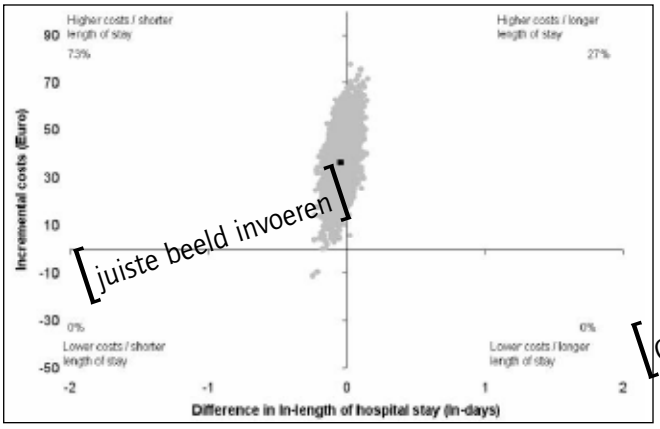

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Discussion

Screening of malnutrition at admission to the hospital and early treatment of the malnourished patients seem to improve clinical outcome. Almost 80% of the malnourished patients were recognized through screening compared with 50% in usual clinical practice (4;5). The dietetic treatment started in an earlier stage of hospitalization. Through standardization of nutritional care, the daily intake of the malnourished patient increased with approximately 600 kcal and 12 grams of protein. The number of eating moments was extended and the focus changed from medical nutrition (supplemental drinks) to normal attractive and tasty food.
There was no difference in total number of consul` patients more often than in the intervention group. This can be explained by increased efficiency of the standardized nutritional care in the intervention group. The dieticians' work is limited to original tasks: evaluating the nutritional needs and –status, informing and motivating the patient, and coordinating the individual clinical nutritional care. The nutritional assistant takes care of in-between meals and stimulation of the patient to eat during their hospital stay.

Effectiveness of early screening and treatment of malnourished patients reduced the length of hospital stay in malnourished patients with low handgrip strength (frail patients). Earlier research in elderly also found that only the very thin were seen to benefit from nutritional supplementation.(19) Analysing this subgroup was not part of the original design and therefore it represents a post hoc analysis.
The incremental costs of a reduction of the length of hospital stay with one day in the malnourished group through extra nutritional care and dietetic treatment were EUR 76 (63 USD). In the total group and in the sub-group of malnourished patients with low handgrip strength the incremental costs were even lower. Assuming that the mean costs of one hospital day are EUR 476 (393 USD) for university hospitals and EUR 337 (278 USD) for peripheral hospitals (20) the savings of implementing the SNAQ screening and treatment are substantial.

The SNAQ-screening and treatment did not result in weight change during the hospital stay.
Weight change is a very difficult parameter in clinical practice. The fluid balance of patients who are admitted to a hospital is often disturbed. The weight at admission is in some patients too high and in other patients too low. Gaining weight is very difficult to realize in the short period of hospitalization, even with enriched meals and extra in-between meals. Consumption of about 7000 kcal more than the patients' metabolic requirements is required for a weight gain of 1 kg. Consequently, weight change does not seem a responsive outcome measure in this frail clinical population. Future studies should focus on length of hospitalization or reduction of complications as relevant outcome measures.

The development and validation of the SNAQ and the effectiveness and cost-effectiveness analyses were carried out in one study. A historical control group was used in the (cost-) effectiveness analyses. Consequently, treatment allocation was not concealed and patients, care providers and outcome assessors were not blinded to the intervention. Randomization was not feasible, because it would have been inevitable that the nurse, who scored a high SNAQ score in a patient in the control group, would have given more attention to the nutritional status of this patient. In this way there would have been more attention to the recognition and early treatment of malnutrition in the control group and this would have introduced bias.
The most important disadvantage of this design, in contrast to an RCT-design, is that other factors, beside the SNAQ screening and treatment, may have influenced the endpoints. For example, we

checked if there had been any important (policy) changes on the wards. In the first month of the year 2002, before the study period of the control group, the internal ward started a protocol to shorten the length of stay and to improve the management of the post-clinical home care facilities. Since this protocol was implemented before the start of this study, we do not expect the effects of this protocol to bias the results. Possible effects cannot be ruled out but there were no trends detectable.
Furthermore we have studied the comparability of the historical control group and the intervention group in detail. It appeared that both groups were comparable with regard to patient characteristics (table 1) and length of hospital stay of well-nourished patients. No confounders were identified and there were no seasonal effects. We therefore assume that the time effect that could have influenced the results was negligible.

Although the study population was recruited in one hospital, results of this study seem relevant to other hospitals. The study population is a good reflection of the population of a general hospital. Also, the prevalence of malnutrition was in consensus with the prevalence in other studies (4;21-23).

The role of the nutritional assistant on the ward is of great importance in the SNAQ-treatment. He / she stimulates patients to eat their meals and in-between meals and reports to the dietician when oral nutrition is insufficient. During this study the nutritional assistant spent 4 hours per day on the distribution of the in-between meals and the registration of the consumption of the in-between meals. Nevertheless, this new approach appeared to be cost-effective. That is few incremental costs (EUR 76) are needed to reduce hospitalization by one day. We expect that when the SNAQ-treatment is implemented in a hospital, these tasks will be integrated in the other tasks of the nutritional assistant and that the incremental costs will even be lower.

This cost-effectiveness analysis gives more information on the costs of nutritional intervention and dietetic treatment in proportion to the total costs of hospitalization. These numbers can be used in making management decisions on nutritional care in hospitals. Optimal nutritional care in malnourished patients who are waiting for treatment or are recovering from illness is an essential part of the total medical care. Future economic evaluations are needed to evaluate if nutritional interventions in the peri-clinical setting are also cost-effective.

Conclusion

Application of the SNAQ screening and treatment plan seem to improve the recognition of malnourished patients and gives the opportunity to start treatment at an early stage of hospitalization. With a small investment in in-between meals and dietetic care the nutritional care during the hospital stay was improved and the duration of hospital stay was shorter in a sub-group of frail malnourished patients.

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CHAPTER 5

Are malnourished patients complex patients?

Health status and care complexity of malnourished patients detected by the Short Nutritional Assessment Questionnaire (SNAQ)

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Abstract

Introduction

This article describes the characteristics of patients identified as malnourished using the Short Nutritional Assessment Questionnaire (SNAQ) in terms of health status (quality of life, functional capacity and body composition) and care complexity. We expected that by the quick and easy SNAQ method of screening on malnutrition, inferences could be made about general health status and care complexity. This information can be used in an optimal multi-disciplinary treatment of the malnourished patient.

Methods

The research population consisted of a group of 588 patients admitted to a ward of internal medicine and surgery of the VU university medical center. Patients with a SNAQ score of at least three points were considered malnourished. The SNAQ score was compared to the health status that was determined by serum albumin, handgrip strength, quality of life and body composition and estimated care complexity.

Results

At admission, 172 patients (29%) had a SNAQ score of at least three points. These patients had a significantly poorer quality of life, poorer physical functioning, a lower fat free mass index and higher care complexity.

Conclusion

These findings confirm our assumption that a considerable proportion of malnourished patients should be considered as complex patients and that malnutrition is an important aspect and indicator of overall health status of the patients. The SNAQ is a simple malnutrition screening tool, applicable in the current complex hospital situation, to identify these complex malnourished patients.

Introduction

Disease related malnutrition exists in a high proportion of hospitalised patients and is caused by reduced food intake, malabsorption and/or catabolism [1]. Severe malnutrition is easily recognized but in highly complex patients, in whom malnutrition may be less severe and is part of an impaired health status, malnutrition tends to be recognized only in a late stage of the treatment [2].
Early recognition and treatment of malnutrition is of great importance because of the adverse consequences of malnutrition such as impaired immune function [3;4], reduced respiratory functioning [5], reduced overall muscle strength and increased fatigue [6], impaired thermoregulation [7], impaired wound healing [8], increased apathy and depression, impaired social interactions and increased self neglect [9].

Both malnutrition and disease severity can have independent negative effects on the prognosis of patients. In combination these factors may create a vicious circle that can only be broken by a combination of treatment of the underlying disease and nutritional support. All malnourished patients, but specifically those who are medically complex patients, need to be recognized and treated in an early stage of the medical treatment.
An undisputed definition of disease related malnutrition is lacking. First, BMI (kg/m^2) and unintentional weight loss are part of most definitions of malnutrition. The BMI-mortality curves suggest that in the general adult population a BMI of 18.5 – 25 kg/m^2 is preferable, since it is associated with the lowest mortality. Mortality is increased when the BMI is lower than 18.5 kg/m (underweight) and when the BMI is higher than 25 kg/m (overweight) (10). Whereas a low BMI may indicate chronic malnutrition, recent unintentional weight loss indicates a more acute deterioration of the nutritional status. Second, nutritional variables combined with biochemical parameters are associated with severity of illness (such as low serum albumin) in so-called nutritional indices. These indices predict surgical risk and should therefore be termed health risk indices rather than nutritional indices. Serum albumin is an independent predictor of mortality in a wide range of clinical conditions, although deaths due to starvation may occur with a normal serum-albumin concentration [10].

It has been recommended that all hospitals have protocols for nutritional screening, -assessment and -referral [11]. Screening, as opposed to the more time-consuming and detailed process of nutritional assessment, should ideally be a quick and simple process that can be carried out by nurses at admission. In 2003 we developed a screening instrument, the Short Nutritional Assessment Questionnaire (SNAQ), containing three nutrition-related questions in which no calculation is needed. The SNAQ proved to be valid and reproducible [12]. The early recognition and treatment of the malnourished patients, using the SNAQ, proved to be both effective and cost effective [13]. In previous articles we described that patients with a SNAQ-score of at least three points had a lower BMI, more involuntary weight loss and higher hospital costs [12;13]. These patients were referred to a dietician and termed as malnourished in the medical charts. When we assume that malnutrition is part of a complex health problem, it is to be expected that a high score on the quick and easy SNAQ method of screening on malnutrition may be associated with impaired health status and increased care complexity. This information may optimise multi-disciplinary treatment of malnourished patients.
This article describes the characteristics of patients with a SNAQ score of at least three points in terms of health status (quality of life, functional capacity and body composition) and care complexity (INTERMED-score).

Patients and methods

Patients

The research population consisted of a group of 588 patients, admitted to a general internal ward (general internal medicine, gastroenterology, dermatology, rheumatology, nephrology) and a general surgical ward (general surgery and surgical oncology) of the VU university medical center in the periods from April 2002 until October 2002 and February 2003 until June 2003. Patients who were not able to give informed consent, could not be weighed, had an expected length of hospital stay of less than three days or were younger than 18 years of age were excluded from the study. The study-design was in accordance to the Declaration of Helsinki and approved by the institutional review board of the VU university medical center.

Nutritional status by the Short Nutritional Assessment Questionnaire (SNAQ)

The three questions of the SNAQ (figure 1) were posed at admission to the hospital by nurses of the wards. Patients with a SNAQ score of at least three points were considered severely malnourished.

Health status

Body weight, BMI, serum albumin and handgrip strength

On the day of admission at the hospital, all patients were weighed on the same calibrated scale (SECA 880) and were asked for their height. When patients did not know their height, it was measured (SECA 220). Patients were asked whether they had lost weight unintentionally over the last month and the last 6 months. The BMI was calculated as weight (kg) / height $(m)^2$. Serum albumin was measured. The handgrip strength was measured in the non-dominant hand as the better of two readings on a mechanical dynamometer (Baseline, Smith & Nephew, USA). The measurement was performed as recommended by the American Society of Hand Therapists [14] and the standards of Mathiowetz et al. were used [15]. A trained researcher performed the measurements.

Quality of Life

The validated Dutch version of SF-36 was used to assess quality of life [16]. This questionnaire is focused on physical, social and mental aspects of functioning and health. The SF-36 consists of 36 items organized into eight scales (physical functioning, social functioning, role limitations caused by physical problems, physical pain, mental health, role limitations caused by emotional problems, vitality and general health) [17]. Each of the scales was recoded into standardized scores with a scoring range between 0 and 100 (100 = optimal functioning). The eight scales form two higher ordered clusters of the physical and mental composite scores. The norm lies on a score of 50 points [17].

Bio impedance analysis

Whole body resistance and reactance were measured with four surface electrodes placed on the nondominant wrist and ankle as described by Lukas et al [18]. An electrical current of 50 kHz and 0,8 mA was briefly generated (Xitron 4000B analyser, Xitron technologies, San Diego, CA, USA) and applied to the skin with adhesive electrodes (3M Red Dot T, 3M Health care, Borken, Germany) with the patient lying supine. Fat free mass (FFM) was calculated by the Geneva formula that has been validated in 343 healthy subjects between 18 and 94 years with a BMI between 17.0 and 33.8 kg/m^2 [19]. This equation was also validated in elderly subjects [20]. The fat free mass index (FFMI) was calculated as FFM (kg) / length (m^2). Reference values of Kyle were applied (16.7 to 19.8 kg/m^2 for men and 14.6 to 16.8 kg/m^2 for women) [21].

Care complexity: INTERMED

INTERMED is an observer-rated instrument to assess care complexity. It has been validated in several medical inpatient populations [22;23]. Information from four domains (biological, psychological, social and health care) is integrated and assessed in the context of time (history, current state and prognosis). Of each of the four domains, five variables are rated 0 to 3 according to a manual with clinical anchor points, resulting in a potential range of 0 to 60. Scoring is based on a patient interview and a review of the medical chart. The following variables were scored:

1. chronicity;
2. diagnostic dilemma;
3. severity of symptoms;
4. diagnostic challenge;
5. complications and life treat;
6. restrictions in coping;
7. prior psychiatric dysfunctioning;
8. resistance to treatment;
9. current psychiatric symptoms;
10. current mental health treat;
11. restrictions in integration;
12. social dysfunctioning;
13. residential instability;
14. restrictions in social network;
15. social vulnerability;
16. intensity of previous treatment;
17. prior treatment experience;
18. organization of care;
19. appropriateness of referral and
20. need for coordination of care.

A cut off-score of more than 20 points was found to be optimal in detecting patients at risk of longer length of hospital stay and poor quality of life at discharge. For this cut-off score, good inter-rater reliability was found indicated by a Kappa of 0.85 [24].

Statistics

Differences between groups were tested with independent t-test, non-parametric Mann-Whitney test or chi-square test where appropriate. Odds ratios (OR) with 95% confidence intervals (95% CI) were used to compare the prevalence numbers in the group of patients with a SNAQ score of at least three points with the patients with a SNAQ score of 0,1 or 2 points. Statistical analysis was performed by using SPSS 12.0 (SPSS Inc. Chicago).

Results

In the study 588 patients were included. At admission, 172 patients (29%) had a SNAQ score of ≥ three points and were characterized as malnourished.
Table 1 shows the differences in nutritional parameters, quality of life and care complexity of the group with a SNAQ score of at least three points in comparison with the patients with a low SNAQ score. The patients with a SNAQ score of at least three points had a significantly higher age, a lower BMI, more unintentional weight loss, lower serum albumin, lower hand grip strength and lower scores on all domains of quality of life and on all domains of care complexity.

Table 1 Differences in nutritional parameters, quality of life and care complexity for the group with a SNAQ score of ≥ three points in comparison with the other patients in the total group.

	SNAQ ≥ three points	SNAQ score 0,1 or 2 points	Difference between groups: p-value ((t-test (t), Mann-Whitney test (m), Chi-square test (c))
N	172	416	
Sex (male/female) (%)	38% / 62%	41% / 59%	0.6 (c)
Age (years) Older than 70 years (%)	62.7 ± 18.1 44%	58.2 ± 17.5 28%	0.007 (t) <0.001 (c)
Nutritional and health status			
BMI (kg/m2) BMI <18.5 (%)	22.9 ± 5.0 19%	25.6 ± 4.8 2%	<0.0001 (t) <0.0001 (c)
% Weight change in the past 6 months >10% involuntary weight loss (%)	-10.6 ± 8,6 48%	1.4 ± 6.3 1%	<0.0001 (m) <0.0001 (c)
Serum albumin (g/l) Albumin <34 g/l (%)	32.6 ± 6.7 53%	35.3 ± 6.6 36%	<0.0001 (t) <0.0001 (c)
Quality of life			
Mental combined score quality of life Below norm (50) (%)	41.3 ± 10.5 77%	46.0 ± 11.0 42%	<0.0001 (t) 0.01 (c)
Physical combined score Below norm (50) (%)	32.5 ± 10.6 95%	39.4 ± 10.8 53%	<0.0001 (t) <0.0001 (c)
Physical functioning	39.9 ± 31.6	57.5 ± 32.3	<0.0001 (m)
Role physical	17.2 ± 32.2	45.4 ± 44.6	<0.0001 (m)
Physical pain	50.6 ± 22.5	59.2 ± 24.7	0.005 (m)
General health	44.1 ± 18.5	54.0 ± 17,7	<0.0001 (m)
Vitality	42.0 ± 20.9	53.6 ± 21.0	<0.0001 (m)
Social functioning	44.9 ± 24.5	57.6 ± 26.5	<0.0001 (m)
Role emotional	45.2 ± 47.4	65.1 ± 45.2	<0.0001 (m)
Mental health	57.4 ± 16.8	63.9 ± 18.6	<0.0001 (m)

Care complexity			
INTERMED total score >20 points (%)	16.4 ± 8.4 27%	12.5 ± 6.9 12%	<0.0001 (t) <0.0001 (c)
Prognosis somatic care needs (% >1)	63%	56%	0.1 (c)
Prognosis psychological care needs (% >1)	12%	6%	0.04 (c)
Prognosis social care needs (% >1)	13%	4%	0.001 (c)
Prognosis health care needs (% >1)	38%	22%	0.3 (c)

Health status

Quality of Life

The patients with a SNAQ score of at least three points had a significantly lower score than the other patients in all domains of quality of life. The OR for a SNAQ score of at least three points and a score on the quality of life below the norm for the different domains are shown in *table 2*. The OR for the physical combined score was 5.3 (95% CI: 1.9 – 15.2) and the OR for the mental combined score was 2.0 (95% CI: 1.1 – 3.5). In the patients with a SNAQ score of at least three points, 95% had a physical combined score below the norm and 77% had a mental combined score below the norm.

Table 2 The odds ratios for a SNAQ score of ≥ three points and a score below the norm on the different domains of the quality of life (SF-36)

	Odds ratio	95% confidence interval
Physical functioning	2.4	1.6 – 3.8
Role physical	4.4	2.4 – 7.9
Physical pain	1.4	0.9 – 2.1
General health	2.4	1.5 – 3.9
Vitality	1.7	1.1 – 2.8
Social functioning	2.1	1.3 – 3.5
Role emotional	2.3	1.5 – 3.5
Mental health	1.7	1.0 – 2.8

Functional capacity

Handgrip strength was determined in 465 patients (79%). 123 measurements were missing, primarily because of logistic reasons (handgrip dynamometer not available or surgical procedure before the measurements could take place). Secondly, a small number of patients were considered too ill to perform the tests. The patients with missing values had higher INTERMED scores.

Twenty-eight percent of the 465 patients had a SNAQ-score of at least three points. Sixty-seven percent of these patients with a high SNAQ score had a handgrip strength below the norm. In the patients with a low SNAQ score this percentage was 51%. The mean percentage of the norm in the group with a low SNAQ score was higher than in the group with a SNAQ score of at least three points (table 1).

Body composition

Impedance analyses was performed in a subgroup of 349 patients (60%) (male: female = 2:3) and the fat free mass (FFM) and fat free mass index (FFMI) was calculated. Thirty percent (n=105) of these patient had a SNAQ-score at least three points. The missing patients had higher INTERMED scores and were older.

Table 3 shows the results of the impedance analyses. All results are reported separately for men and women because body composition is different in both sexes.

In patients with a SNAQ score of at least three points, 41% had a low FFMI, 41% had a normal FFMI and 18% had a high FFMI. The OR for patients with a SNAQ score of at least three points for having a low FFMI was 2.8 (95% CI: 1.7 − 4.5). Comparing the patients with a SNAQ score of at least three points and a low FFMI with the patients with a SNAQ score of at least three points and a normal FFMI only the BMI of the patients with a low FFMI was significantly lower (p<0.0001). There was no difference in age, INTERMED-score, involuntary weight loss, quality of life or handgrip strength.

Table 3 Body composition and SNAQ score

	Men			Women		
	≥ 3 points	Other patients	p-value (t-test (t), Chi-square (c))	≥ 3 points	Other patients	p-value (t-test (t), Chi-square (c))
N	39	102		66	142	
Fat free mass index	17.4 ± 1.6	18.8 ± 2.3	<0.0001 (t)	15.1 ± 2.3	16.2 ± 2.0	0.001 (t)
FFMI						
low/normal/high (%)	33/59/8	19/49/32	0.01 (c)	46/30/24	20/45/35	0.001 (c)

Care complexity

96 patients had an INTERMED score of 20 points or more of whom 46 patients had a SNAQ score of at least three points (sensitivity 48%, positive predictive value 27%). Of the remaining 492 patients 126 patients had had a SNAQ score of at least three points (specificity 74%, negative predicted value 88%). The mean INTERMED score in the total group was 13.6 ± 7.6. In the group of patients with a SNAQ score of ≥ three points the INTERMED score was higher (16.4 ± 8.4, p<0.0001). The OR of patients with a high SNAQ score (≥ 3) for a high INTERMED score (>20) was 2.5 (95% CI: 1.6-3.9). The percentage of patients with a score of more than 1 point on the items 'mental health treat' (prognosis psychological care needs) and 'social vulnerability' (prognosis social care needs) was higher in the group of patients with a SNAQ score of at least three points (table 1). The percentages of patients with a score of more than 1 point (care needs or acute care needs) on the items 'complications and life treat' (prognosis somatic care needs) and 'need for coordination of care' (prognosis health care needs) were not significantly different.

Discussion

We found that poor nutritional status assessed by a simple screening instrument (SNAQ) is not an isolated problem but is very often related to poor overall health status and increased psychosocial care complexity.
Patients with a SNAQ score of at least three points had more health care needs, poorer quality of life, lower functional capacity and a lower fat free mass index. In this group, 54% was above the age of 70 years, 19% had a BMI<18.5, 53% had a serum albumin level below normal (indicating chronic disease) and 48% had more than 10% unintentional weight loss. As to health status, 95% had a quality of life physical composite score below normal and 77% had a mental combined score below normal, 67% had low handgrip strength and 41% a low FFMI. Finally, 27% had a high care complexity. These combined findings underline the assumption that a considerable proportion of malnourished patients should be considered as complex patients and that malnutrition is an important aspect and indicator of overall health status of the patients.

In 79% of the patients handgrip strength was measured and in 60% of the patients a bioelectrical impedance (BIA) measurement was performed. The higher INTERMED score, the higher age and the equivalent SNAQ-score of the not completely evaluated patients imply that the presented data on body composition and functionality were measured in a healthier subgroup with an identical prevalence of malnutrition. Again, patients with a SNAQ score of at least three points had substantial lower handgrip strength and lower fat free mass. In the group of patients in whom all measurements were performed, the differences in scores on nutritional parameters, quality of life and care complexity were comparable to the results in the total group.

The body composition of the patients with a high SNAQ score was different from the body composition of the patients with a low SNAQ score. Patients with a high SNAQ score had a lower FFMI and in this group twice as many patients had a FFMI value lower than the norm. However, not all patients with a low FFMI were considered malnourished by the SNAQ score. This indicates that a simple screening procedure at admission to the hospital cannot fully substitute an extensive nutritional assessment but is, by nature, intended to identify most of the patients that are malnourished or are at risk of malnutrition.

Screening on malnutrition in all patients using the SNAQ-screening and subsequent nutritional intervention has been proven to shorten the length of hospital stay in a subgroup of frail malnourished patients and proved to be cost-effective in all hospital patients [13]. The SNAQ is a simple screening instrument with a high predictive value for impaired health status and increased care complexity. This instrument is suitable for the current complex hospital situation. For optimal communication, the three questions of the SNAQ should be integrated in the electronic medical chart. Use of a computerised detection system is an optimal strategy in a busy hospital environment.

Western general hospitals are increasingly confronted with complex patients. The high costs of our health care system have prompted that only the most complex patients are admitted to the hospital, whereas their treatment is often under heavy time constraints. For a growing number of patients, integrated treatment is essential, involving early coordination of care, geriatric interventions, and referral to medical and paramedical consultation services. INTERMED detects complex patients with lower quality of life and higher length of hospital stay. Interventions based on the INTERMED score, improve the

care process. Since many patients with an INTERMED score >20 were also malnourished, it is advisable to integrate the SNAQ and its treatment in the INTERMED protocol. Vice versa, in malnourished patients, special attention should be given to the social and psychological health care needs as well since they are more at risk for problems in these areas.

Conclusion

Patients with a SNAQ-score of three points or more are at risk of higher care complexity, a poorer quality of life, an impaired physical functioning and a lower fat free mass index. Due to the simplicity of the SNAQ malnutrition screening tool it is easily applicable in the current complex hospital situation to identify the complex malnourished patients who are in need of nutritional treatment to accompany the treatment of the underlying disease. Since patients who are identified as being malnourished by the SNAQ are likely to have a higher care complexity, it is advisable to screen malnourished patients on care complexity and vice versa.

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CHAPTER

6

Undernutrition and overnutrition in hospital outpatients

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Abstract

Background

The primary purpose of this study was to determine the prevalence of undernutrition and overnutrition in a general outpatient population with subdivision in different specialisms and diseases. A secondary objective was to asses the accessibility of guidelines and the attitude of the nursing staff on nutritional treatment.

Methods

In a cross sectional design, all patients who visited the outpatient clinic of the VU university medical center on the 5th of April 2005 entered the study. 727 patients were included.
Patients filled out a questionnaire consisting of questions concerning recent weight loss, length, age and medical specialism(s) and existing diseases. The actual weight of all patients was measured.
The head nurse of each department completed a questionnaire on recognition and treatment of malnourished patients.

Results and conclusion

6% of all outpatients were undernourished, 36% were overweight and 17% were obese. Patients with gastrointestinal disease, renal disease, neurological disease, and oncological disease were most at risk of undernutrition. Cancer patients with hematological, gastrointestinal and lung tumors were most at risk of undernutrition. Only 15% of all undernourished, 6% of the overweight and 11% of the obese outpatients received dietetic treatment.
The circumstances in the outpatients clinic to administer optimal care for both undernourished and overnourished patients were not sufficient. Education programs for the nursing and medical staff on this subject and the availability of guidelines and weighing scales should become optimalised. In the subgroups of patients who are more at risk of undernutrition standard screening on undernutrition with a feasible and valid undernutrition screening tool is needed.

Introduction

Nutritional status ranges from undernutrition to overnutrition. Overnutrition is a core health issue because of the major health consequences such as hypertension, type 2 diabetes, cardiovascular disease, gallbladder disease, certain types of cancer and psychosocial problems. It also conveys increased risk of dyslipidemia, insulin resistance, osteo-arthritis, reproductive hormone abnormalities and lower back pain. In many countries about half of the adult population is overweight and up to 30% of adults are clinically obese.[1-3]

The problem of disease related undernutrition is less extensive but has a large impact on mortality and morbidity. The consequences are diverse: reduction of muscle mass, respiratory function and immune function,[4-7] impaired wound healing[8] and higher care complexity.[9] These complications result in increased morbidity and mortality, a lengthened stay in hospital and increasing costs of health care.[10-14] Groups who are at high risk of being undernourished, both in hospital and in the community are elderly,[15-17] patients with chronic illness (such as COPD and HIV/AIDS), patients with gastrointestinal, oncological, neurological, orthopedic and renal diseases[14;18-20] and patients who are elective for surgery.[21]

Although the occurrence of disease related undernutrition in patients admitted to hospitals is high (25-40%), its recognition by the medical and nursing staff is only 50%.[19;22] Earlier research pointed out that the use of a screening instrument at admission to the hospital improves the recognition of undernourished patients by the medical and nursing staff from 50% to 80%.[22] Also, early treatment in hospital appeared to be (cost) effective.[23]

In The Netherlands the general policy is to discharge hospital patients sooner than they were several years ago. Given the decreasing length of hospital stay, the problem of disease related undernutrition might therefore be shifting to the outpatient clinics. For a general outpatient population no reliable data on the prevalence of undernutrition is available. Wilson et al performed a prevalence analysis on undernutrition in a non-cancer outpatient population and found prevalences of undernutrition of 11% in patients older than the age of 65, and of 7% in patients younger than 65.[24] The prevalence of disease related undernutrition in outpatients varies with the type of illness, for example 30% in gastrointestinal patients,[25] 20-35% in COPD (20;26) and 22-37% in HIV infection and AIDS.[27]

Undernutrition is frequently unrecognized and untreated in many health care settings.[18;19;24;28] Implementing routine screening to detect undernutrition has been hindered by the lack of universally agreed criteria of undernutrition and the low priority of undernutrition among the medical and nursing staff. Although nurses do consider nutritional care to be important, it is of low priority as a result of lack of time,[29;30] lack of education[31] and lack of management policies and regulations within the National Health Services.[32;33]

The primary purpose of this study was to determine the prevalence of undernutrition and overnutrition in a general outpatient population with subdivision in different specialisms and diseases. A secondary objective was to asses the accessibility of guidelines and the attitude of the nursing staff on disease related undernutrition and the recognition of undernutrition.

Patients and methods

This study consists of 2 parts. The first part is a description of the prevalence of undernutrition and overnutrition in a general outpatient population and the second part is a description of the presence and application of nutritional guidelines and the awareness of undernutrition amongst the nursing staff.

Part 1: prevalence of undernutrition and overnutrition

Study design and patients

In a cross sectional design, all patients who visited the outpatient clinic of the VU University medical center on the 5th of April 2005 entered the study. All departments, except from the pediatric and obstetrics department participated in the study. Patients were excluded from the study when they were younger than the age of 18, pregnant or could not be weighed.

Methods

Administrative personnel of the outpatient departments handed out a questionnaire to all patients. This questionnaire consisted of questions concerning recent weight loss, length, age and medical specialism(s). Patients were asked whether they were elective for surgery and / or suffered one of the following diseases: cardiovascular disease, gastrointestinal disease, rheumatoid disease, cancer (and location of the tumor), renal disease, lung disease, diabetes mellitus, infectious disease, neurological disease and psychological disease. After having filled out the questionnaire, screeners (nurses, medical students, health science students), who were present at every department, collected and checked the completed questionnaires and measured the patients' actual weight on a calibrated scale (SECA 880).

Nutritional status

Nutritional status is defined by involuntary weight loss over the last month and the last 6 months and Body Mass Index (BMI). BMI is calculated as kg/m^2. Patients were characterized as undernourished when one or more of the following conditions were present: a BMI of less than 18.5 and /or unintentional weight loss of more than 5% in the last month or more than 10% in the last 6 months.[28;34-38] Patients with a BMI in the range of 18.5-25 were characterized as well nourished. Patients with no unintentional weight loss within the defined ranges and a BMI in the range of 25-30 were characterized as overweight and patients with a BMI of 30 and over were characterized as obese.[37]

Part 2: attitude on undernutrition of the nursing staff

Subjects

In all outpatient departments the head nurses filled out a questionnaire on the presence and application of resources for and the awareness of disease related undernutrition (availability of guidelines on undernutrition and weighing scales). The departments involved were ophthalmology, neurology, dermatology, otolaryngology, gastroenterology, gynecology, oral maxillofacial surgery, internal medicine, surgery, oncology, radiotherapy, nephrology, cardiology, rheumatology and pulmonology.

Methods

The head nurses completed a questionnaire on the procedure on undernutrition at his / her depart-

ment. The questions concerned nutritional guidelines, procedures on measuring weight and height of patients, information in the medical chart about nutritional status, definition of undernutrition, dietetic involvement at the department, availability of brochures for undernourished patients and possibilities of discussing undernourished patients in a multidisciplinary team. The head nurses were also asked to predict the percentage of undernourished patients on their department.

Results

727 patients filled out the questionnaire. 22 patients (3%) were excluded because the nutritional status could not be determined because of incomplete data. 705 patients remained in the study.
Of these patients, 44% were female and 56% male. The mean age was 54.0 ± 16.5 years and varied between 19 and 88 years. 135 patients (19%) were older than 70 years. *Table 1* shows the characteristics of the patients who participated in the study.
Of all patients, 40 patients (6%) were undernourished, 253 patients (36%) were overweight and 121 patients (17%) were obese.
135 patients (19%) were older than 70 years of age. Eight of these patients (6%) were undernourished, 55 patients (22%) were overweight and 18 patients (15%) were obese. 15% of the undernourished patients, 6% of the overweight patients and 11% of the obese patients received dietetic treatment.

Table 1 Characteristics of all outpatients divided by nutritional status

	Undernourished (BMI <18.5 and / or unintentional weight loss)	Well nourished (BMI 18.5-25)	Overweight (BMI 25-30)	Obese (BMI >30)
N (%)	40 (6%)	291 (41%)	253 (36%)	121 (17%)
Male/female (%)	48 / 52	39 / 61	51 / 49	40 / 60
Age (y) ±SD	52.6 ± 17.3	51.8 ± 18.4	56.8 ± 14.7	54.9 ± 13.9
Age >70 (%)	8 (20%)	54 (19%)	55 (22%)	18 (15%)
BMI (kg/m) ± SD	19.9 ± 3.6	22.5 ± 1.6	27.2 ± 1.3	33.8 ± 3.8
Nutritional treatment (%)	6 (15%)	16 (6%)	15 (6%)	13 (11%)
≥2 specialists (%)	2 (5%)	31 (11%)	35 (4%)	16 (13%)

Outpatient departments

Table 2 shows the number of patients at the different outpatient departments, subdivided by nutritional status. The percentage undernourished patients was highest on the surgery department (13%), followed by the pulmonology department with 12%. There were no undernourished patients at the departments of otolaryngology and oral maxillofacial surgery. The prevalence of overweight was highest at the departments of otolaryngology (48%), cardiology (44%), radiotherapy (43%) gastroenterology (43%) and oncology (42%). The prevalence of obesity was highest at the department of internal medicine (32%) and pulmonology (32%) followed by ophthalmology (22%) and dermatology (22%).

Table 2 Nutritional status in the outpatient departments

	N (% of the total group)	Under-nourished (BMI <18.5 and/ or unintentional weight loss)	Well nourished (BMI 18.5-25)	Over-weight (BMI 25-30)	Obese (BMI >30)
Surgery	39	5 (13%)	17 (44%)	10 (26%)	7 (18%)
Pulmonology	25	3 (12%)	8 (32%)	6 (24%)	8 (32%)
Radiotherapy	56	5 (9%)	18 (32%)	24 (43%)	9 (16%)
Gastroenterology	23	2 (9%)	9 (39%	10 (43%)	2 (9%)
Oncology	38	3 (8%)	15 (39%)	16 (42%)	4 (11%)
Internal medicine	41	3 (8%)	11 (27%)	14 (34%)	13 (32%)
Ophthalmology	67	4 (6%)	29 (43%)	19 (28%)	15 (22%)
Dermatology	79	3 (5%)	34 (43%)	25 (32%)	17 (22%)
Orthopediatry	26	1 (4%)	15 (58%)	6 (23%)	4 (15%)
Traumatology	26	1 (4%)	13 (50%)	10 (38%)	2 (8%)
Neurology	36	1 (3%)	17 (47%)	14 (39%)	4 (11%)
Cardiology	43	1 (2%)	16 (37%)	19 (44%)	7 (16%)
Otolaryngology	75	0	26 (35%)	36 (48%)	13(17%)
Oral maxillofacial surgery	21	0	14 (67%)	6 (29%)	1 (5%)
Other	110	8 (7%)	49 (45%)	38 (35%)	15 (14%)
Total	705	40 (6%)	291 (41%)	253 (36%)	121 (17%)

The group other consist of the following outpatient departments with a number of patients of less than 20 and are therefore too small to analyze separately. The percentage of malnourished patients is presented between the brackets: endocrinology n=9 (0%), hematology n=19 (16%), nephrology n=8 (12.5%), rheumatology n=15 (0%), plastic surgery n=8 (0%), psychiatry n=3 (0%), urology n=9 (0%), gynecology n=12 (8%), physiotherapy n=2 (50%), gender team n=3 (33%), dietetics n=1 (0%), pain clinic n=18 (6%) and genetics n=1 (0%).

Type of illness

Table 3 shows the nutritional status in the subgroups of diseases. Infectious diseases were not reported because the number of patients was too small (n=3).
The prevalence of undernutrition was highest in patients with gastrointestinal diseases (13%) and renal diseases (12%). The prevalence of overweight was highest in renal disease (43%) and neurological disease (38%) and the prevalence of obesity was highest in diabetes (41%) and renal disease (30%).

Table 3 Nutritional status of outpatients categorized by main disease

	N	Undernourished (BMI <18.5 and/or unintentional weight loss)	Well nourished (BMI 18.5-25)	Overweight (BMI 25-30)	Obese (BMI >30)
Gastrointestinal disease	62	8 (13%)	20 (32%)	22 (35%)	12 (19%)
Renal disease	23	3 (13%)	3 (13%)	10 (43%)	7 (30%)
Neurological disease	58	7 (12%)	22 (38%)	22 (38%)	7 (12%)
Cancer	144	15 (10%)	53 (37%)	53 (37%)	23 16%)
Psychological disease	48	5 (10%)	14 (29%)	18 (38%)	11 (23%)
Lung disease	51	4 (8%)	24 (47%)	10 (20%)	13 (25%)
Diabetes mellitus	80	4 (5%)	18 (23%)	25 (31%)	33 (41%)
Rheumatoid disease	50	2 (4%)	28 (56%)	14 (28%)	6 (12%)
Cardio vascular disease	133	5 (4%)	50 (38%)	47 (35%)	31 (23%)

Cancer patients

144 patients (20.4%) had an oncological disease. 15 (10%) of these patients were undernourished, 54 patients (38%) were overweight and 23 patients (16%) were obese. *Table 4* shows the nutritional status in the subgroups of cancer patients. Undernutrition had the highest prevalence in hematological (22%), lung (14%) and skin (14%) tumors. Overweight was most prevalent in patients with cancer in the reproductive organs (56%) and the gastrointestinal tract (50%) and obesity in patients with cancer in the reproductive organs (22%) and in breast cancer (22%).

Table 4 Nutritional status categorized by tumor localization.

	N	Undernourished (BMI <18.5 and/or unintentional weight loss)	Well nourished (BMI 18.5-25)	Overweight (BMI 25-30)	Obese (BMI >30)
Blood	9	2 (22%)	3 (33%)	3 (33%)	1 (11%)
Lung	21	3 (14%)	9 (43%)	7 (33%)	2 (10%)
Skin	7	1 (14%)	5 (71%)	1 (14%)	0
Gastrointestinal tract	16	2 (13%)	4 (25%)	8 (50%)	2 (13%)
Otolarynx	24	2 (8%)	14 (58%)	5 (21%)	3 (13%)
Mamma	37	3 (8%)	10 (27%)	16 (43%)	8 (22%)
Reproductive organs	9	0	2 (22%)	5 (56%)	2 (22%)
Other	21	2 (9%)	5 (24%)	9 (43%)	5 (24%)
Total	144	15 (10%)	52 (36%)	54 (38%)	23 (16%)

Attitude of the nursing staff

In 2 of the 15 outpatient departments a guideline on undernutrition was present, and only on 1 department a nurse was assigned to evaluate the guideline based interventions. In 11 departments a sufficient amount of weighing scales was available to weigh each patient, but only in 7 departments all patients were weighed.
There was information on undernutrition or the risk of undernutrition in the medical chart of the patient in 2 departments. Undernourished patients were discussed in a multidisciplinary team in 2 departments. Patients received a brochure on undernutrition in 1 department.

Estimates of the prevalence of undernutrition made by the nursing staff for their own department ranged from 1 to 40%. 3 head nurses could not make an estimation of undernutrition. Of the 8 head nurses that filled out an estimation, 2 head nurses overestimated the percentage undernourished patients by far.
6 of the departments did not use a definition of undernutrition. Between the departments that did use a definition, there was no consensus in the used definitions.

Discussion

In this cross-sectional study, 6% of all outpatients were undernourished. This study shows that patients with gastrointestinal disease, renal disease, neurological disease, and oncological disease were most at risk of undernutrition. Cancer patients with hematological, gastrointestinal and lung tumors were most at risk of undernutrition. Only 15% of all undernourished outpatients received dietetic treatment.
As to overnutrition, 36% of the patients were overweight and 17% was obese. The groups of patients with renal disease, neurological disease and diabetes had the highest prevalence of overnutrition. 6% of the overweight patients and 11% of the obese patients received dietetic treatment.

Since the VU university medical center, as a University hospital, has a complex outpatient population, the numbers on prevalence of undernutrition cannot be automatically extrapolated to all general hospitals. The prevalence of undernutrition in this study is in accordance with the only available study in the (non-cancer) outpatient population from Wilson et al[24] who reported undernutrition in 11% of persons older than the age of 65, and 7% of patients younger than 65 years.
Studies performed in separate subgroups of disease report a wide range of prevalences. Studies in COPD patients report prevalences of undernutrition of 20-35% (20;26). These prevalences are much higher than the prevalence of 8% in our group of lung patients. The prevalences of undernutrition found in our study were in agreement with the prevalences from the literature for gastrointestinal patients and cancer patients. For these patients groups the prevalence of undernutrition found in the literature both in gastrointestinal patients and in cancer patients 10-35%.[21;39] The prevalence of undernutrition in our population was 13% in gastrointestinal patients and 10% in cancer patients.

A reason for the wide ranges in the prevalence of undernutrition is that there is no golden standard definition of undernutrition. Therefore, undernutrition is operationalised by many different criteria in many different studies, which makes it almost impossible to compare between studies. There is no consensus because undernutrition is a complex problem, and for every disease the criteria may be different. In disease related undernutrition the combined criteria of BMI and unintentional weight loss as used in this study are widely accepted [28;34-38].

The Dutch prevalence of overweight is in the range of 25% to 40% and the prevalence of obesity is in the range of 9 to 10%.[40] The prevalence of overweight and obesity in our population is higher than the data from the literature. This can be explained by the high percentage of patients with diabetes mellitus and cardiovascular disease.

Using a cross sectional design has the disadvantage that certain groups of the outpatient population can be missed, for instance because a certain specialist did not hold consulting hours on the 5th of April 2005. We checked all specialisms for their presence on the 5th of April. All specialists groups were present with exception of the oncological otolaryngology. On the otolaryngology department no undernourished outpatients were present on the screening day but we expect the prevalence of undernutrition to be higher on a day when the oncological patients are present. Previous studies in this patient group reported prevalences of malnutrition of 35 till 50%[36] up to 57%.[41;42]

The patients who did not participate in the cross sectional screening were not registered. We expect this to be a small number of patients because all patients received a questionnaire and researchers were present on every floor of the outpatient clinic to collect the questionnaires and to measure the weight of the patients. Another shortcoming is that subjective data were obtained from patients recall. Data like weight 6 months ago has to be treated with caution, just like data filled out by the patients on diseases.

At less than 20% of the departments, the presence and application of resources (protocol and weighing scales) for determining the nutritional status were sufficient.
The level of awareness on undernutrition is alarming: about 40% of the departments did not have a definition of undernutrition; the other departments used 6 different definitions.
3 head nurses could not make an estimation of undernutrition. Of the 8 head nurses that filled out an estimation, 2 head nurses overestimated the percentage undernourished patients by far. The insight of the occurrence, definition and treatment of undernutrition among the medical and nursing staff appears to be inadequate. Also the routine habit of measuring weight loss does not seem to exist.

To reduce the number of unrecognized malnourished (undernourished and overnourished) patients, the attitude of all care providers in the outpatient clinic with regard to disease related malnutrition has to be improved. This could be attained at the basis by improving the education program of nurses and physicians. Furthermore the circumstances of availability of weighing scales and nutritional guidelines have to be improved.
When weighing all patients and calculating BMI and weight loss is not feasible, screening with a simple and quick screening tool is a good alternative. The SNAQ screening instrument[22] is a suitable malnutrition screening instrument in this setting and has recently been validated for the outpatient setting (data not yet published). The SNAQ consists of 3 questions concerning recent unintentional weight loss, decreased appetite in the last month and the use of supplemental or tube feeding in the last month. Based on this score patients who are at risk of undernutrition will receive a brochure on disease related undernutrition and instructions from the nursing staff. Patients who already appear to be undernourished are referred to a dietician.

The percentage of overweight and obese patients that were receiving nutritional treatment was also very low (6% and 11%). This can also be explained by the lack of priority of the medical and nursing staff in determining the nutritional status of patients.

These findings urge for an extensive education program for the outpatient medical and nursing staff on undernutrition and overnutrition, especially since the focus of medical treatment is more and more shifting to the outpatient clinic.

Conclusion

In this cross-sectional study, 6% of all outpatients were undernourished, 36% were overweight and 17% were obese. This study shows that patients with gastrointestinal disease, renal disease, neurological disease, and oncological disease were most at risk of undernutrition. Cancer patients with hematological, gastrointestinal and lung tumors were most at risk of undernutrition. Patients with renal disease, diabetes and psychological disease were most at risk of overweight and obesity, although this was a quite common phenomenon in all patient groups.
Only 15% of all undernourished, 6% of the overweight and 11% of the obese outpatients received dietetic treatment.
The circumstances in the outpatients clinic to administer optimal care for malnourished patients (both undernourished and overnourished) were not sufficient. Patients were not weighed at a regular basis, medical charts contained no or insufficient space for data on nutritional status and, in general, nursing and medical staff paid little or no attention to the problem of disease related undernutrition, overweight and obesity. Education programs for the nursing and medical staff on this subject and the availability of guidelines and weighing scales should become optimalised. In the subgroups of patients who are more at risk of undernutrition standard screening on undernutrition with a feasible and valid undernutrition screening tool is needed. BMI should be routinely calculated in all patients to identify the underweight, overweight and obese patients.

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CHAPTER 7

Malnutrition screening in hospital outpatients.

Is the SNAQ malnutrition screening tool also applicable in this population?

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Abstract

Background

In the outpatient setting, only 15% of the malnourished patients was recognised and received nutritional treatment. To increase this number, a quick and easy malnutrition screening tool will be helpful. However, for this population such a tool is lacking. In this study the SNAQ (Short Nutritional Assessment Questionnaire), developed for the hospital inpatients, was used as a basis for the development of such an instrument.

Objective

To develop a quick and easy malnutrition screening tool and to measure the diagnostic accuracy of this tool in hospital outpatients.

Design

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 3 original SNAQ questions proved to be the best set of questions for the outpatient population as well.

In the preoperative and general hospital 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%.

Conclusions

The 3 SNAQ questions that were most predictive of malnutrition for hospital inpatients also appeared to be most predictive for hospital outpatients. With an acceptable diagnostic accuracy it may be concluded that the original SNAQ is valid for the hospital outpatients population.

Introduction

Disease-related malnutrition is a widespread problem in nearly all health care settings. Prevalences of disease-related malnutrition vary from 25-40% in hospital inpatients to 15-25% in home care units and 20-25% in nursing homes.[1-7] To our best knowledge, no data are available on the prevalence of disease-related malnutrition in general hospital outpatients. The prevalence of disease-related malnutrition (based on Body Mass Index (BMI) and percentage of unintentional weight loss) in our own general outpatient population (VU university medical center in Amsterdam, The Netherlands) was 7%.[8]

Disease-related malnutrition may have harmful effects for patients. Studies have reported increased postoperative complications,[9-11] decreased quality of life [12], decreased wound healing[13] and an increased mortality and morbidity.[14] These harmful effects lead to increased length of hospital stay and higher hospital costs.[15-19]

In order to diminish the consequences of disease-related malnutrition it is of paramount importance to recognize malnourished patients in an early stage of their medical treatment. Since the length of hospital stay is decreasing, the time to set out an optimal nutritional treatment plan during the hospital stay is very limited. The recognition and treatment of malnourished patients will shift more and more to the hospital outpatient setting. Especially in peri-operative patients, but also in general hospital outpatients, treatment of malnutrition is an important part of optimal care.[14]

Several studies have pointed out that the recognition of disease-related malnutrition by the medical and nursing staff is often inadequate.[15;20] In our own general outpatient population only 15% of the malnourished patients received nutritional treatment.[8] These findings emphasize the need for an appropriate screening tool to detect malnourished patients. To our knowledge, no malnutrition screening tool has been validated in a preoperative and general hospital outpatient population.

A malnutrition screening tool for the hospital outpatient clinic should be quick, easy and uncomplicated to apply and interpret in clinical practice. An example of such a tool is the Short Nutritional Assessment Questionnaire (SNAQ). The SNAQ (*figure 1*) has been proven to be a valid and reproducible screening tool to determine the nutritional status of hospitalised patients.[21]

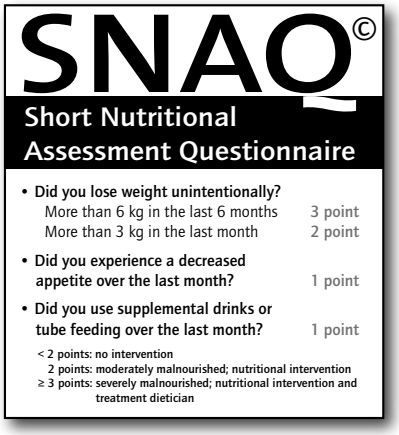

Figure 1 Short Nutritional Assessment Questionnaire (SNAQ), a screening tool for malnutrition developed for the hospital inpatient population.

The recognition of disease-related malnutrition improved from 50% to 80% with the use of this malnutrition screening tool at admission to the hospital.[15;21] Implementation of this screening tool accompanied by a treatment plan at admission for all hospitalised patients, has been proven to be effective and cost effective.[15;22]

The SNAQ has not been validated for the hospital outpatient population. Therefore, the first objective of this study was to determine whether the 3 SNAQ questions that were most predictive of malnutrition in the hospital setting are 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 preoperative and the general outpatient population.

Patients and methods

This study was performed in 3 steps. First, the development of the SNAQ outpatient malnutrition screening tool was performed by selecting the optimal set of questions that are most predictive of malnutrition in a preoperative outpatient population. Secondly, this screening tool was validated in the same preoperative population. Finally, this screening tool was validated in a general outpatient population.
The study design was in accordance with the Declaration of Helsinki and approved by the medical ethical committee of the VU university medical center.

1. Development SNAQ in the preoperative population

Patients

In the period of May 2004 to August 2004 all patients visiting the preoperative outpatient clinic of the VU university medical center were included in the study. These patients were listed for elective surgery, varying from extensive surgery (like an oesophagus resection or an aorta reconstruction), to relatively minor operations (like a knee operation). Patients were excluded from the study when they were under the age of 18 years, were pregnant, suffered from senile dementia, were incompetent of the Dutch language, or were not able to or did not give informed consent.

Nutritional status

All patients were weighed (wearing indoor clothes and shoes) by the nurses of the preoperative outpatient clinic on the same calibrated scale (SECA 880) and were asked for their height. When patients did not know their height, it was measured (SECA 220).
Within 5 working days after their visit to the outpatient clinic, the principal investigator (FN) contacted the participating patients (see next section) and inquired about unintentional weight loss. Based on measured weight, 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.[10;23-26]

Procedure of development SNAQ

The SNAQ malnutrition screening tool was developed in a hospital population by selecting the questions which were most predictive of malnutrition using logistic regression analysis.[21] Since the disease status

and prevalence of disease-related malnutrition in the outpatient population differs from the hospital population, it is possible that the questions that were most predictive in the hospital inpatient population are different from the set of most predictive questions in the hospital outpatient population.
The investigator interviewed the patients by phone after their visit to the preoperative outpatient clinic. The fifteen nutritional questions (*table 1*) which were significantly related to malnutrition in the hospital population were asked.[21] 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.

Table 1 Questions which were significantly related to malnutrition in the hospital inpatient and outpatient population

Questions	OR (CI) inpatients (21)	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 while 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)

** All questions, except the first one, do concern the period of the last month.*

Selecting the optimal SNAQ questions

For the determination of the predictive value of 3 SNAQ questions and the additional questions, binary logistic regression was performed with presence or absence of malnutrition (as defined by BMI and unintentional weight loss) as dependent variable and the questions of table 1 as independent variables. The backward stepwise Waldtest was used. To develop a practical screening tool, the regression coefficients associated with the questions were transformed into a simple score that can be added up to obtain an aggregate score.

2. 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 3 groups, based on the definition of malnutrition: well nourished, moderately malnourished and severely malnourished.
Diagnostic accuracy was assessed at cut-off value 2, comparing the severely malnourished plus moderately malnourished patients with the well-nourished patients and at a cut-off value of 3 points or more, comparing the severely malnourished patients with the moderately malnourished plus well nourished patients. The diagnostic accuracy of the SNAQ was expressed in sensitivity, specificity, positive predictive value and negative predictive value. The sensitivity represents the probability (0-100%) that the SNAQ score is 2 points or more for moderately malnourished patients and 3 points or more for severely malnourished patients. The specificity represents the probability (0-100%) that the SNAQ score is less than 2 points for well nourished patients. The positive predictive value (0-100%) represents the probability that a patient with a score of 2 points is moderately malnourished and with 3 points or more is severely malnourished. The negative predictive value (0-100%) represents the probability that a patient with a score of less than 2 points is well nourished.
The area under the receiver operator characteristic (ROC) curve represents the diagnostic accuracy of the SNAQ score compared to the objective criteria of malnutrition (BMI <18.5 and unintentionally weight loss). The greater the area under the curve, the better the accuracy of the SNAQ. The score varies between 0.5, when the SNAQ is no better than the change of correctly categorizing the two groups, 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.
Statistical analyses were performed using the SPSS-system for Windows, version 12.0 (SPSS, Chicago, VS).

3. Diagnostic accuracy in the general hospital outpatient population

On the 5th of 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 the study when they were under the age of 18 years, were pregnant, suffered from senile dementia, failed in their competence of the Dutch language or did not gave informed consent. Determination of weight, height and classification of nutritional status was performed as described in the preoperative population.
Trained interviewers (n=15) asked patients the 3 SNAQ questions, age, questions on nutritional status, medical condition, dietetic therapy, elective surgery and existence of several diseases as described in the former article.[8]
Statistics were performed as described in section 2.

Results

1. Development of the SNAQ in the preoperative population

In this sub study 1107 patients were included. 109 Patients (10%) were excluded because of the following causes: the investigator did not succeed to contact the patient by phone within a period of 5 working days (n=50), the telephone number was not detectable (n=31), the patient could not/would not participate (n=25) or the patient was unable to speak due to oral or throat related conditions (n=3). After exclusion of another 19 patients (2%) in which no definition of nutritional status could be determined because of incomplete data, the data of 979 patients were analysed.
There were no significant differences between included patients and excluded patients in sex, age, SNAQ score, weight loss, BMI and prevalence of oncological disease.

Patients

The characteristics of this pre-operative population are presented in *table 2*. Age varied from 18-93 with a mean of 49 ± 17 years of age. The percentage of women in this study population was 58%. The most common referring specialisms to the preoperative outpatient clinic were otolaryngology (21%), gynaecology (19%), orthopaedics (9%), surgical oncology (7%), plastic surgery (7%) and neurological surgery (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.

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 % woman	58.1%	57.1%	62.7%	0.749‡
Age in years (± SD)	49 (16.5)	55 (16.4)	51 (17.1)	0.024†
BMI in kg/m2 (± 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‡

Development of the SNAQ

Binary logistic regression analysis was performed to determine the optimal set of questions to screen for disease-related malnutrition for the outpatient population. This resulted in the following 3 questions: "Did you lose weight unintentionally (more than 6 kg in the last six months and/or more than 3 kg in the last month)?", "Did you use supplemental drinks or tube feeding over the last month?" and "Did you experience difficulties with eating and drinking over the last month?" The question "Did you experience difficulties with 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 (respectively an OR of 2.7 (95% CI 1.6-4.5) and an OR of 2.2 (95% CI 1.2-4.2)) and were therefore exchangeable.

In order to make the SNAQ an easy-to-use tool, the score was achieved by making round numbers for 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, 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.

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

Questionnaire	OR (CI) outpatients	β 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

2. Diagnostic accuracy of the SNAQ in the preoperative population

9% (n=89) Of the patients had a SNAQ malnutrition score of 2 points or more and 8% (n=78) of the patients had a score of 3 points or more, whereas 5% of patients was moderately malnourished and 7% severely malnourished according to the objective criteria of malnutrition.
The diagnostic accuracy of the SNAQ for cut-off value 2 and 3 are presented in *table 4*. The ROC curve of the SNAQ for these patients showed an area under the curve (AUC) of respectively 0.74 (95% CI 0.66-0.81) and 0.78 (95% CI 0.72-0.83).

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)

3. Diagnostic accuracy in the general hospital outpatient population

Patients

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 19-88 with a mean of 54 (± 17) years of age. The percentage of women in this study population was 56%.

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 % woman	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/m2 (± 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

The subgroups with the highest prevalence of malnutrition were surgery (13%), pulmonology (12%), radiotherapy (9%) and gastroenterology (9%). Of all included patients 20% had an oncological disease. 7% (n=47) Of the patients had a SNAQ malnutrition score of 2 points or more and 5% (n=32) of the patients had a score of 3 points or more, according to the objective criteria of malnutrition 2% of patients was moderately malnourished and 6% severely malnourished.
The diagnostic accuracy for cut-off value 2 and 3 are presented in table 4. The ROC curve of the SNAQ for these patients showed an area under the curve (AUC) of respectively 0.87 (95% CI 0.80-0.94) and 0.85 (95% CI 0.77-0.93).

4. 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 prevalence of malnutrition of 8% or higher. For the preoperative outpatient population these departments were: surgery 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 are presented in *table 6*.

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 outpatient population				
- cut-off value 2 points or more, high risk	59% (42-72)	94% (90-97)	73% (58-85)	89% (85-93)
- cut-off value 3 points or more, high risk	57% (39-74)	90% (86-94)	48% (32-64)	93% (89-96)
General hospital outpatient population				
- cut-off value 2 points or more, high risk	71% (54-85)	100% (98-100)	100% (86-100)	96% (93-98)
- cut-off value 3 points or more, high risk	69% (48-86)	98% (96-100)	82% (60-95)	97% (94-99)

Discussion

In this, to our best knowledge, first diagnostic accuracy study of a disease-related malnutrition screening tool in a general hospital outpatient population, the prevalence of moderate and severe malnutrition in the preoperative patients in the VU university medical center was respectively 9% and 8%. In the general outpatient population respectively 7% and 5%. The diagnostic accuracy of these two diagnostic accuracy studies, using the SNAQ malnutrition screening tool, resulted in a sensitivity of 53-67% and a specificity of 94-97%.

Because of the differences between hospital outpatients and hospital inpatients we checked whether the same set of questions was most predictive of malnutrition in both patient groups. Two models, containing 3 questions, were equally predictive for outpatients. One of those was exactly the same as the original SNAQ for hospital inpatients. Therefore we concluded that the SNAQ malnutrition screening tool, developed for the hospital inpatient population, in its original form is also applicable for the outpatient population.

Detection of malnourished patients by the nursing and medical staff, before adopting the SNAQ malnutrition screening tool, was only 15% (8). Possible explanations for this are the high workload of the nursing and medical staff in the outpatients clinics and a lack of malnutrition guidelines.[8]
Introduction of a malnutrition screening tool for the hospital outpatient population is expected to improve detection of disease-related malnutrition. Weighing all patients and calculating the BMI and the amount of unintentional weight loss is the preferred way of assessing nutritional status. This often appears not to be feasible because the medical and nursing staff generally do not give priority to the detection of malnutrition in their busy time schedule. However, implementation of the SNAQ malnutrition screening tool in the routine care in the hospital outpatient setting is feasible because this will only take a few minutes of the nurses time. Implementation of the SNAQ in the hospital outpatient setting may improve the recognition and treatment of the malnourished outpatients from 15% to 53-67%.

The diagnostic accuracy of the SNAQ for moderately plus severely malnourished patients (cut-off value 2 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 can be explained by the lower prevalence of disease-related malnutrition in the outpatient population and the differences between both populations. For example; an expected higher intensity of disease 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 of the diagnostic accuracy.

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

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

A treatment protocol, based on the SNAQ score, has been developed to guarantee optimal care in the preoperative phase. All patients with a SNAQ score of two points or more (moderately/severely malnourished) will receive advice in a brochure or by group education how to improve their nutritional status. Patients with a SNAQ score of at least 3 points (severely malnourished) will receive dietetic treatment. This protocolled treatment can improve the nutritional status at admission to the hospital. Whether this treatment plan is effective and cost effective will be investigated.
Besides the preoperative department, screening should at least take place at departments with a high prevalence of malnutrition. In our study these departments were haematology, pulmonology, radiotherapy, gastroenterology, oncology, internal medicine and gynaecology.

Conclusion

The SNAQ malnutrition screening tool in its original form is applicable in the hospital outpatient population. 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 on high malnutrition risk departments may improve the recognition to 71%.
Since calculating BMI and percent involuntary weight loss of each patient is not 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 protocolled nutritional treatment plan based on the SNAQ score improves the nutritional status in the preoperative phase and decreases the prevalence of disease-related malnutrition at admission to the hospital.

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CHAPTER 8

General discussion

Main findings

Malnutrition is relatively common in hospitalized patients, but it is under-recognised and under-treated: that was the main result of the first Dutch national screening on malnutrition in 2001.
The failure to recognise and treat malnutrition, especially where it is common, is ethically and medically unacceptable. In these circumstances, the routine use of a simple screening procedure may prove valuable. Each healthcare setting should be obliged to have a transparent policy about nutritional screening, which may vary according to the percentage of recognised and treated malnourished patients, available resources and prevalence of malnutrition. A quick and easy and valid malnutrition screening tool with a standardised nutritional care plan may be essential to improve the nutritional status in Dutch hospital care.

We developed the Short Nutritional Assessment Questionnaire (SNAQ), which can be integrated in the nurses' intake at admission of the patient to the hospital. The SNAQ proved to be a valid and reproducible instrument to detect malnourished hospital patients in an early stage of hospitalisation. The SNAQ is quick and easy to use: it can be filled out in less than 5 minutes without calculations of the percentage of weight loss or BMI. Therefore it can be applied with a nutritional care plan in Dutch hospitals on all medical wards in adult patients.

The nutrition care plan following identification of malnourished patients with the SNAQ consisted of energy- and protein-enriched meals and two in-between meals for the patients that were moderately or severely malnourished. Severely malnourished patients received dietetic treatment. The SNAQ screening and nutritional care plan was implemented in a general hospital population and was compared with a control group who received standard clinical practice. Due to the SNAQ screening and nutritional care plan, recognition of malnourished patients increased from 50% to almost 80% and dietetic treatment started in an earlier stage of hospitalisation. Daily intake of malnourished patients increased by approximately 600 kcal and 12 g protein through standardisation of the nutritional care. The number of meals increased and the type of meals changed from medical nutrition (i.e. supplemental drinks) to normal food. The allocation of tasks between dietician, nurse and nutritional assistant became clearer. The nurse screened the nutritional status at admission and evaluated the nutritional status by weighing the patient during hospitalisation. The nutrition assistant handed out the in-between meals and encouraged the patients to eat and drink these. Due to this optimised task allocation the total workload of the dietician was not increased despite of the fact that more malnourished patients received dietetic treatment. The length of hospital stay was reduced in malnourished patients with low hand grip strength and the cost effectiveness analysis pointed out that, with an investment of EUR 76 on screening, in between meals and dietetic treatment the length of hospital stay will be reduced with one day. Assuming that the mean costs of a 1-day stay in the hospital are EUR 476 for university hospitals and EUR 337 for peripheral hospitals,[1] implementation of SNAQ screening and treatment would result in substantial savings together with quality improvement of care.

The patients who were characterised as malnourished by the SNAQ had more health care needs, poorer quality of life, lower functional capacity and a lower fat free mass index. These findings underline the assumption that a considerable proportion of the malnourished hospital patients should be considered to be patients with complex health care needs and that malnutrition is an important aspect and indicator of the overall health status of patients.

The hospital outpatient group was not included in the national screening on malnutrition of 2001. For a general outpatient population no reliable prevalence of malnutrition is known. Since hospital stay duration decreased, the problem of disease related malnutrition may be shifting to the outpatient clinic. We performed a cross sectional prevalence study in which the nutritional status of all patients who visited the outpatient clinic of the VU university medical center at the 5th of April 2005, was measured. Seven hundred and five patients were included.
In this study, 6% of all outpatients were undernourished, 36% were overweight and 17% were obese. Only 15% of all undernourished, 6% of the overweight and 11% of the obese outpatients received dietetic treatment.
Patients with gastrointestinal disease, renal disease, neurological disease and oncological disease were most at risk of undernutrition. Departments with a relative high risk for undernourished patients were surgery (13%), pulmonology (12%), radiotherapy (9%), gastroenterology (8%) and internal medicine (8%). To increase the number of recognised and treated undernourished outpatients, screening with a quick and easy screening instrument, especially in these high risk departments, might be a first step to improve diagnostic and therapeutic accuracy.

The three original SNAQ questions were found to be most predictive for malnutrition in the outpatient population. Therefore, implementation of the SNAQ malnutrition screening tool may improve recognition and treatment of malnourished patients from 15% before screening to 53-67%. If screening is restricted to high malnutrition risk departments, recognition may improve up to 71%.

The SNAQ in relation to other malnutrition screening tools

Several professional organisations, governments and international agencies support nutritional screening in hospitalized patients, among which the European Society of Parenteral and Enteral Nutrition[2] and the Council of Europe.[3-5]
in 2005 a systematic review was performed to answer the question "Which quick-and-easy malnutrition screening tools detects disease-related undernutrition in hospital in- and outpatient setting best?".[6]
Inclusion criteria for a study in this systematic review were if the tool was
1) validated
2) in an adults population
3) with the outcome: disease related malnutrition present or absent
4) with sensitivity and specificity derivable.
Methodological quality was assessed in studies including an acceptable reference standard (including at least weight loss or another anthropometric changing over time and a measurement of current body composition as BMI) and clinical relevant sensitivity and specificity (>65%). Two reviewers independently selected all studies and appraised study quality formally with the QUADAS checklist for diagnostic studies.[7] For each included quick and easy malnutrition screening tool the sensitivity and specificity (95% CI) were abstracted.
The search enclosed 1513 citations of which finally, nine studies with quick-and-easy malnutrition screening tools with an adequate sensitivity and specificity compared to an acceptable reference standard remained. No tool remained adequate for the general hospital outpatient population after further

quality assessment. For the general hospital inpatient population, two quick-and easy tools, the SNAQ and the MST (Malnutrition Screening Tool [8]), were of sufficient study quality. However, although the diagnostic accuracy of the MST was slightly better, the MST-study was prone to bias as the QUADAS 'score' was lower for blinding. In addition, the cut off point of the MST for positive screening was defined post-hoc and lacked cross validation.
The conclusions of this review was that the SNAQ validation study is of very good quality, and that only the SNAQ fulfilled all the important criteria for a nutritional screening tool. Therefore, SNAQ appears to be the most appropriate candidate to be the quick-and-easy malnutrition screening tool for the hospital inpatient population.
A consensus meeting of the Dutch Dietetic Association took place in December 2005 to determine which malnutrition screening tool on screening on malnutrition at admission should be used in a national implementation campaign in all Dutch hospitals. Based on the results and conclusion of the systematic review of Van Venrooij [6] the SNAQ was accepted to be this tool. Next to the SNAQ, the MUST (Malnutrition Universal Screening Tool) [9], can be used. The MUST is a diagnostic malnutrition screening tool which includes calculation of unintentional weight loss, Body Mass Index and severity of disease. Since this tool is similar to the reference standard as used in the validation of the SNAQ, the diagnostic accuracy is probably better than any quick and easy malnutrition screening tool. In hospitals or separate departments in which calculation of BMI and percentage of unintentional weight loss and BMI and measuring of the body weight at admission by the nurse is feasible, implementation of the MUST is preferable. Unfortunately, this seems to be rarely the case.

The past, the present and the future of disease related malnutrition screening

The past

The awareness of the magnitude of disease related malnutrition in the modern medicine started with the publication of Mc Wirther & Penington in 1994.[10] This publication increased awareness and stimulated further research. In 2000, the Dutch Dietetic Association initiated a national campaign to increase awareness on disease related malnutrition with the title: "Eat well to get well" (Wie beter eet wordt Sneller Beter). The goal of this campaign was to draw attention to disease related malnutrition in society and among health care professionals. This national campaign was the first joined activity of dieticians, physicians and nutritionists to tackle the problem of disease related malnutrition in The Netherlands. This campaign was followed by the first Dutch screening on malnutrition as described in chapter 1.
In 2004 an expert group "Eat well to get well" was established to revive the interest in the problem of disease related malnutrition aiming at politicians, physicians, dieticians, nurses, and patients and to improve the nutritional care in all care settings. The direct motive for the establishment of this expert group was the government campaign on improvement of primary care and hospital performance, known by the name "Sneller Beter" (Better Faster).
The "Sneller Beter" Programme comprises three core activities. These are 1) benchmark hospitals and primary health care; 2) indicators for safer and better care and 3) the quality, innovation and efficiency programme. The benchmarks for the hospitals and primary health care providers highlight the differences between care providers, and show where improvement is needed. The aim of the indicators project is to develop an efficient, effective monitoring method, while the quality, innovation and efficiency programme seeks to achieve major results quickly. Three priorities have been identified: patient security, logistics and

control. Since optimising the recognition of malnourished patients and the nutritional care fits this format, initiatives on this subject can be performed in the slipstream of the "Sneller Beter" program.

The present

In 2005 the initiated expert group "Eat well to get well" developed a benchmark on disease related malnutrition. In 2007, this malnutrition benchmark will be added to the national set of hospital benchmarks. The malnutrition benchmark will include an ICD (International Classification of Disease) -code malnutrition. In each hospital, the number of patients with this ICD-code will be compared to the prevalence of malnutrition as measured in the National Prevalence Measurement of Health Care Problems.
Since 2004, the prevalence of malnutrition is part of the National Prevalence Measurement of Health Care Problems (Landelijke Prevalentiemeting Zorgproblemen (LPZ)). The prevalence of disease related malnutrition is measured every year in a cross sectional study in which about 60 hospitals, 120 nursing homes and 20 home care agencies participate.
This benchmark will encourage hospitals to improve the recognition of disease related malnutrition. To facilitate this improvement of recognition of malnourished hospital patients, a national implementation campaign will be started to implement screening on malnutrition in all patients at admission to the hospital followed by a standard nutritional treatment plan in autumn 2006. The pilot phase of this implementation project started in the beginning of 2006, aiming at development and testing an implementation toolkit for the scheduled national implementation campaign. This campaign will be granted by the Ministry of Health, Welfare and Sport and executed by the expert group "Eat well to get well".

The future

With regard to the hospital situation, we expect that these joint efforts may improve the health care situation on disease related malnutrition substantially. In 2007 the malnutrition benchmark will be part of the set of benchmarks that assess the quality of care of all Dutch hospitals. In this way an adequate recognition of disease related malnutrition will be part of the quality assessment of hospitals. The malnutrition screening implementation campaign will have given all Dutch hospitals the opportunity and tools for implementation of malnutrition screening in all patients at admission to the hospital, followed by a standard nutritional care plan.

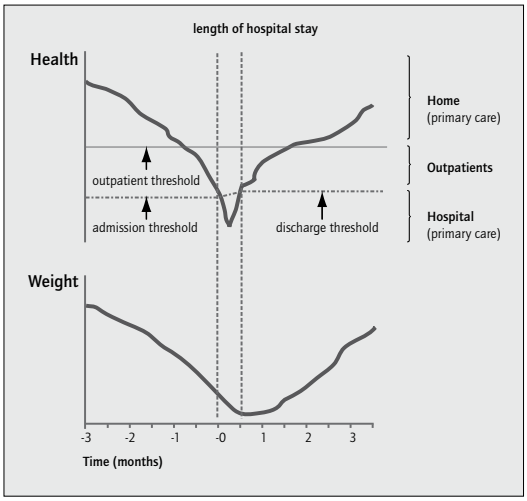

Figure 1 Change in Health status and weight during a disease course (from (9))

Although it is expected that the recognition of hospital malnutrition will improve, new issues on disease related malnutrition will need to be addressed. *Figure 1* shows the change in health status and weight during a disease course. Deterioration of health may progress for months before admission to hospital. Weight loss begins before admission, frequently continues in hospital and persists for a period after discharge. The proportion of time during disease course spent in hospital is often well below 5%. Besides this, patients identified as malnourished or at risk of becoming malnourished in one health care setting are often not followed up when they are transferred into another health care setting. This may be due to lack of continuity of information. Therefore, there is a need to establish a coherent and structured approach to detect and manage malnutrition throughout all health care settings.

In order to be able to treat malnutrition in an early stage, it is recommendable that physicians in all settings, but especially the General Practice (GP) physician incorporates the nutritional status in the general patient analysis. Calculating the BMI and percentage of involuntary weight loss might be possible when appropriate software is available. Validation of a quick and easy malnutrition screening tool, such as the SNAQ, is another possibility. The GP physician can inform the patients on the adverse effects of unintentional weight loss and if necessary refer to a dietician. Improvement of the recognition and treatment of malnutrition in the early stages of disease will probably effect in a lower prevalence of malnutrition at admission to hospital. Cost-effectiveness research will have to point out what profits (both financially and in health status) more intensive nutritional screening and treatment in the primary care setting and the outpatient setting will have.
For the outpatient setting, much improvement is necessary. Implementation of the SNAQ screening with a nutritional care plan in the high malnutrition risk departments may result in a substantional improvement of the recognition and treatment of malnourished patient. A practical barrier may be that this improved recognition will lead to an intensified work load of the dietetic department. In a general hospital this can result in an increase of 300 to 400 outpatient referrals to a dietician per month.
For this reason it is of paramount importance that not only dieticians and nutritionists but also the management of the hospitals, nursing homes, revalidation centres, home care facilities and politicians agree on the importance of adequate nutritional care.

General conclusive remarks

Disease related malnutrition is a wide spread problem which is not properly addressed in current medical practice. Screening on malnutrition should ideally be as common as measuring body temperature and blood pressure. Implementation of malnutrition screening in all Dutch hospitals potentially initiates improvement in the total health care system.
Future research should focus on development of screening- and treatment methods that are cost-effective in other subgroups of patients such as elderly patients, General Practice patients, nursing home patients, home care patients and chronically ill patients. Effect of nutritional therapy needs to be studied more in respect to health consequences, length of hospital stay, quality of life, immune status and cognitive functioning. These effects needs to be studied in specified groups of (hospitalised) patients, for instance the malnourished patients with low hand grip strength.
Dieticians and the expert group "Eat well to get well" and other initiatives may be necessary to constantly keep interest in the problem and solutions of disease related malnutrition vivid in politicians, physicians, nurses, managers and patients.

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Summary

Malnutrition is common, under-recognised and under-treated. That was the main result of the 2001 national screening on malnutrition as described in chapter 2. This screening was organised by the Dutch Dietetic Association and followed a national awareness campaign with the title "Eat well to get well" to draw attention to disease related malnutrition in society and among health care professionals. 7606 patients participated in the screening of which 12% (884) appeared to have lost more that 10% of their weight unintentionally, 13% (962) had lost 5-10% of their weight unintentionally and 75% (5760) did not lose weight. In this study nutritional status was defined by solely unintentional weight loss. This definition leaves out the patients that are malnourished based on a low Body Mass Index (BMI<18.5) with no recent weight loss.
Only 54% of the patients with more than 10% unintentional weight loss were referred to a dietician for nutritional treatment.
This screening shows the extent of the problem of disease related malnutrition: the high prevalence and low recognition and treatment. The frequent failure to recognise and treat malnutrition, especially where it is common is unacceptable. The main conclusion for the Dutch situation was that the development of a quick, easy and valid malnutrition screening tool with a standardised nutritional care plan was needed.

Chapter 3 describes the development and validation of the Short Nutritional Assessment Questionnaire (SNAQ) initially only for the hospital setting. The SNAQ can be integrated in the nurses' intake of the patient at admission to the hospital. The SNAQ exists of three questions that needs no calculation or measuring and can be filled out in less than 5 minutes. The SNAQ proves to be a valid and reproducible instrument to detect and treat malnourished hospital patients in an early stage of the hospitalisation. The SNAQ and its linked nutritional care plan is a practical instrument that can easily be used in all Dutch hospitals and on all medical wards in adult patients, even if nurses are not focussed on inquiring specific details of nutritional status.

The nutrition care plan of the SNAQ consisted of energy- and protein-enriched meals and two in-between meals for the patients that were moderately or severely malnourished. Severely malnourished patients received dietetic treatment. The SNAQ screening and nutritional care plan was implemented in a general hospital population and was compared to a control group who received usual clinical practice (chapter 4). Due to the SNAQ screening and nutritional care plan the recognition of malnourished patients improved from 50% to almost 80% and the dietetic treatment started in an earlier stage of the hospitalisation. Through standardisation of the nutritional care, the daily intake of the malnourished patients increased by approximately 600 kcal and 12 g protein. The number of meals was increased and the type of meals changed from medical nutrition (i.e. supplemental drinks) to normal food. The allocation of tasks between the dietician, nurse and the nutritional assistant improved. The nurse screened the nutritional status at admission and evaluated the nutritional status by weighing the patient during the hospitalisation. The nutrition assistant handed out the in-between meals and stimulated the patients to eat and drink. Due to this optimised task allocation the total workload of the dietician was not elevated despite of the fact that more malnourished patients received dietetic treatment.
The length of hospital stay was reduced in malnourished patients with low hand grip strength and the cost effectiveness analysis pointed out that with an investment of 76 euros on screening, in between meals and dietetic treatment the length of hospital stay reduced with one day. Assuming that the mean costs of a 1-d stay in the hospital are EUR 476 for university hospitals and EUR 337 for peripheral hospitals, implementation of SNAQ screening and treatment could result in substantial savings.

Chapter 5 gives an answer to the question "Are malnourished patients complex patients?". The patients who are characterised as malnourished by the SNAQ had more health care needs, poorer quality of life, lower functional capacity and a lower fat free mass index. These findings underline the assumption that a considerable proportion of the malnourished hospital patients should be considered complex patients and that malnutrition is an important aspect and indicator of the overall health status of patients.

In the national screening on malnutrition of 2001 the hospital outpatient group was not included. For the general outpatient population no reliable data on the prevalence of malnutrition is available. Since the patients are discharged from the hospital sooner than they were several years ago, the problem of disease related malnutrition may be shifting to the outpatient clinic. We performed a cross sectional prevalence study in which the nutritional status of all patients who visited the outpatient clinic of the VU University medical center on the 5th of April was measured (chapter 6). 705 patients were included and 6% was malnourished. Patients with gastrointestinal disease, renal disease, neurological disease and oncological disease were most at risk of malnutrition. High risk departments were surgery (13%), pulmonology (12%), radiotherapy (9%), gastroenterology (8%) and internal medicine (8%).
In this hospital outpatient setting, only 15% of the malnourished patients was recognised and received nutritional treatment. To increase this number, especially in the high risk departments, screening with a quick and easy screening instrument would be a first step to improve these numbers. However, for this population such a tool is not available.
In chapter 7 the SNAQ as developed for the hospital inpatient population, was used as a basis for the development of such an instrument. The objective was to develop a quick and easy malnutrition screening tool and to measure the diagnostic accuracy of this tool in hospital outpatients.
First, the optimal set of questions that were most predicting of malnutrition was selected for the preoperative outpatient population. Secondly, the diagnostic accuracy for preoperative outpatients was determined (979 patients) and finally, the diagnostic accuracy for general hospital outpatients was established (705 patients).
The four original SNAQ question were also most predictive of malnutrition in the hospital outpatient population. Implementing the SNAQ malnutrition screening tool may improve the recognition and treatment of malnourished patients from 15% before screening to 53-67%. Deciding to screen only on high malnutrition risk departments the recognition may improve up to 71%.

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Pomotiecommissie

De promotiecommissie bestaande uit ***prof. dr. J.J. van Binsbergen, prof. dr. S. Danner, prof. dr. C.J.J. Mulder, prof. dr. M.W. van Tulder, prof. dr. ir. A.M.W.J. Schols, prof. dr. W.A. van Staveren*** wil ik bedanken voor de beoordeling van dit proefschrift.

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Patiënten & VUmc

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Studenten

In dit onderzoek heb ik hulp gehad van een aantal studenten. ***Anne Carina, Hedy, Sanne, Brigit, Esther*** en ***Annemarie***, hartelijk dank!

Familie & vrienden

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Boven alles bedank ik ***God*** die altijd bij me is en blijft.

Hinke Kruizenga *6 maart 2006*

Curriculum Vitea

Hinke Martine Kruizenga werd op zondag 10 augustus 1975 geboren in Assen en heeft daar 19 jaar heel prettig gewoond met moeder, vader, twee oudere zussen, een jonger broertje en een jonger zusje. Na afronding van de HAVO aan het Gomarus College in Groningen is zij in 1992 gestart met de opleiding Voeding & Diëtetiek aan de Hanzehogeschool in Groningen. Na afronding heeft ze van 1996 tot 1998 Voeding & Gezondheid gestudeerd aan de Wageningen Universiteit. Het eerste afstudeervak ging over vitamines bij ouderen (vakgroep Humane voeding onder begeleiding van prof.dr. W.A. van Staveren) en het tweede afstudeervak over de meerwaarde van voedingsvezel in sondevoeding (vakgroep fysiologie & Numico Research, onder begeleiding van dr. V.V. Schreurs). Dit was haar eerste echte ervaring met onderzoek. Ze heeft heel Wageningen afgefietst met potjes ontlasting van de proefpersonen aan het stuur. Na afronding van de studie in Wageningen kreeg ze een baan bij de afdeling Diëtetiek & Voedingswetenschappen van het VU medisch centrum in Amsterdam. Eerst als diëtist maar al snel kwam daar klinisch voedingsonderzoek bij. Van 2000 tot 2002 heeft ze onderzoek gedaan naar de effecten van radiotherapie op voedingstoestand en energieverbruik bij patiënten die radiotherapie ondergaan in het hoofd-halsgebied. Van 2002 tot december 2005 is ze bezig geweest met haar promotieonderzoek naar de effecten van vroege herkenning en behandeling van ondervoede patiënten in het ziekenhuis. Dit onderzoek werd uitgevoerd onder leiding van prof. dr. ir. J.C. Seidell en dr. M.A.E. van Bokhorst – de van der Schueren. Op dit moment is ze projectleider ondervoeding van het VWS project "Vroege herkenning & behandeling van ondervoeding in de Nederlandse ziekenhuizen". Het doel van dit project is implementatie van screening op ondervoeding bij opname en instelling van geprotocolleerde voedingsbehandeling in 70% van de Nederlandse ziekenhuizen. Daarnaast is ze docent bij het instituut voor gezondheidswetenschappen van de Vrije Universiteit. Ze verzorgt hier de mastercursus Klinische Voeding. Ook is ze werkzaam bij de afdeling Diëtetiek & voedingswetenschappen van het VU medisch centrum waar op dit moment haar voornaamste taak is de SNAQ ziekenhuisbreed te implementeren. Ze woont samen met haar man, Harry Veen, en haar zoon David in Haarlem.