Prevalence of malnutrition in nonsurgical hospitalized patients and its association with disease complications[1,2]

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See corresponding editorial on page 1063.

ABSTRACT The prevalence of malnutrition and its predictive value for the incidence of complications were determined in 155 patients hospitalized for internal or gastrointestinal diseases. At admission, 45% of the patients were malnourished according to the Subjective Global Assessment (physical examination plus questionnaire), 57% according to the Nutritional Risk Index [(1.5 × albumin) + (41.7 × present/usual weight)], and 62% according to the Maastricht Index [(20.68 − (0.24 × albumin) − (19.21 × transthyretin (prealbumin) − (1.86 × lymphocytes) − (0.04 × ideal weight)]. Crude odds ratios for the incidence of any complication in malnourished compared with well-nourished patients during hospitalization were 2.7 (95% CI: 1.4, 5.3) for the Subjective Global Assessment, 2.8 (1.5, 5.5) for the Nutritional Risk Index, and 3.1 (1.5, 6.4) for the Maastricht Index. Odds ratios were reduced to 1.7 (0.8, 3.6), 1.6 (0.7, 3.3), and 2.4 (1.1, 5.4), respectively, after a multivariate analysis that included disease category and disease severity. Because the confounding factors adjusted for are not only a measure of the severity of the disease but may also be influenced by malnutrition itself, the actual risk for complications due to malnutrition could be higher than the adjusted odds ratios. In conclusion, malnutrition was frequent in patients with gastrointestinal disease and other internal diseases at the time of admission. The severity of malnutrition in the patients predicted the occurrence of complications during their hospital stay and this association was not completely explained by confounding factors. *Am J Clin Nutr* 1997;66:1232–9.

KEY WORDS Malnutrition, Subjective Global Assessment, Nutritional Risk Index, Nutritional Index, internal diseases, gastrointestinal diseases, postoperative complications, Maastricht Index, odds ratio, humans

INTRODUCTION

Many hospitalized patients are malnourished. However, the relation among malnutrition, disease, and complications is unclear. About 30% of patients in surgical wards have been found to be malnourished at admission (1–10). There is limited information about the nutritional status of nonsurgical hospital patients (5, 7, 11–13). Nutritional depletion is usually caused by the joint action of an underlying disease, eg, cancer and dietary deficiency (**Figure 1**). It is not clear to what extent each of these two factors is responsible. If insufficient food intake is a factor in the development of nutritional depletion and also of the associated complications, then treatment should be focused not only on the disease but also on nutritional intervention. In malnourished surgical patients perioperative parenteral nutrition may indeed reduce the rate of postoperative complications (14, 15). The association between malnutrition and occurrence of complications in nonsurgical patients is less clear. We therefore assessed the nutritional status of patients at admission to an internal medicine ward and a ward for gastrointestinal diseases and the association of nutritional status with the subsequent development of complications.

SUBJECTS AND METHODS

Subjects

Only seriously ill patients are hospitalized in the Netherlands; others are treated as outpatients. We excluded patients admitted only for observation after endoscopic treatment, patients who were unconscious or clinically unstable, and all those unable or unwilling to give their informed consent. All 155 eligible patients who gave their informed consent entered the study. Nutritional status was assessed within 24 h after admission. The study was approved by the Committee for Ethics and Research in Humans.

Design

The University Hospital of Nijmegen University Medical School serves as the tertiary referral hospital for an area 50 by 100 km (30 by 60 miles) in the southeastern part of the Netherlands with a catchment area population of 2.3 million. We assessed nutritional status in patients admitted to the gastrointestinal and internal medicine wards over one 4-mo period and another 2.5-mo period 9 mo later. No nutrition support team was active in the wards. The patients' nutritional status at entry was evaluated; during the first study period nutritional status was also evaluated at discharge. No single nutritional

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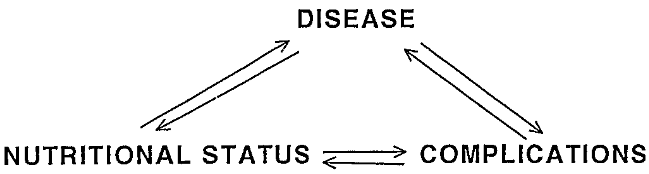

FIGURE 1. Mutual relations between nutritional status, underlying disease, and complications during the course of the disease.

index is considered a reference standard; therefore, we applied three previously investigated, well-established methods simultaneously. The occurrence of disease complications during the hospital stay was studied as a function of the nutrition status at entry.

Assessment methods for malnutrition

The Subjective Global Assessment (2, 16, 17) is a clinical score. It was performed by a trained independent physician using a standardized questionnaire concerning food intake and complaints such as vomiting, diarrhea, and loss of weight. A physical examination focused on nutritional status, and weights were corrected for edema, ascites, and dehydration. On the basis of these data the physician classified the patient as not, mildly, moderately, or severely malnourished (*see* Appendix A). The physician had no knowledge of the patient's medical history, diagnosis, laboratory test results, or the reason for admission.

The Nutritional Risk Index (18, 19) is derived from the serum albumin concentration and the ratio of actual to usual weight with the equation

$$\text{Nutritional Risk Index} = (1.489 \times \text{serum albumin, g/L}) + 41.7 \times (\text{present weight/usual weight}) \quad (1)$$

A Nutritional Risk Index > 100 indicates that the patient is not malnourished, 97.5–100 mild malnourishment, 83.5 to < 97.5 moderate malnourishment, and < 83.5 severe malnourishment. The usual weight was defined as the stable weight ≥ 6 mo before admission. The actual weight was determined with the patient sitting on a calibrated balance (Seca, Hamburg, Germany).

The Maastricht Index (20) uses serum albumin and transthyretin (prealbumin) concentrations, blood lymphocyte count, and percentage of ideal weight according to the following equation:

$$\text{Maastricht Index} = 20.68 - (0.24 \times \text{albumin, g/L}) - (19.21 \times \text{transthyretin, g/L}) - (1.86 \times \text{lymphocytes, } 10^6\text{/L}) - (0.04 \times \text{ideal weight}) \quad (2)$$

This index is called the Nutritional Index by the investigators in Maastricht (20) who developed it; we use the term Maastricht Index to avoid confusion with the Nutritional Risk Index. We measured height with a measuring staff (Seca) and wrist circumference (Stanley Tools, New Britain, CT) and then derived ideal weight from the tables of the Metropolitan Life Insurance Company (21). Nutritional status is graded as either malnourished or not malnourished with the Maastricht Index; patients with a Maastricht Index > 0 are considered malnourished.

In the 90 patients studied in the first 4-mo period, nutritional status was assessed twice: once at admission and once at discharge. We also determined the Nutritional Risk Index and the Maastricht Index in 175 healthy blood donors and in 34 healthy elderly participants in the strenuous Nijmegen Four Days Walking March. In these 209 healthy subjects the apparent percentage of malnourished persons was 1.9% according to the Nutritional Risk Index and 3.8% according to the Maastricht Index. These low values showed that a high percentage of malnutrition in patients was not likely to be caused by false-positive diagnoses (22).

TABLE 1
Diagnoses of the 155 patients at admission to a nonsurgical ward[1]

Nonmalignant disease				Cancer	
Gastrointestinal	*n*	Nongastrointestinal	*n*	Type	*n*
Crohn disease	10	Diabetes	10	Esophagus	4
Abdominal pain[2]	8	Hypo-γ- globulinemia	4	Pancreas	4
Liver cirrhosis	5	Anemia	4	Hepatocellular	3
Hepatic encephalopathy	3	Cardiac decompensation	4	Colon	3
Pancreatitis	3	Pneumonia	3	Gastric	2
Ulcerative colitis	3	Thrombosis	3	Lung	2
Short-bowel syndrome	3	AIDS	3	Osteosarcoma	1
Rectal bleeding	3	COPD	2	Leukemia	1
Gastrointestinal bleeding	3	Hypertension	2	M Kahler	1
Acute pancreatitis	2	Fever[2]	2	Non-Hodgkin lymphoma	1
Vomiting	2	Others	12	Thyroid	1
Gastroenteritis	2				
Gastric ulcer	4				
Esophageal bleeding	2				
Others	30				
Total	83		49		23

[1]COPD, chronic obstructive pulmonary disease; AIDS, acquired immunodeficiency syndrome.
[2] Of unknown origin.

TABLE 2
Number of new complications in 155 patients in a nonsurgical ward during their hospital stay[1]

		Noninfectious complications			
Infectious complications	*n*	Severe	*n*	Less severe	*n*
Severe		Fever (not bacterial)	18	Vomiting	11
Pneumonia	7	Intestinal bleeding	6	Dermatosis	10
Septicemia	5	Dehydration	4	Diarrhea	9
Abdominal abscess	2	Kidney failure	4	Obstipation	9
		Decubitus ulcer	3	Phlebitis	9
		Heart failure	3	Anemia	6
Less severe		Hemoptysis	2	Mild intestinal bleeding	4
Cystitis	5	Venous thrombosis	2	Edema	4
Local candidiasis	4	Transient ischemic attack	2	Hyper- and hypoglycemia	4
Wound infection	3	Pancreatitis	2	Delayed wound healing	4
Conjunctivitis	2	Fistula	2	Rhinorrhagia	3
Laryngitis	1	Vaso-vagal collapse	2	Arthralgia	3
Onychia	1	Lung embolism	2	Atelectases	3
Furuncle	1	Cerebrovascular accident	2	Thrombopenia, leukopenia	3
Cholangitis	1	Epileptic insult	1	Oral mucosal defects	2
		Ileus	1	Minor decubitus ulcer	2
		Cutaneous ulcus	1	Mild cardiac arrhythmias	2
		Liver decompensation	1	Otorrhea	2
		Pleural fluid	1	Muscle cramps	2
				Mild metabolic deterioration	2
				Other	8
Total	32	Total	59	Total	104

[1] There were no complications in 74 patients. Some patients had more than one complication.

We also merged the results of the Subjective Global Assessment, the Nutritional Risk Index, and the Maastricht Index into a single combined index (Combi Index). We considered patients to be malnourished according to the Combi Index if they were malnourished to any degree according to at least two of the three underlying methods.

Albumin was measured by photometry on a BM/Hitachi 747 automatic analyzer (Hitachi, Tokyo), transthyretin (prealbumin) by immunonephelometry (Cobas Fara II; Hoffmann-La Roche, Basel, Switzerland) with a rabbit antihuman transthyretin (prealbumin) antiserum (Dako, Copenhagen), and total number of blood lymphocytes with an automatic blood cell counter (Sysmex NE 8000; TOA Medical Electronics, Kobe, Japan). A pool of serum from 209 healthy donors was used as a working standard for transthyretin and calibrated against the CRM-470 international reference preparation for transthyretin of the International Federation of Clinical Chemistry. (CRM is certified reference material.) In the present study, serum albumin and transthyretin concentrations were correlated with each other ($r = 0.39$, $P = 0.001$).

Confounding variables and complications

We recorded the presence or absence of cancer or nonmalignant disease as a potential determinant of complications. Nonmalignant disease was further divided into gastrointestinal and nongastrointestinal disease (**Table 1**). For multiple diagnoses, the diagnosis that was the reason for admission was chosen. We recorded number of drugs used, duration of hospital stay, and functional capacity as proxies of the severity of the disease. The functional capacity was graded into three categories: category 1—patients can take care of their personal hygiene (eg, washing and shaving), can eat without help, and have no limitations in performing daily activities such as walking and reading; category 2—patients need assistance with personal hygiene and eating and have limitations in performing daily activities; and category 3—patients are completely dependent on assistance for personal hygiene and eating.

A complication was defined as a state in which a disease or accident is added to an existing illness without being related specifically to this illness (23). Complications were divided

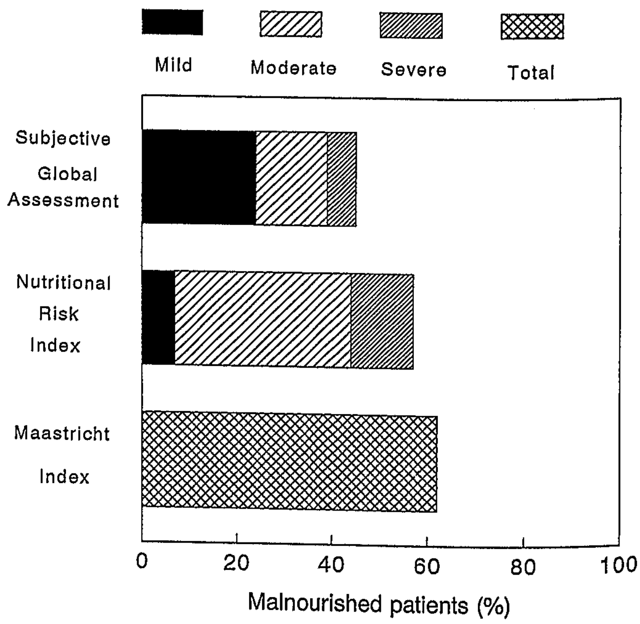

FIGURE 2. Prevalence of malnutrition in 155 nonsurgical hospitalized patients at admission. The Maastricht Index does not specify grades of malnutrition.

TABLE 3
Characteristics of 155 patients in a ward for internal and gastrointestinal diseases, by nutritional status at admission[1]

Characteristic	Subjective Global Assessment Malnourished (n = 70)	Subjective Global Assessment Well nourished (n = 85)	Nutritional Risk Index Malnourished (n = 88)	Nutritional Risk Index Well nourished (n = 67)	Maastricht Index Malnourished (n = 93)	Maastricht Index Well nourished (n = 62)	Combi Index Malnourished (n = 90)	Combi Index Well nourished (n = 65)
Age (y)	57.3 ± 17.0[2]	57.0 ± 19.5	59.3 ± 17.1	53.4 ± 18.9	57.1 ± 17.6	56.4 ± 18.8	58 ± 17.4	54.9 ± 19.2
Duration of hospital stay (d)	18.4 ± 13.1	14.2 ± 11.3[3]	18.4 ± 14.4	13 ± 9.3[4]	18.6 ± 14	13.8 ± 9.4[3]	20 ± 13.9	12.6 ± 7.9[5]
Number of different drugs used per day	7.7 ± 4.7	5.1 ± 3.4[5]	7.2 ± 4.2	5 ± 4[4]	7.1 ± 4.3	5.5 ± 4[3]	7.6 ± 4.2	5.1 ± 4[4]
Patients with cancer (%)[6]	21	10[3]	18	10	17	12	20	9[3]
Patients with decreased functional capacity (%)[7]	60	35[4]	59	26[5]	51	37	60	25[5]
Surgery within 3 mo before admission (n)	12	6	12	5	10	8	12	6

[1] Combi, merged results from the other three indexes.
[2] $\bar{x}$ ± SD.
[3–5] Significantly different from malnourished group (Student's *t* test for variables expressed as means and chi-square test for variables expressed as percentages): [3] $P < 0.05$, [4] $P < 0.01$, [5] $P < 0.001$.
[6] There were no differences significant between disease categories (gastrointestinal and nongastrointestinal).
[7] Refers to categories 2 and 3 combined (*see* Methods).

into mild and severe and also into infectious and noninfectious. A list of relevant complications was compiled before the start of the study (**Table 2**). Physicians and nurses were instructed to record all new complications in the patients' files. The results of the nutritional-status assessment were kept hidden from attending physicians and nurses so as not to influence the treatment of the patient. The occurrence, type, and severity of complications that occurred after admission were derived from the patients' files after discharge.

Data analysis

A chi-square test was used to compare the results of the various indexes. To analyze the association between the complications and the nutritional status graded for severity, the nonparametric Spearman test and the Kruskal-Wallis test were used because the group size in some groups was too small for an individual comparison between all separate groups. Odds ratios with 95% CIs were calculated for the development of complications in malnourished compared with well-nourished patients. Multivariate-logistic-regression analysis with backwards variable exclusion was used to adjust for confounding factors (24). Dichotomous variables were coded as 0 or 1.

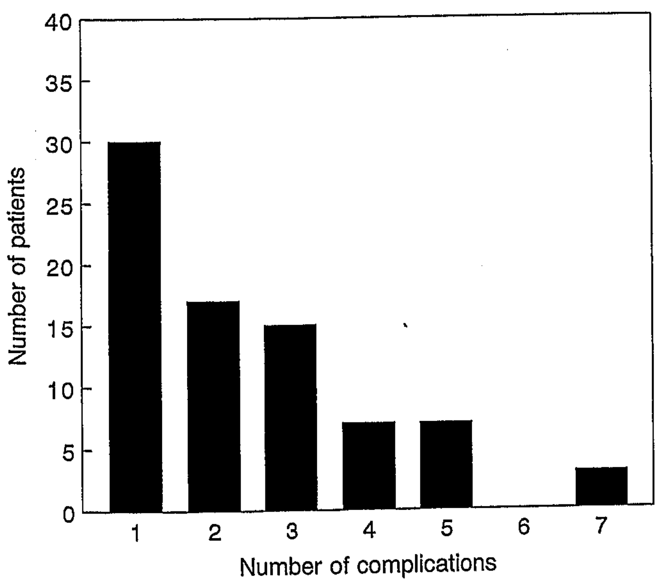

FIGURE 3. Number of complications per patient in 81 of the 155 patients in a nonsurgical ward during an average hospital stay of 16 d. There were no complications in the 74 other patients.

RESULTS

During the total study period of 5.5 mo, 330 patients were admitted. We excluded 93 patients who were admitted exclusively for observation after endoscopic treatment and who were discharged within 3 d and 13 patients who were unconscious or clinically unstable and thus unable to give their informed consent or to answer the questions on the questionnaire (*see* Appendix A). Another 18 patients refused to participate. In 51 patients nutritional status could not be assessed within 24 h after admission. Most of these patients had been admitted over the weekend for acute conditions; their nutritional status may therefore have been worse than that of the patients who entered the study. The remaining 155 patients (65 women and 90 men), who had a mean (± SD) age of 57.1 ±18.2 y (range: 21–93 y), were included in the study. The diagnoses of these 155 patients are given in Table 1 and the mean duration of their hospital stay was 16.1 d.

The frequency of any degree of malnutrition at hospital admission varied from 45% as assessed by the Subjective Global Assessment to 62% with the Maastricht Index (**Figure 2**). The severity of malnutrition diverged between indexes, with the Subjective Global Assessment scoring most cases as mild whereas the Nutritional Risk Index scored most cases as moderate or severe.

During the first 4-mo period, data were gathered on 90 patients both at admission and at discharge. Their nutritional status improved slightly, but significantly, during the hospital stay (64% malnourishment at admission, 53% at discharge; $P < 0.05$) according to the Maastricht Index. The Subjective

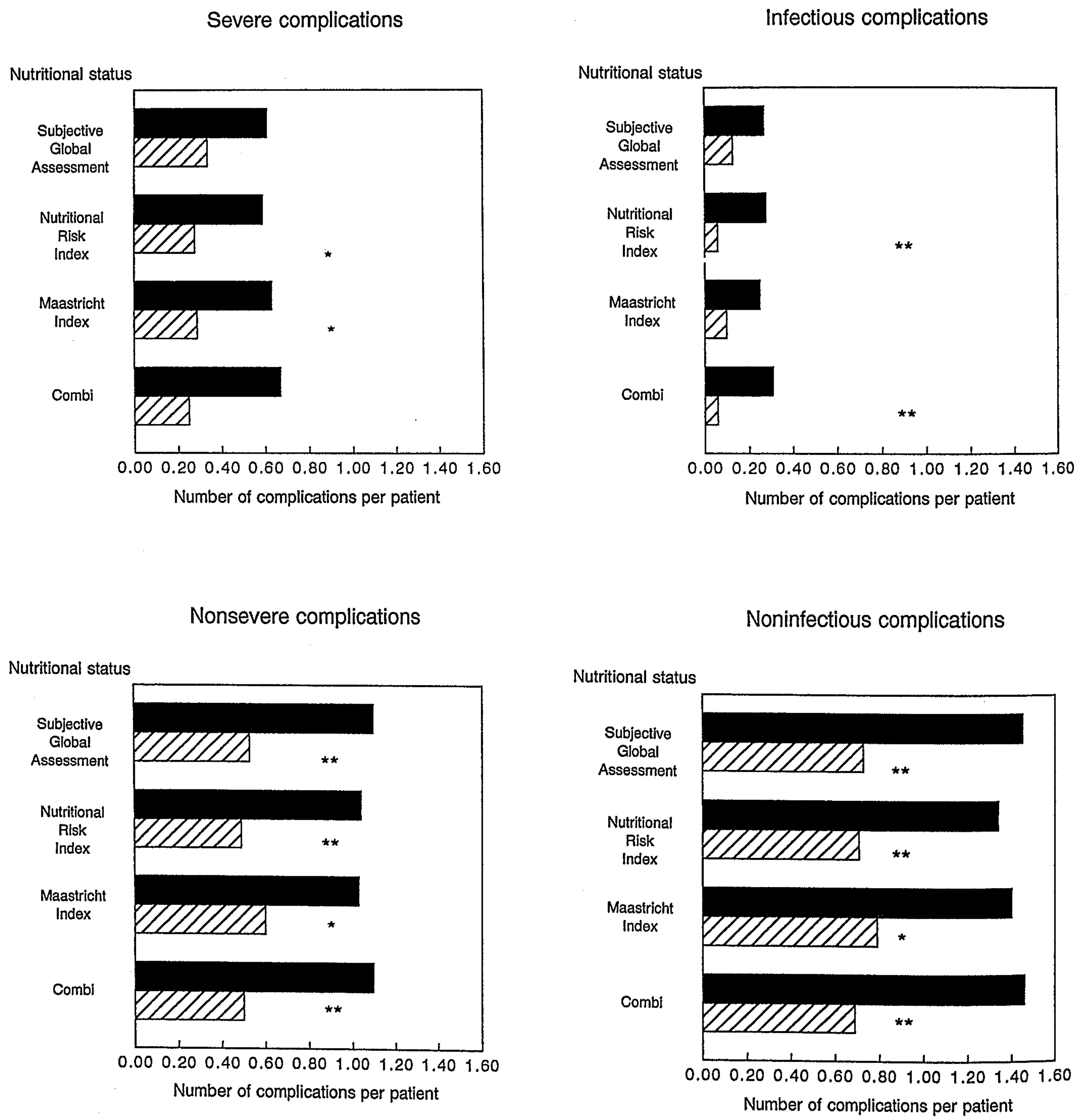

FIGURE 4. Mean number of complications during the hospital stay in malnourished (solid bar) and well-nourished (hatched bar) patients at entry to the hospital according to various methods of nutritional assessment. Significantly different from malnourished patients: * $P < 0.05$, ** $P < 0.01$. Combi Index, merged results from the Maastricht Index, the Nutritional Risk Index, and the Subjective Global Assessment.

Global Assessment and the Nutritional Risk Index did not show significant changes (41% compared with 51% and 52% compared with 49%, respectively). According to the Subjective Global Assessment, more of the gastrointestinal than internal-medicine patients were malnourished (61% compared with 30%). Because the other methods did not show any significant differences between gastrointestinal and intestinal-medicine patients (Nutritional Risk Index: 59% compared with 47%; Maastricht Index: 65% compared with 64%), the results of the patients at the two wards were taken together. In the second period the Subjective Global Assessment was performed by a different physician, but the percentage of patients malnourished at admission was similar to that in the first part of the study, 46% compared with 41%, respectively.

The severity of malnutrition was related to the diagnosis. According to the Subjective Global Assessment, 54% of the patients with inflammatory bowel disease were malnourished: 16% were mildly malnourished, 23% were moderately malnourished, and 15% were severely malnourished. According to the Nutritional Risk Index, 77% of patients with inflammatory

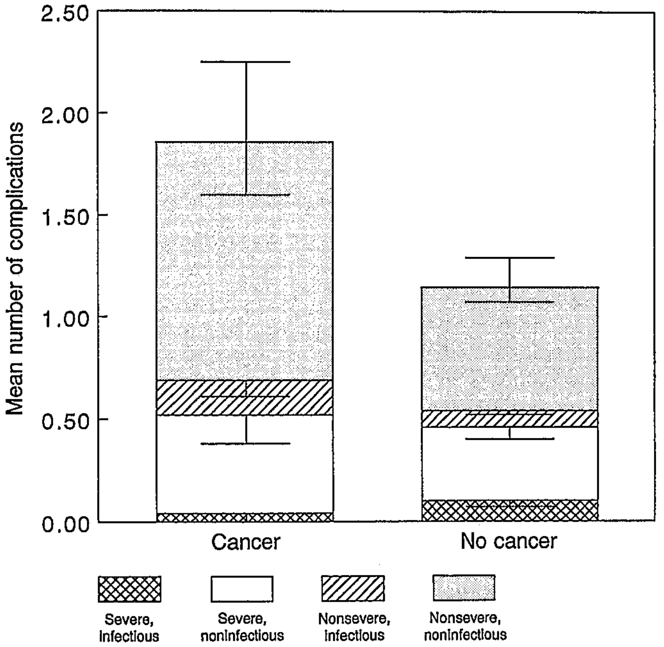

FIGURE 5. Mean (± SEM) number of complications per patient during their hospital stay as a function of the presence or absence of cancer.

bowel disease were malnourished: 31% were moderately malnourished and 46% were severely malnourished. According to the Maastricht Index, 90% of the patients with active inflammatory bowel disease were malnourished. A tendency toward more severe malnutrition was seen in cancer patients. Malnourished patients also differed from well-nourished patients in duration of hospital stay, number of different drugs used, and functional capacity (**Table 3**).

No complications occurred in 74 of the 155 patients; 32 patients suffered three or more complications (**Figure 3**). Two patients died during their hospital stay. The mean numbers of complications per patient for the various groups of complications for well-nourished and malnourished patients are shown in **Figure 4**. A significantly higher number of complications was seen in malnourished than in well-nourished patients. Patients with cancer were more at risk of developing complications than were noncancer patients (**Figure 5**). Significant differences were observed in the total number of complications and in nonsevere, noninfectious complications between patients with cancer and without cancer ($P < 0.05$ for both).

The mean numbers of complications for the two indexes that grade the severity of malnutrition are shown in **Figure 6**. It was not possible to compare the separate groups because some of the group sizes were too small, but the Spearman correlation coefficient was significantly different from 0 with both the Subjective Global Assessment ($r = 0.30$) and the Nutritional Risk Index ($r = 0.24$). The Kruskal-Wallis test yielded similar results.

The crude odds ratios for the association between malnutrition and the occurrence of complications are shown in **Table 4**. The risk of complications was increased in malnourished patients according to all of the nutritional-assessment methods.

Several variables could confound this relation by causing both malnutrition before admission and complications later in the hospital stay. The major potential confounder was the severity of disease. We entered the presence of cancer and of nonmalignant diseases, divided into gastrointestinal and non-

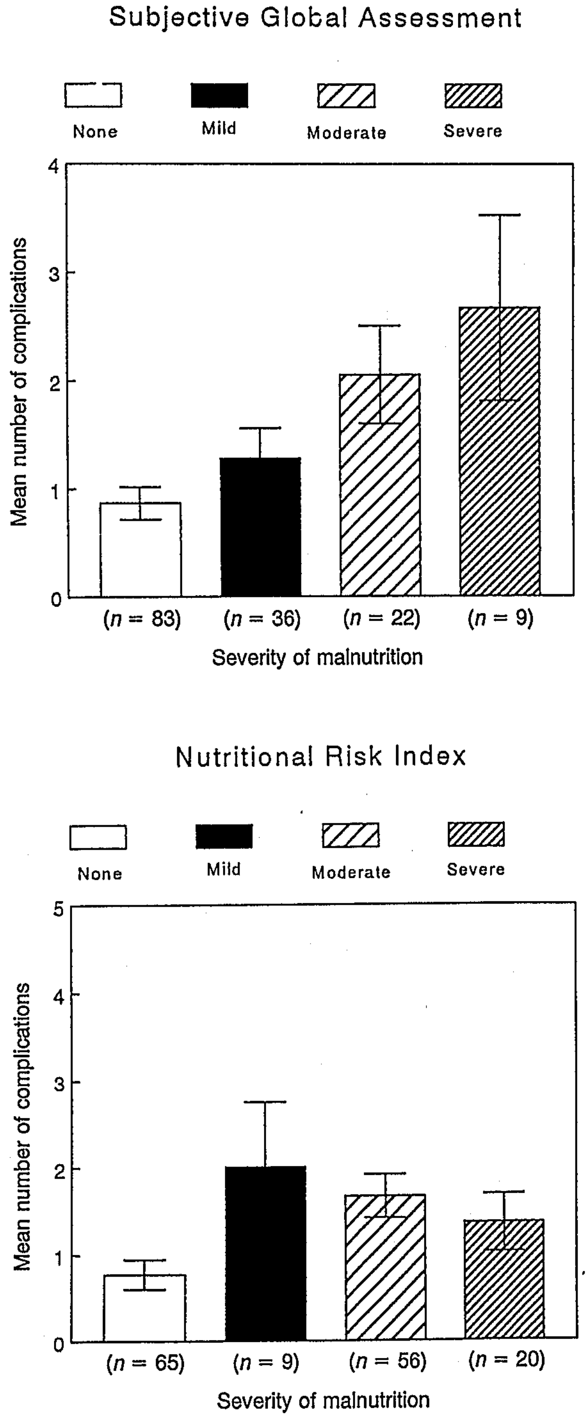

FIGURE 6. Mean (± SEM) number of complications in patients during their hospital stay as a function of the grade of malnutrition at admission. The Maastricht Index does not subdivide malnourished patients by severity of malnourishment and is not depicted.

gastrointestinal, as independent variables in a multivariate analysis and added the number of drugs used, duration of hospital stay, and functional capacity as proxies for the severity of the disease. Adjustment for these potential confounding factors lowered the odds ratios for the risk of complications in malnourished patients (**Table 5**). However, all odds ratios remained elevated, and that for the Maastricht Index remained significantly > 1 for all complications.

TABLE 4
Crude odds ratios (with 95% CIs) for risk of complications during hospital stay in patients malnourished at entry compared with well-nourished patients in a nonsurgical ward, by assessment method

Type of complication[1]	Subjective Global Assessment	Nutritional Index Index	Maastricht Index	Combi Index[2]
Severe (n = 73)	2.5 (1.2, 5.2)	2.7 (1.2, 5.9)	2.4 (1.0, 5.4)	3.5 (1.4, 8.5)
Nonsevere (n = 122)	2.7 (1.4, 5.3)	2.5 (1.3, 4.9)	2.6 (1.3, 5.5)	2.9 (1.4, 6.2)
Infectious (n = 32)	3.1 (1.2, 8.2)	3.8 (1.2, 11.0)	1.9 (0.6, 5.6)	4.3 (1.2, 15.7)
Noninfectious (n = 163)	2.7 (1.4, 5.2)	2.6 (1.3, 4.0)	2.9 (1.4, 6.1)	3.2 (1.5, 6.6)
All complications (n = 195)	2.7 (1.4, 5.3)	2.8 (1.5, 5.5)	3.1 (1.5, 6.4)	3.3 (1.6, 7.1)

[1] n = number of occurrences. Some patients had more than one complication.
[2] Merged results from the other three indexes.

DISCUSSION

Prevalence of malnutrition

We found that ≥ 40% of the patients in a ward for nonsurgical patients were malnourished at admission, and that the risk of subsequent complications was higher in malnourished patients. The frequency of malnutrition was as high as or higher than that reported in surgical patients (1–10). This percentage of malnutrition may be an underestimate because patients were excluded if nutritional status could not be assessed within 24 h after admission. As stated previously, most of these patients had been admitted during the weekend with acute conditions and probably had a more severe illness. The validity of the indexes used was confirmed in a study of the prevalence of apparent malnutrition in healthy volunteers (22), which was performed in parallel with the present study. It showed 1.9% apparent malnutrition in healthy volunteers according to the Nutritional Risk Index and 3.8% according to the Maastricht Index. However, the Maastricht Index overestimated the prevalence of malnutrition in elderly volunteers (22). This incorrect overestimation of malnutrition in elderly subjects probably had only a limited influence on the results of the present study because only 16% of the patients were aged > 70 y.

One could argue that the group of patients was very heterogeneous and that it might have been preferable to study patients with one disease in detail. We deliberately studied this heterogeneous population because our aim was to study the relation between nutritional status and complications in patients on a nonsurgical ward. If a correlation could be shown in this heterogeneous population, it would have strengthened the need for active treatment of malnutrition.

The high prevalence of malnutrition in cancer patients, especially according to the Subjective Global Assessment, may suggest that the presence of cancer weighed heavily in the diagnosis of malnutrition made by a subjective method, even though cancer is not by itself diagnostic of malnutrition. However, the physician assessing nutritional status had no knowledge of the medical histories or the diagnoses of the patients.

Malnutrition and complications

Nutritional status, the occurrence of complications, and underlying diseases constitute a triangle in which it is unclear what causes what (Figure 1). One could argue that malnutrition is not the cause of complications but that both malnutrition and complications are the result of the underlying disease or of other factors. The Nutritional Risk Index and the Maastricht Index use serum concentrations of proteins to assess nutritional status, which are influenced by nutritional status but also by inflammatory stress due to a disease. This is why we also used the Subjective Global Assessment, which is not influenced by serum proteins.

Patients who were malnourished at admission developed more complications during their hospital stay. Patients who were more severely malnourished were more at risk than were less malnourished patients. The crude odds ratios for the risk of complications in malnourished compared with well-nourished patients varied between 1.9 and 4.3. Larsson et al (9) reported a crude odds ratio of 1.9 and Robinson et al (13) reported a ratio of 2.6. The increased risk of complications in malnourished patients could have been due to confounders such as age, underlying disease, or severity of disease. Therefore, we adjusted the crude odds ratios for these variables. Because a general index for the severity of disease does not exist, we used

TABLE 5
Multivariate odds ratios (with 95% CIs) for occurrence of complications in malnourished patients compared with well-nourished patients after adjustment for confounding variables, by assessment method

Type of complication[1]	Subjective Global Assessment	Nutritional Risk Index	Maastricht Index	Combi Index[2]
Severe (n = 73)	1.2 (0.4, 3.3)[3–5]	1.2 (0.4, 3.2)[3–5]	1.5 (0.6, 3.9)[3,5]	1.3 (0.4, 3.6)[3,4]
Nonsevere (n = 122)	1.9 (0.9, 4.0)[3,5,7]	1.6 (0.8, 3.5)[3,5]	2.2 (1.0, 4.8)[5]	2.3 (1.0, 5.0)[5]
Infectious (n = 32)	1.5 (0.5, 4.8)[3,5]	1.0 (0.3, 4.1)[3,5]	1.4 (0.3, 6.9)[3,4,6]	1.4 (0.3, 7.5)[3,5]
Noninfectious (n = 163)	1.7 (0.8, 3.6)[3,5,7]	1.4 (0.6, 2.0)[3,5,7]	2.2 (1.0, 5.0)[3,5,6]	1.5 (0.6, 3.6)[3,5,6]
All complications (n = 195)	1.7 (0.8, 3.6)[3,5,7]	1.6 (0.7, 3.3)[3,5,7]	2.4 (1.1, 5.4)[3,5,6]	1.7 (0.7, 4.0)[3,5,6]

[1] n = number of occurrences.
[2] Merged results from the other three indexes.
[3–7] Adjusted for the following within 3 mo before admission: [3] functional capacity, [4] number of drugs used, [5] duration of hospital stay, [6] disease category, and [7] surgery.

proxy variables such as the number of drugs used, duration of hospital stay, and functional capacity. Such adjustment decreased the odds ratios to values between 1.0 and 2.4. Presence of cancer was an especially important confounder. However, odds ratios for the risk of complications in malnourished compared with well-nourished patients still remained elevated after multivariate adjustment, and the Maastricht Index was still significantly > 1. One might argue that these values are inflated because of residual confounding; this is a well-known problem when confounding variables are measured with insufficient precision, as was probably the case here. On the other hand, one may also argue that we overadjusted the crude odds ratios by including confounders such as functional capacity, which may itself have been an end result of malnutrition. If this is the case then the adjusted odds ratios underestimate the independent effect of malnutrition.

Although the disease category strongly predicted the occurrence of complications, treatment of the disease is not always possible or successful, and nutritional intervention would still be valuable if it reduced the occurrence of complications. Therefore, the effect of nutritional intervention on the rate of disease-specific complications in nonsurgical patients merits study.

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APPENDIX A: Subjective Global Assessment[1]

Questionnaire	
What was your usual weight 6 months ago?	—
Did you lose weight during the past year?	—
Did you lose appetite?	—
Did you use food supplements?	—
Are there complaints of	
Nausea	—
Vomiting	—
Diarrhea	—
Dizziness when rising	—
Swollen feet	—
Swollen abdomen	—
Loss of physical capacity	—
Physical examination	
Extent of loss of subcutaneous fat upon physical examination	—
Extent of loss of muscular mass upon physical examination	—
Presence and extent of ascites	—
Presence and extent of edema	—
Presence and extent of dehydration	—
Correction of weight for ascites, edema, and dehydration	—

[1] Patients were classified as not, mild, moderately, or severely malnourished.