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# Malnutrition in Hospitals: It Was, Is Now, and Must Not Remain a Problem!

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**Background:** Malnutrition is an under-recognized problem in hospitalized patients. Despite systematic screening, the prevalence of malnutrition in the hospital did not decrease in the last few decades. The aim of our study was to evaluate the prevalence of malnutrition and to determine the explicit daily calorie intake of hospitalized patients, to identify the risk factors of developing malnutrition during hospitalization and the effect on the financial reimbursement according to the German DRG-system.





**Material/Methods:** 815 hospitalized patients were included in this study. The detection of malnutrition was based on the nutritional-risk-screening (NRS) and subjective-global-assessment (SGA) scores. A trained investigator recorded the daily calorie and fluid intake of each patient. Furthermore, clinical parameters, and the financial reimbursement were evaluated.

**Results:** The prevalence of malnutrition was 53.6% according to the SGA and 44.6% according the NRS. During hospitalization, patients received on average 759.9±546.8 kcal/day. The prevalence of malnutrition was increased in patients with hepatic and gastrointestinal disease and with depression or dementia. The most important risk factors for malnutrition were bed rest and immobility (OR=5.88, 95% CI 2.25–15.4). In 84.5% of patient records, malnutrition was not correctly coded, leading to increased financial losses according to the DRG-system (94.908 Euros).

**Conclusions:** Hospitalized patients suffer from inadequate nutritional therapy and the risk for developing malnutrition rises during the hospital stay. The early screening of patients for malnutrition would not only improve management of nutritional therapy but also, with adequate coding, improve financial reimbursement according to the DRG-system.

**MeSH Keywords:** **Costs and Cost Analysis • Diagnosis-Related Groups • Inpatients • Malnutrition**

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## Background

Patients with malnutrition have an increased risk of morbidity, mortality, hospitalization, and re-hospitalization [1–3]. The European Society for Enteral and Parenteral Nutrition (ESPEN) defines malnutrition as a disease-related weight-loss, a protein deficiency, or a deficit in specific nutrients [4]. Major factors responsible for the development of malnutrition in ambulatory and hospitalized patients are illnesses that lead to a reduced intake of food (e.g., old age and malignant and chronic diseases) [5–7]. But why are inpatients at risk for developing malnutrition? Dewys already reported in 1980 that the prevalence of malnutrition is very high at the time of admission and increased further during the period of hospitalization [8]. However, 30 years later, malnutrition remains an underestimated challenge for hospitals. Regular control of the nutritional status is recommended by the nutrition guidelines, using a nutrition evaluation score so that a nutritional therapy can be quickly commenced. Nevertheless, the prevalence of malnutrition in inpatients is as high as 50%, which is still very high [6,9,10].

The aims of the present study were: 1) to evaluate the current prevalence of malnutrition in inpatients, 2) determine the quality of nutritional therapy during hospitalization, by explicitly recording the patients' daily nutritional intake 3) to define the patients with increased risk factors for malnutrition, including nutrition and clinical parameters, and 4) to determine the quality of documentation of the DRG (Diagnosis-Related Groups) and the level of the financial reimbursement.

## Material and Methods

Over a 12-month period, 815 consecutive patients of the Department of Medicine of the University Erlangen-Nuremberg participated in our study. All patients involved in the study were prospectively registered and the nutritional status was assessed on admission. The nutrition status was captured with the NRS and SGA score. SGA is a tool that uses a medical history and a brief physical examination to categorize exactly the nutrition status. The degree of malnutrition is categorized into A, B, and C. The highest degree of malnutrition corresponds to category C. NRS is another tool to capture the risk for malnutrition. The single reason for exclusion from the study was patient refusal to take part. A trained nutritional scientist recorded the daily calorie intake of each patient in order to determine their total calorie intake during hospitalization. The daily oral intake of food and the additional amount of enteral or parenteral nutrition administered were recorded. The patient's calorie intake was calculated on a daily basis until their discharge from hospital. The wasted food was not measured. The DRG group was compiled following discharge of the patients and

the financial reimbursement was calculated. Clinical parameters (sex, age, body mass index, blood pressure, heart rate, temperature, co-morbidities, the presentation of malnutrition (using the NRS and SGA scores), dental status, nicotine and alcohol consumption, existence of dementia (using the mini mental status), depression score, and laboratory tests (blood count, coagulation, albumin, protein, C-reactive protein, creatinine, urea and triglyceride) were collected.

The study was approved by the local ethical committee at the University of Erlangen-Nuremberg

## Statistical analysis

The analysis of the malnourished patients was based on the categorization through the NRS 2002 and the SGA screening tool. Clinical and laboratory variables are summarized by means and standard deviations for continuous variables, and absolute and relative frequencies for categorical variables. Differences between malnourished and well-nourished patients are reported and tested by means of the Mann-Whitney Test and Chi<sup>2</sup>-Test, respectively. A p-value < 0.05 was considered to be statistically significant. To determine risk factors for malnutrition, we use generalized estimating equations (GEE) to fit a logistic regression model [11]. A stepwise procedure, which eventually includes all variables with p < 0.01, was used to find the most important clinical and laboratory variables that characterize high-risk patients for malnutrition. We report Odds-Ratios of the GEE to determine the specific risk related to these risk factors together with 95% confidence intervals and p-values. The correlation of visits that relate to the same patients are considered implicitly by the GEE model and to account for missing data, we used multiple imputation [12,13]. The statistical analysis was utilized with SPSS, 17.0.0, 2010 (Chicago SPSS inc.) and R (R Development Core Team (2010)).

The analytical calculations were carried out according to the NRS classification. Few descriptive descriptions were categorized according to the SGA.

## Results

Using standardized patient questionnaires, 815 patients (63.8% males, 36.2% females) were analyzed. The average patient age was 62.2 years (males 61.4 years and females 63.4 years). The underlying disease was non-malignant in 520 (63.8%) patients and malignant in 295 (36.3%). The non-malignant diseases were diabetes mellitus (n=178, 22.3%), coronary heart disease (n=132, 16.2%), cardiac insufficiency (n=73, 9%), myocardial infarct in the patient's history (n=70, 8.6%), arterial hypertension (n=411, 50.4%), acute renal failure (n=30, 3.7%), chronic renal failure (n=107, 13.1%), dementia (n=35, 4.3%),

**Table 1.** Baseline and clinical parameters and laboratory values of malnourished and well-nourished patients where available. For continuous variables mean  $\pm$  standard deviation and p-values of Mann-Whitney test are reported, for categorical variables absolute values and p-values of Chi<sup>2</sup>-test are reported, respectively.

	Malnourished	Well-nourished	P
Age (years)	65.2 $\pm$ 15.1	59.9 $\pm$ 14.7	<0.0001
Sex (m/w)	212/152	260/191	0.92
BMI (kg/m <sup>2</sup> )	23.2 $\pm$ 4.7	27.5 $\pm$ 5.0	<0.0001
Diast. blood pressure/mmHg	74.5 $\pm$ 13.4	78.3 $\pm$ 12.3	<0.0001
Heart Frequency/min	80.1 $\pm$ 15.3	74.8 $\pm$ 12.9	<0.0001
Breathing rate/min	17.9 $\pm$ 4.3	16.9 $\pm$ 2.4	<0.0001
Blood platelet ( $\mu$ l)	293 $\pm$ 150.5	253.7 $\pm$ 104.1	<0.0001
Erythrocytes ( $\mu$ l)	3.9 $\pm$ 0.7	4.4 $\pm$ 0.9	<0.0001
Haemoglobin (g/dl)	11.9 $\pm$ 2.2	13.3 $\pm$ 2.1	<0.0001
Albumin (g/l)	35 $\pm$ 7.2	39.8 $\pm$ 5.4	<0.0001
Protein (g/l)	64.4 $\pm$ 9.2	69 $\pm$ 7.6	<0.0001
Leucocytes ( $\mu$ l)	9.2 $\pm$ 4.7	7.9 $\pm$ 3.5	<0.0001
C reactive Protein (mg/l)	49.3 $\pm$ 69.4	27.6 $\pm$ 52.3	<0.0001
Urea (mg/dl)	1.2 $\pm$ 0.9	1.1 $\pm$ 0.5	0.64
Dentures (existing/not exist.)	191/166	175/263	<0.0001
Mobility (good/not good)	152/206	360/78	<0.0001
Home inhabitants (yes/no)	33/325	8/430	<0.0001
Make purchases (themselves)	214/143	372/66	<0.0001
Cook (themselves)	212/145	357/81	<0.0001

stroke in the anamnesis (n=5, 7%), chronic obstructive pulmonary disease (n=129, 15.8%), asthma bronchial (n=54, 6.6%), pneumonia (n=37, 4.5%), liver cirrhosis (n=61, 12.4%), acute pancreatitis (n=29, 3.6%), chronic pancreatitis (n=100, 12.3%), Crohn/Colitis (n=41, 5%), diverticulosis (n=128, 15.7%) and food allergy (n=89, 10.9%). The malignant diseases were intestinal malignancies (colon, gastric, oesophagus, pancreas, cholangiocellular carcinomas, and liver cancers) and extraintestinal tumors (neuroendocrine tumor, mammary carcinoma, uterine carcinoma and leukanemia).

The overall prevalence of malnutrition was 53.6% according to the Subjective-Global-Assessment (SGA) (SGA B: 35.3% and SGA C: 18.3%) and 44.6% according the Nutrition-Risk-Score (NRS) (n=361). Especially in cancer patients, the prevalence of malnutrition was according to SGA 61% (SGA B: 37.5% and SGA C: 23.5%) and 52.9% according the NRS. Not malnourished patients are classified in category A. The average BMI was 25.6 kg/m<sup>2</sup>. There were no significant differences between the genders as regards the BMI (female: 25.3 $\pm$ 0.38, male: 25.8 $\pm$ 0.39; p=1.09).

### Nutrition therapy during the hospitalization

By recording the calorie intake on a daily basis, we were able to ascertain that our inpatients receive on average 759.9 $\pm$ 546.8 calories per day. The duration of hospitalization totalled on average 5.7 $\pm$ 6.3 days.

To assess the part of the supportive nutrition therapy, each form of application was accordingly recorded in categories. Thus it showed that in addition to oral food, 39.6% of the patients received additional parenteral nutrition, due to reduced oral intake of food. These patients received on average 556.1 $\pm$ 514.7 kcal per day. 18.8% of the patients, which could not be nourished orally adequately, received additional enteral nutrition. These patients received on average 448.3 $\pm$ 600 kcal per day. Finally, there was a group of patients (n=50), that received contemporaneous parenteral and enteral nutrition. 33.4% of these patients received an average of 1316 calories per day, 12.7% received an average of 1207 calories per day and just 6.1% of these patients received an average of 1764 calories per day by means of simultaneous parenteral and enteral nutrition. In total, 17 patients received no food during their hospitalization

**Table 2.** Frequencies and percentages of patients with depression depending on SGA.

Depression vs. SGA	Well nourished	Moderately malnourished or suspected to be	Severely malnourished
No depression	304 (83.06%)	172 (62.54%)	66 (48.53%)
Slight depression	32 (8.74%)	41 (14.91%)	28 (20.59%)
Moderate depression	23 (6.28%)	52 (18.91%)	27 (19.85%)
Severe depression	7 (1.91%)	10 (3.64%)	15 (11.03%)

**Table 3.** Results of the generalized estimating equations logistic regression following multiple imputations: Odds, 95% confidence interval and p-values for all risk factors that were selected by the stepwise procedure are illustrated. Odds >1 indicates a high risk of malnutrition according NRS, Odds <1 indicates a low risk.

	Odds	95% CI	p-value
Loss of subcutaneous body fat (normal)	1		<0.0001
Loss of subcutaneous body fat (medium)	6.04	(3.65, 9.98)	
Loss of subcutaneous body fat (high)	31.96	(13.66, 74.8)	
Food supply (less)	3.07	(1.84, 5.1)	<0.0001
Reduced physical capacity, 6 months (none)	1		<0.0001
Reduced physical capacity, 6 months (medium)	2.98	(1.81, 4.89)	
Reduced physical capacity, 6 months (bedridden)	5.88	(2.25, 15.4)	
Liver disease (yes)	0.55	(0.28, 1.08)	0.08
Gastrointestinal symptoms (yes)	0.38	(0.22, 0.65)	<0.0001
Albumin (g/l)	0.94	(0.9, 0.98)	<0.0001

and they therefore had no calorie intake. These patients were mostly admitted to hospital for very short periods of time and, on average, spent a resting period of only 1.5 days in hospital.

**Baseline, clinical and laboratory values**

Higher age was associated with a significantly increased risk for malnutrition. Between genders there was no significant difference (Table 1). Malnourished patients have significantly lower BMI values than patients who are not suffering from malnutrition (Table 1). Older patients (>60 years) with malnutrition present higher BMI values than younger patients (<60 years) with malnutrition (23.9±4.7 versus 22.0±4.4 kg/m<sup>2</sup>) (p<0.0001)

Patients with malnutrition more frequently have dentures, are less mobile and more commonly residents at nursing homes. In addition, the malnourished patients are frequently responsible for doing their own grocery shopping and preparing their own meals (Table 1).

Patients with malnutrition as compared to patients without malnutrition were shown to have significantly lower levels of blood platelets, erythrocytes, hemoglobin values and a lower

total protein and albumin. The inflammation parameters such as leucocytes and C reactive protein are higher in malnourished patients. Mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), urea, triglyceride, sodium, potassium did not vary between the groups (p>0.05, not reported in Table 1).

Malnourished patients were shown to have lower diastolic blood pressure, higher heart rate and a higher respiratory rate and were in a worse clinical state in comparison with those patients who were well-nourished. Systolic blood pressure and temperature did not differ significantly between the groups.

Carrying out the calculation categorized by the presence of cancer the same significant differences in clinical parameters can be shown between malnourished and well-nourished patients.

**Depression und dementia**

The deeper a depression, the stronger the correlation was shown to be with malnutrition (p<0.0001, Chi<sup>2</sup>-Test, Table 2). Furthermore, an increase in the severity of dementia increased significantly the prevalence of malnutrition (p<0.0001, Chi<sup>2</sup>-Test.). This is best illustrated by the SGA categorization for malnutrition.

### Risk factors for malnutrition

Table 3 demonstrates the results of the generalized estimating equations logistic regression after multiple imputations. The stepwise variable selection procedure suggests that high loss of body fat, food supply, low BMI, bedridden patients, liver disease, gastrointestinal symptoms, and decreased albumin values are significant characteristics of malnourished patients. For example, the chances of being malnourished are 5.88% higher for bedridden patients, and patients with no gastrointestinal symptoms are approximately one third less likely to be malnourished than patients with gastrointestinal symptoms.

### Duration of hospital stay and DRG

Duration time of the hospital stay was in well-nourished patients significantly shorter than in malnourished patient group,  $4.0 \pm 4.2$  days and  $7.8 \pm 7.7$  days;  $p < 0.0001$ .

Without recording a diagnosis of “malnutrition” in accordance with the DRG, the average level of the financial reimbursement received upon admission to hospital was in mean  $2,516.1 \pm 3,065.1$  Euros. In cases where a diagnosis of “malnutrition” was recorded in accordance with the DRG, the average level of financial proceeds received upon admission to hospital increased up to  $3,235.4 \pm 3,981.8$  Euros. However, 84.5% of the medical doctors did not correctly record the diagnosis “malnutrition”. With disregard of the coding this led to a loss of revenue of approx. 94.908 Euro.

## Discussion

Our study shows that the prevalence of malnutrition in a university hospital is still high, at a current percentage of 44.6%. Patients at risk are hepatic- and gastrointestinal diseased patients, bed-ridden patients, and those of old age with an underlying condition of depression or dementia. Malnourished patients are hospitalized statistically significantly longer and thus present respective significantly worse clinical parameters, with low blood pressure, low heart and respiratory rate, low serum proteins, and increased parameters of inflammation.

The subject of the high prevalence of malnourished patients in hospitals was addressed in the 1970's [14,15], the discussion of which led to the making of various recommendations and the provision of guidelines with regard to the relevance of a nutritional therapy for both inpatients and outpatients. Despite the establishment of various nutritional guidelines, the existence of proof demonstrating that the rate of morbidity and mortality is higher in malnourished patients [16–20], and despite the existence of a variety of possible nutritional therapies, it is astonishing that the prevalence of malnutrition has not

decreased in any way during the previous 40 years [18,21,22]. One of the reasons could be the enormous undersupply of nutrition during hospitalization. We could show that an inpatient in average receives only  $759.9 \pm 546.8$  and only 58% of the cases received appropriate support with the medical indication for nutritional therapy.

In order to evaluate the nutritional therapy during hospitalization we documented the daily calorie intake (oral, enteral and parenteral) of each patient taking part in the study. The inpatients received an average of only around 760 calories per day by means of oral food. Patients who received additional enteral or/and parenteral nutrition increased their calorie intake to a maximum of 1764 calories per day. Some patients were not allowed to eat because of clinical investigations up to 3 days, without application of parenteral or enteral nutrition.

The present study demonstrated that our patient population with a high risk for malnutrition presented hepatic insufficiency, they are bedridden and presented intestinal disorders significantly more frequently and present correspondingly high loss of body fat, decreased food intake, low BMI and lower albumin.

As identified by other authors [6,23], malnourished patients are not only older, but are significantly more likely to suffer from dementia or depression. It has been proven on numerous occasions that patients with malnutrition present a raised morbidity and mortality risk [3,24,25]. Clinical parameters could serve as surrogate endpoints for the increased morbidity of malnourished patients. The malnourished patients in our study showed a significantly increased heart rate, a significantly raised respiratory rate and significantly diminished diastolic blood pressure. Those indicating parameters should have a greater clinical value in the daily hospital routine, to detect patients at risk for malnourishment earlier and therefore to be able to better manage those patients' nutritional therapy.

An important clinical parameter to record the nutritional status is the BMI. According to the WHO classification, malnutrition constitutes a BMI which is lower than 18.5. Severe malnutrition is defined as being a BMI of 16 (WHO report in 1990). The malnourished patients who took part in this study presented significantly lower BMIs than those patients who were well nourished. However, the average BMI of the malnourished patients was  $23.2 \text{ kg/m}^2$ . The ESPEN guidelines state that patients who are older than 60 years and who have a BMI in excess of 20 are already subject to an increased risk of malnutrition. Our study indicated that also younger patients (<60 years) with a BMI of more than 20 may also present malnutrition and patients >60 years with malnutrition can develop BMI values higher than 23. The WHO categorization of nutritional status in the 1990s was evaluated by comprehensive data relating to healthy young patients. Therefore the old WHO criteria for



medically indicating nutrition therapy should not be used anymore. In the daily clinical routine however, the patient is still not identified as at risk until a BMI <18.5.

After imputation of all documented clinical and physical parameters in a logistic regression model we could detect subcutaneous body fat, less food supply, reduced BMI, reduced physical activity, liver disease, gastrointestinal symptoms and reduced albumin as predictors for malnutrition. These parameters should be recorded promptly after admission to capture early the patients at risk of malnutrition.

Presently we analyzed the economic aspect of the malnutrition in a clinical setting. From an economic point of view, the correct coding of a diagnosis as "malnutrition" is essential in order to ensure that the appropriate level of DRG funds are allocated.

The prolonged hospitalization of the malnourished patient, does not only have clinical, but also economic consequences [26,27]. In order to ensure the receipt of adequate financial proceeds for patients with malnutrition, it is imperative that the diagnosis "malnutrition" be recorded according to the DRG. An unexpected observation of this study was that 84.5% of the medical doctors did not record the diagnosis "malnutrition", resulting in a consequential financial loss of 94.908 Euros.

The present results illustrate that inpatients do not get the necessary amount of nutrition, although a good nutrition status is highly relevant for a patient's recover. Apart from the clinical relevance it is also in the financial interest of the hospital, since a systematic recording of malnutrition according to

DRG increases the financial proceeds for each patient. Because of this, we recommend to optimize the nutritional therapy in the hospital in making the food needs more attractive, and enable this in offering staff time for encouraging patients to eat, and helping where necessary.

The limitation of the present study is that the mortality rate of the patients was not recorded and therefore the impact of malnutrition on the prognosis of the patient cannot be calculated. However, the relevance and the impact of malnutrition on the clinical course of patients have already been described several times.

## Conclusions

We conclude that: 1) despite knowledge regarding the consequences of malnutrition (including the increased risk of morbidity and mortality), the prevalence of this condition is still high in hospitals; 2) an increased risk of malnutrition is observed in patients with dentures, gastrointestinal disorders, dementia and depression as well as in patients with high loss of body fat, decreased food supply, low BMI, bedridden patients, liver disease and gastrointestinal symptoms; 3) an insufficient nutritional therapy could lead to further weight loss, increased morbidity and extended hospitalization; and 4) in order to optimize the financial proceeds received for these patients, it is essential that the diagnosis "malnutrition" be made and correctly coded. In situations where this does not occur, losses in the financial proceeds are inevitable.

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