Hidden hunger in the hospital?

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CHAPTER 4

HIGH PREVALENCE OF MALNUTRITION BOTH ON HOSPITAL ADMISSION AND PREDISCHARGE

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ABSTRACT

Objectives In Dutch hospitals malnutrition screening is routinely performed at admission, but not during follow-up or before discharge. Therefore we evaluated nutritional status during hospitalization and predischarge in a routine care setting.

Methods The Patient-Generated Subjective Global Assessment (PG-SGA) was used to assess nutritional status (PG-SGA Categories: A = well nourished, B = moderate/suspected malnutrition, C = severely malnourished) in adult patients on four wards of a university hospital at admission, day 5, day 10, and day ≥ 15. Because data were obtained in the context of clinical routine, not all data points are available for all patients. Last assessment before discharge (within ≤ 4 d) was taken as predischarge measurement.

Results PG-SGA data at admission were obtained in 584 patients (age 57.2 ± 17.3 y, 51.4% women, body mass index 27.0 ± 5.5 kg/m^2). Prevalence of PG-SGA stage B/C was 31% at admission, 56% on day 5 (n = 292), 66% on day 10 (n = 101), and 79% on day ≥ 15 (n = 14). PG-SGA predischarge data were available in 537 patients, 36% of whom were PG-SGA stage B/C. Of the 91 patients assessed both at admission and predischarge, 30% of well-nourished patients became malnourished and 82% of malnourished patients remained so.

Conclusions Prevalence of malnutrition in hospitalized patients is high at admission (31%) and, importantly, also high predischarge (36%). Malnutrition is more prevalent in patients with a longer length of stay. These findings underscore the importance of follow-up of nutritional status in hospitalized patients and adequate transmural nutrition care after discharge to prevent malnutrition from remaining undetected and untreated.

INTRODUCTION

Disease-related malnutrition is common among hospitalized patients and is associated with negative health outcomes, including higher risk of pressure ulcers and infections [1-4], decline of functional status [5, 6] and quality of life [7, 8], increased length of hospital stay, higher risk of readmission, and higher mortality rates [9-11]. In 2011, additional costs of disease-related malnutrition in adult patients were estimated at €170 billion annually in Europe, and €1.2 billion attributable to in-hospital malnutrition in The Netherlands [12].

Early and structural detection of malnutrition and its risk factors is one of the first steps in tackling in-hospital malnutrition [13]. In recognition of this need, screening for malnutrition is mandatory for hospitals in The Netherlands and has been successfully implemented using validated screening instruments, such as the Short Nutritional Assessment Questionnaire [14] and the Malnutrition Universal Screening Tool (MUST) [15]. After implementation of national policy, mean percentage of patients screened for malnutrition at hospital admission increased from 51% in 2007 to 72% in 2010 [16]. Results from a previous multicenter study suggest that use of a validated screening tool is associated with more adequate nutritional interventions and lower malnutrition prevalence [17].

Malnutrition screening on admission has provided an important basis for better nutritional management in hospitalized patients. However, nutritional status may change during hospitalization, and de novo malnutrition will not be detected by admission screening alone. Moreover, poor nutritional status may not be restored during hospitalization, in particular considering higher disease burden and mean age in the current hospital population, and conversely, shorter length of hospital stay [18, 19]. To our knowledge, only a few studies have focused on changes in nutritional status during hospital stay. Previous studies in Canada found that in 20% of patients admitted for 7 d or more, nutritional status deteriorated during hospital stay, as measured by the Subjective Global Assessment (SGA) [20, 21]. Notably, in this acute care setting more than half of patients (53%) were moderately or severely malnourished at discharge, indicating need for continued nutritional care after discharge.

To accommodate malnutrition screening at admission, nutritional status monitoring during hospitalization, assessment at discharge, and proactive interdisciplinary interventions, a fitting instrument is needed. Screening instruments such as the MUST, with main criteria regarding low body mass index (BMI) and critical weight loss, are suitable for valid and reliable risk screening at hospital admission but are not suitable for monitoring of short-term changes in nutritional status. A large change in body weight is needed to detect changes in BMI for risk assessment, and disturbances in fluid status often obscure weight loss in the acute setting. Alternatively, the Patient-Generated Subjective Global Assessment (PG-SGA) is a four-in-one-instrument, taking into account nutrition impact symptoms, physical activity, (co-)morbidity, and metabolic demand and is possibly more suitable to meet these needs [22-24]. The PG-SGA was originally validated in patients with cancer but is now more widely used in research in other patient groups [25-30], as well as in international clinical practice (e.g., Australia, Brazil, the United States). Since the launch of the Dutch version of the PG-SGA [31], the PG-SGA is being implemented in various health care settings in The Netherlands, including hospitals, and is now also included in the Dutch malnutrition guideline [32].

In the present study, therefore, we aimed to evaluate prevalence of malnutrition at admission, during hospitalization, and before discharge using the PG-SGA in a mixed university hospital population in the context of routine care.

MATERIAL AND METHODS

Study population

A practice-based study was conducted among adult patients (age ≥ 18 y) admitted to four wards of a single university hospital, the University Medical Center Groningen (UMCG), March 2016 to July 2017. Quantitative clinical data were collected in the context of routine care during a minimum of 6 effective months per ward. We prolonged the sampling window for three wards because data collection was impaired or delayed as a result of holiday periods and staff shortage. A concise overview of data collection time frames per ward is provided in **Appendix Figure A1**. The four wards, two surgical and two medical wards, were selected to reflect a mixed university hospital population and had admitting specialties of otorhinolaryngology, maxillofacial surgery, ophthalmology, orthopedic and plastic surgery, general internal medicine (including geriatric medicine), nephrology and renal transplantation, and dermatology. Patients were included if they were admitted at least 1 night. Patients were excluded if they were admitted for a specialty other than those mentioned, if patients were in isolation other than contact isolation, if patients were not able to answer questions or follow instructions in Dutch or English, or if data collection was not possible or desirable as assessed by the ward's head nurse on duty (e.g., terminal care, severe delirium).

Data collection

Because we adopted a practice-based approach, measurements were performed by nursing staff as much as possible. Regular staff was supported by students of health care studies, such as nurses and dietitians in training, during the week (not on weekends), also performing measurements in the context of regular care as much as possible. Both nursing staff and students received training in administering the PG-SGA before start of the study.

Care as usual was provided during the study period, including dietetic treatment conforming to hospital protocol based on national guidelines [32]. This included malnutrition screening at admission using the MUST and dietetic consultation and nutritional intervention in case of MUST score ≥ 2 or on doctor's referral. In addition, an overview of PG-SGA scores was provided weekly to the ward's head nurse or dietitian, enabling intervention for malnourished patients who were not yet identified by regular care protocols. Bias as a result of changes in awareness and subsequent treatment were intentional from a care and ethical perspective. Intervention actions and treatment efficacy were, however, not recorded as part of the present study. Our practice-based approach included no formal evaluation to assess feasibility, but benefits and barriers of additional nutritional status monitoring in daily practice were evaluated with ward staff.

Data were collected within 24 h of set time points: at admission, day 5, day 10, and day ≥ 15 (i.e., before discharge in case of length of stay > 14 d). Because data were collected in the context of routine care, not all data points were available for all patients (patients were discharged or were unavailable for measurement). Data were analyzed per set time point and predischarge (i.e., last available assessment within 4 d before discharge; cross-sectional). Changes in nutritional status during hospitalization were evaluated in patients with a measurement at both admission and predischarge (longitudinal).

The standard in-hospital malnutrition protocol and additional actions in the context of the study are summarized in **Table 1**.

This study was performed in accordance with the Declaration of Helsinki and was approved by the Medical Ethical Committee of the UMCG (METc UMCG 2016/ 106).

Table 1. Standard hospital malnutrition protocol and additional actions in the context of the study

	Standard hospital protocol			***Additional actions in the context of the practice-based study***
Admission	Height and weight measurement by nurse			
	MUST by nurse or food assistant			PG-SGA by trained nurse or student
	Low risk No action	**Medium risk** Patients receive brochure on malnutrition risk; additional snacks provision by food assistant	**High risk** Automatic signal for dietetic referral; nutritional intervention plan	
Day 4			Intake monitored by food assistant, evaluated by dietitian; additional intervention if goals are not met	
Day 5				PG-SGA by trained nurse or student
Day 10				PG-SGA by trained nurse or student
Before discharge (if length of stay >14 days)				PG-SGA by trained nurse or student
During hospitalization	- Dietetic referral by doctor - Dietitian participates in multidisciplinary meeting once a week on the medical wards, or has a weekly meeting with the head nurse on the surgical wards			- Weekly overview of PG-SGA scores provided to head nurse
At discharge	Follow-up at outpatient clinic, or transfer or treatment (not standard)			

Data were collected within 24 hours of set time points

PG-SGA

Nutritional status and need for interventions were assessed using the PG-SGA [31, 33]. If possible, items on weight, food intake, symptoms, and activities and function, also known as the PG-SGA Short Form (PG-SGA SF) [22], were completed by the patient. If needed, assistance was provided by a nurse, student, or patient family members. The worksheets addressing disease and its relation to nutritional requirements, metabolic demand (fever and use of corticosteroids), and physical examination (muscle status, fat stores, and edema)—that is, the professional component of the PG-SGA—were completed by a trained nurse or student. The Pt-Global web tool (available on the Pt-Global website, www.pt-global.org) was used to calculate the PG-SGA score and to determine the PG-SGA Global Assessment Category.

Nutritional status was defined by the assigned PG-SGA Global Assessment Category (stage A = well nourished, stage B = moderate or suspected malnutrition, stage C = severely malnourished), with presence of malnutrition operationalized as PG-SGA stage B or C. Need for interventions was assessed by triage category based on PG-SGA score (i.e., score 4-8 requiring intervention by dietitian in conjunction with nurse or physician as indicated by symptoms, and score ≥ 9 indicating a critical need for improved symptom management or nutrient intervention options).

Other measures

Patients' height and weight were assessed at admission as part of routine care, using validated and standardized equipment according to standard hospital protocol. If measurement of height was not possible or data were unavailable, alternative estimates using knee height, ulna length, or demi-span were used. If alternative estimates were also unavailable, last measured or self-reported height was used. If measurement of weight was not possible or data were unavailable, last measured or self-reported weight were used. Follow-up measurement of weight was preferably performed at the same day as study measurement (day 5, day 10, and day ≥ 15 if length of stay > 14 d) or according to standard hospital protocol (two times per week during hospitalization). Data on height, weight, demographic characteristics, and hospital length of stay were extracted from the hospital care systems.

Statistical analyses

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 23.0. Data are presented as means with standard deviations (SD) for normally distributed data, medians with interquartile range (IQR) for non-normally distributed data, and numbers with percentages for categorical data. For main analyses, descriptive statistics were used, and an additional χ^2 test was used to test difference in nutritional status change between ward types, for which we considered a two-tailed P value of < 0.05 as statistically significant.

RESULTS

Data overview and patient characteristics

Because data were collected in the context of routine care, not all data points were available for all patients. Data per time point were marked as complete if PG-SGA category and PG-SGA total score were available. In case of incomplete data, PG-SGA data were only partly available—for example, only the PG-SGA SF was filled in. Data were marked as missing if patients were not measured using the PG-SGA or were unavailable for measurement (e.g., because of surgery, medical consultations, or other procedures). An overview of the data available for the analysis is provided in **Figure 1**.

Data were analyzed cross-sectionally for all separate data points. For patients in whom both measurement at admission and predischarge were available, we also assessed the longitudinal changes in nutritional status.

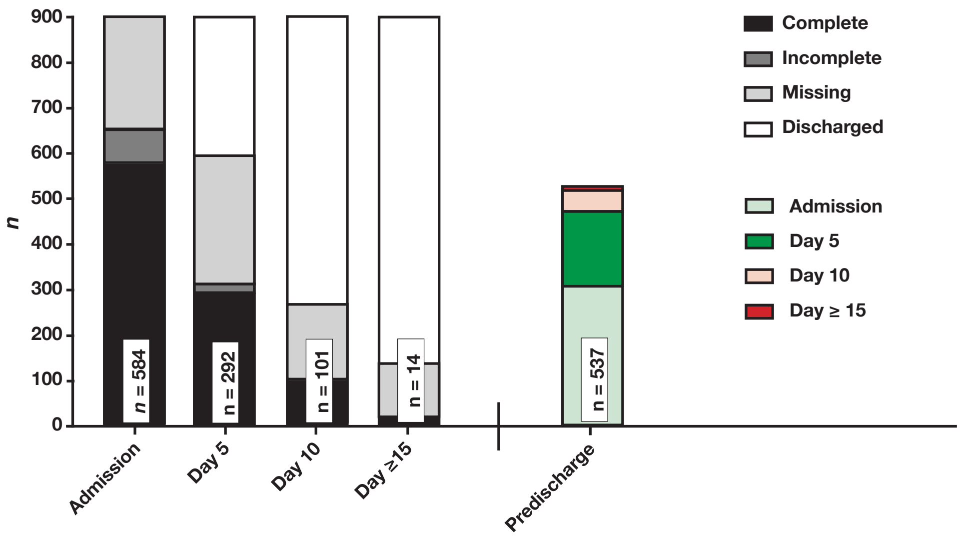

Figure 1. Overview of data available for analysis
Number of patients with complete data (PG-SGA Category and total score available) per data point are shown as data labels. Patients not included in the analysis had either incomplete or missing data, or were discharged. Pre-discharge data was a composite measure of the data point closest to actual discharge (within ≤ 4 days)

Assessment of nutritional status using the PG-SGA was completed in 584 patients at admission (age 57.2 ± 17.3 y, 51.4% women, BMI 26.9 ± 5.5 kg/m^2), in 292 patients on day 5, in 101 patients on day 10, and in 14 patients on day ≥ 15. The median length of stay for patients measured at admission was 4 d, with a range from 1 to 42 d (interquartile range = 2-8 d). Patient characteristics per time point are presented in **Table 2**. By default, length of stay was progressively longer for the patients in whom assessment of nutritional status was obtained at the later data points. Moreover, patients with later data points available

Table 2. Patient characteristics at different time points during hospitalization (cross-sectional)

Characteristics	Admission N = 584	Day 5 N = 292	Day 10 N = 101	Day ≥15 N = 14
Age (*years*), mean ± SD	57.2 ± 17.3	61.0 ± 15.6	63.0 ± 16.7	65.9 ± 17.0
Gender (*n,%*)				
Male	284 (48.6)	129 (44.2)	55 (54.5)	7 (50.0)
Female	300 (51.4)	163 (55.8)	46 (45.5)	7 (50.0)
Height (*cm*), mean ± SD	173.5 ± 9.2	172.5 ± 9.3	172.4 ± 9.6	173.9 ± 10.6
Weight (*kg*), mean ± SD	81.3 ± 18.3	80.3 ± 18.7	79.2 ± 17.1	81.1 ± 13.4
BMI (*kg/m²*), mean ± SD	27.0 ± 5.5	27.0 ± 5.6	26.7 ± 5.4	26.9 ± 4.2
Length of stay (*days*), median [IQR]	4 [2-8]	8 [6-12.75]	15 [11-18]	20.5 [16-29.5]
Ward type (*n,%*)				
Surgical	317 (54.3)	83 (28.4)	23 (22.8)	4 (28.6)
Medical	267 (45.7)	210 (71.6)	78 (77.2)	10 (71.4)
Admission specialism* (*n,%*)				
ORL	110 (18.8)	2 (0.7)	1 (1.0)	0 (0.0)
OS	105 (18.0)	62 (21.2)	19 (18.8)	1 (7.1)
RT	101 (17.3)	95 (32.5)	40 (39.6)	5 (35.7)
GIM	95 (16.3)	72 (24.7)	21 (20.8)	3 (21.4)
PS	52 (8.9)	15 (5.1)	3 (3.0)	0 (0.0)
MS	46 (7.9)	4 (1.4)	0 (0.0)	0 (0.0)
N	36 (6.2)	29 (9.9)	11 (10.9)	5 (35.7)
D	33 (5.7)	13 (4.5)	6 (5.9)	0 (0.0)
Other	6 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)

** ORL = Otorhinolaryngology, OS = Orthopedic Surgery, RT = Renal Transplantation, GIM = General Internal Medicine, PS = Plastic Surgery, MS = Maxillofacial Surgery, N = Nephrology, D = Dermatology, Other includes Ophthalmology and other subspecialisms*

were older, with an overrepresentation of the medical wards and the admission specialties of renal transplantation, general internal medicine, orthopedic surgery, and nephrology.

Predischarge data (within ≤ 4 d of discharge) were available in 537 patients (age 56.5 ± 17.3 y, 52.5% women, BMI 26.8 ± 5.3 kg/ m^2). Predischarge data included 307 admission measurements (57.2%), 172 measurements on day 5 of hospitalization (32.0%), 48 measurements on day 10 (8.9%), and 10 on day ≥ 15 (1.9%). Median difference between predischarge measurement and actual discharge was 2 d. Patient characteristics of patients with a predischarge measurement available are shown in **Appendix Table A1**.

Prevalence of malnutrition at admission, during hospitalization, and predischarge (cross-sectional)

Prevalence of malnutrition (PG-SGA stage B or C) was 31% at admission (182 of 584 patients), 56% (163 of 292) at day 5, 66% (67 of 101) at day 10, and 79% (11 of 14) at day

≥ 15. Need for interventions (PG-SGA score ≥ 4) was present in 60% at admission (348 of 584 patients), 90% (262 of 292) on day 5, 92% (93 of 101) on day 10, and 100% (14 of 14) on day ≥ 15. Data per time point are presented in **Figure 2**.

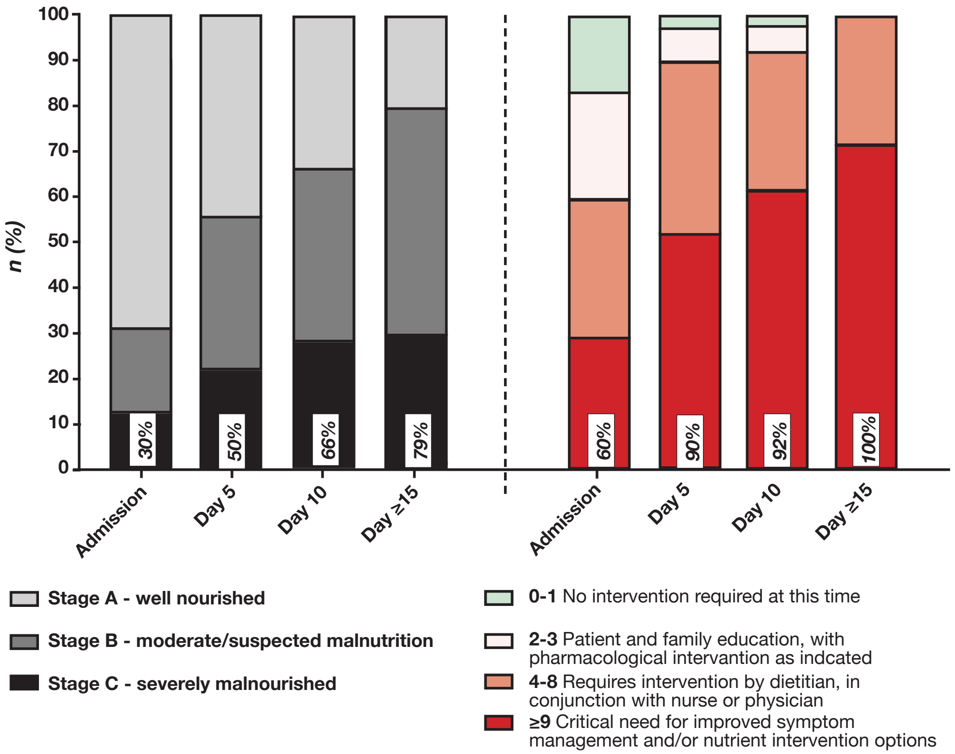

Figure 2. Prevalence of malnutrition and need for interventions at admission and different time points during hospitalization (cross-sectional)
Prevalence of malnutrition (PG-SGA Stage B and C) and need for interventions (PG-SGA score ≥4) per data point are shown as data labels.

Prevalence of malnutrition and need for interventions predischarge is not shown in Figure 2 because these were composite measures of the data presented. Predischarge, 64% of patients (341 of 537) were well nourished, whereas 36% (196 of 537) were malnourished (25% stage B, 11% stage C, respectively). Need for interventions was present in 65% of patients (351 of 537) predischarge (32% PG-SGA score 4-8, 33% PG-SGA score ≥ 9, respectively).

Difference in nutritional status at admission and predischarge (longitudinal)
Repeated measurement data at both admission and predischarge were available in 91 patients (age 60.9 ± 15.1 y, 53.8% women, BMI 26.8 ± 5.7 kg/m²). The majority of these patients were admitted to a medical ward. Other patient characteristics are shown in **Table 3**.

Table 3. Patient characteristics of patients with 2 or more measurements available including measurement at admission and pre-discharge (longitudinal)

Characteristics	Patients with ≥2 measurements including measurement at admission and pre-discharge N = 91
Age (*years*), mean ± SD	60.9 ± 15.1
Gender (*n,%*)	
Male	42 (46.2)
Female	49 (53.8)
Height (*cm*), mean ± SD	173.5 ± 9.4
Weight at admission (*kg*), mean ± SD	80.8 ± 18.9
BMI at admission (*kg/m²*), mean ± SD	26.8 ± 5.7
Length of stay (*days*), median [IQR]	8 [6-9]
Admission specialism (*n, %*)	
Surgical	27 (29.7)
Medical	64 (70.3)
Admission specialism (*n,%*)	
Otorhinolaryngology	2 (2.2)
Orthopedic Surgery	15 (16.5)
Renal Transplantation	34 (37.4)
General Internal Medicine	18 (19.8)
Plastic Surgery	5 (5.5)
Maxillofacial Surgery	5 (5.5)
Nephrology	6 (6.6)
Dermatology	6 (6.6)
Other (including Opthalmology and other subspecialisms)	0 (0.0)
Last measurement before discharge (*n, %*)	
Day 5	66 (72.5)
Day 10	21 (23.1)
Day ≥15	4 (4.4)

** ORL = Otorhinolaryngology, OS = Orthopedic Surgery, RT = Renal Transplantation, GIM = General Internal Medicine, PS = Plastic Surgery, MS = Maxillofacial Surgery, N = Nephrology, D = Dermatology, Other includes Ophthalmology and other subspecialisms*

In 64% of patients (58 of 91), nutritional status (PG-SGA category) predischarge was the same as nutritional status at admission. However, 11% of patients (10 of 91) improved, and 25% (23 of 91) deteriorated (**Table 4**). Of the well-nourished patients at admission, 70% (40 of 57) remained so predischarge, whereas 30% (17 of 57) became malnourished (25% stage B; 5% stage C). Of the malnourished patients at admission, 82% (28 of 34) remained so predischarge, whereas 18% (6 of 34) became well nourished. None of the patients improved from severely malnourished (stage C) at admission to well nourished (stage A) predischarge.

Of the 27 patients admitted to surgical wards, 78% had no change in PG-SGA category, 0% improved, and 22% deteriorated. Of the well-nourished surgical patients at admission, 78% (18 of 23) remained so predischarge, whereas 22% (5 of 23) became malnourished (17% stage B; 4% stage C). Of the malnourished surgical patients at admission, 100% (4 of 4) remained so. Of the 64 patients admitted to medical wards, 58% had no change in PG-SGA category, 16% improved, and 27% deteriorated. Of the well-nourished medical patients at admission, 65% (22 of 34) remained so predischarge, whereas 35% (12 of 34) became malnourished (29% stage B; 6% stage C). Of the malnourished medical patients at admission, 80% (24 of 30) remained so predischarge, whereas 20% (6 of 30) became well nourished. Change in nutritional status did not significantly differ between ward types (χ^2 = 5.5, P = 0.06). Changes in nutritional status stratified per ward type are shown in **Appendix Table A2**.

Table 4. Changes in nutritional status during hospital stay (longitudinal)

PG-SGA Category admission	Change in PG-SGA Category	PG-SGA Category pre-discharge	N (%) within PG-SGA subgroup
Stage A	*No change*	Stage A	40 (70.2)
	Deteriorated	Stage B	14 (24.6)
		Stage C	3 (5.3)
Stage B	*Improved*	Stage A	6 (26.1)
	No change	Stage B	11 (47.8)
	Deteriorated	Stage C	6 (26.1)
Stage C	*Improved*	Stage A	0 (0.0)
		Stage B	4 (36.4)
	No change	Stage C	7 (63.6)
Total *N = 91*	*Improved*		10 (11.0)
	No change		58 (63.7)
	Deteriorated		23 (25.3)

** ORL = Otorhinolaryngology, OS = Orthopedic Surgery, RT = Renal Transplantation, GIM = General Internal Medicine, PS = Plastic Surgery, MS = Maxillofacial Surgery, N = Nephrology, D = Dermatology, Other includes Ophthalmology and other subspecialisms*

DISCUSSION

This study indicates that prevalence of malnutrition in a mixed university hospital population is high at admission (31%) and, importantly, is also high at hospital discharge (36%). Especially in patients with a longer length of stay, the chance of being malnourished and deterioration of nutritional status is high. Almost one-third (30%) of the well-nourished patients at admission were malnourished predischarge, and the vast majority (82%) of malnourished patients remained so.

Our findings correspond to results of previous studies conducted in North America, which reported a malnutrition prevalence before discharge of 53% and 59%, respectively (51% and 54% at admission) [20, 34], compared with 36% in the present study (31% at admission). In the present study we operationalized nutritional status predischarge as the last measurement completed within 4 d before discharge as a composite measure (cross-sectional). We chose this design because this was most reflective of and feasible in daily clinical practice, in accordance with the practice-based nature of our study. The previous studies were, however, longitudinal and therefore selected a study population with a length of hospital stay of at least 7 d, resulting in a median length of stay of 11 d and 12 d, respectively [20, 34], whereas median length of stay in our predischarge sample was only 4 d. The prevalence numbers we found on day 5 (56%) and day 10 (66%) are strikingly similar to the numbers reported in the previous studies. The present study contributes to the body of knowledge on malnutrition during the course of hospitalization and together with the previous studies urges a look beyond screening at admission alone.

Both interesting and alarming, deterioration of nutritional status during hospitalization often occurred (25%) in our study, similar to findings from previous studies (20% and 24%, respectively) [20, 34]. Moreover, a few patients (n = 3; 5% of well-nourished patients at admission) in our sample even deteriorated from well-nourished to severely malnourished (compared with 2% and 10% in previous studies). This deterioration may be due to progression of disease, inadequate detection, inadequate intervention, or a combination of these factors. Although complete absence of deterioration may not be feasible because of progression of underlying disease, the latter two factors should be targeted by nutritional care policies to prevent deterioration during hospitalization as much as possible. As illustrated by our findings and results from previous studies, improvement of nutritional status during hospitalization is possible (11% in the present study, compared with 17% and 21% in previous studies) [20, 34]. In the present study, none of the patients improved from severely malnourished to well nourished, whereas this was reported in 12% and 14% of severely mal- nourished patients in the previous studies. This difference may be explained by differences in nutritional policy and differences in patient characteristics, such as a shorter length of stay (median 8 d in our longitudinal sample versus 11 d and 12 d in previous studies).

Length of stay is an important factor to take into account in evaluating nutritional status during hospitalization. The association between malnutrition and increased length of stay, with disease burden as possible underlying factor, is well established [10, 35-38]. In the present study the difference in samples across time points seems to reflect a higher ratio of patients with a high disease burden and a high chance of being malnourished at the measurement points later in hospitalization. This indicates a sort of real-life selection effect because of the remaining of the high-risk patients. This association between time of measurement and malnutrition risk has been previously reported in a different context [39]. Thus, timing of nutritional screening and assessment is an important factor to take into account in optimizing current nutritional policies to prevent malnutrition or deterioration of nutritional status from remaining undetected and untreated. Additional actions such as structural monitoring or reassessment or structural interventions for patients with prolonged hospitalization should be considered.

In the present study we did not assess the predictive value of our findings for patient outcomes, such as readmissions and mortality, or additional costs. Whereas the association between nutritional status at admission and patient outcomes has already been well described in various previous studies [9, 10, 38, 40], information on the predictive validity of nutritional assessment during hospitalization and at discharge is scarce. In a previous study an association was found between decline in nutritional status and greater risk of complications and higher charges. This association remained when they controlled for presence of cancer, history of surgery, diabetes, age, and ethnicity [34]. Further research is needed to assess efficacy and cost-effectiveness of additional nutritional status monitoring and assessment at discharge.

The practice-based approach of the present study can be considered both a strength and weakness. Because measurements were obtained in the context of routine care, there was a relatively large percentage of missing data, resulting in different sample sizes at different time points, and a smaller subsample of patients with multiple measurements completed. This may have biased our outcomes—for example, through unintentional exclusion of patients who were away for surgery, other interventions, or diagnostics. However, this is very much reflective of the reality of daily practice. The current results therefore provide us with relevant information on the effectiveness of our nutritional policies and give direction for potential future improvements and facilitators and barriers for implementation. For example, measuring patients just before their hospital discharge was challenging, as was measuring by regular nursing staff, mainly because of time constraints and staff shortage.

A limitation of the present study design is that we did not take into account actual food intake during hospitalization; neither did we measure or control for any intervention effects that almost definitely influenced nutritional status during hospitalization. Because the present study was performed in the context of routine care, this was expected and also intentional, to prevent malnourished patients from receiving inadequate care. However, a shortcoming of our data collection was not registering these intervention actions. Reduced food intake has been previously described as a risk factor for nutritional decline during hospitalization [21] and in-hospital mortality [9]. However, obviously, reduced food intake may be of particular importance because it can be influenced by multidisciplinary interventions [41-45], which may also be effective in improving nutritional status after discharge [46]. Other limitations of the present study concern variability of measurement, by different nurses and student researchers, within the context of different wards and in a variety of patient groups not classified by diagnosis. Also, we did not register whether admissions were elective or non-elective.

The high prevalence of malnutrition before discharge underscores the importance of continuation of treatment after hospital discharge and therefore urges a look beyond the hospital walls, for example, through transmural care pathways [47]. This also draws attention to uniformity of work processes and applied instruments, which may require alignment across the chain to ensure clear communication and consistent high-quality nutritional care.

Because nutritional status monitoring or assessment predischarge requires extra time and effort compared with the current malnutrition screening policy at admission, it is important to choose a quick but adequate and reliable instrument sensitive to changes over a shorter time. In the present study we used the PG- SGA, whereas previous studies used the SGA [20, 34]. Because the PG-SGA is based on the SGA, the instruments have similar underlying constructs and both cover multiple domains of the construct malnutrition [48]. However, the PG-SGA relies on patients' self- report for the items on weight, food intake, nutrition impact symptoms, and activities and function (via PG-SGA SF), which can be used as a separate tool for screening and monitoring [22, 49, 50]. In most cases, the PG-SGA SF can be filled in by the patient, usually in less than 3 min [51], and will therefore save time for the health care professionals involved. More research is needed to assess coefficients of variation of the different screening and assessment tools available and aptitude for repeated measurement across care settings.

CONCLUSIONS

The present study found that prevalence of malnutrition in hospitalized patients is high before discharge (36%), and therefore continuation of treatment throughout the chain of care is of upmost importance. Malnutrition is more prevalent in patients with a longer length of hospital stay. Moreover, almost one-third of well-nourished patients at admission were malnourished predischarge. These findings raise questions regarding how to address this issue in clinical practice to prevent deterioration of nutritional status from being undetected and untreated during hospitalization and thereafter.

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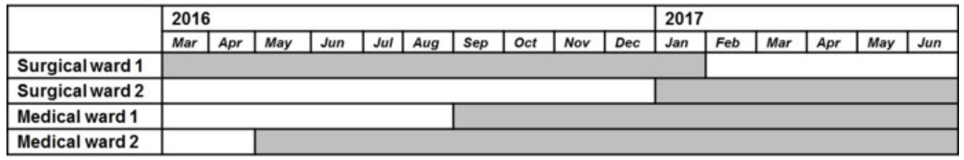
SUPPLEMENTARY MATERIALS

Appendix Figure A.1. Data collection time frames per ward



Appendix Table A.1. Patient characteristics of patients with measurement available pre-discharge (cross-sectional)

Characteristics	Pre-discharge N = 537
Age (*years*), mean ± SD	56.5 ± 17.3
Gender (*n,%*)	
Male	255 (47.5)
Female	282 (52.5)
Height (*cm*), mean ± SD	173.5 ± 9.4
Weight (*kg*), mean ± SD	80.9 ± 17.9
BMI (kg/m^2), mean ± SD	26.8 ± 5.3
Length of stay (*days*), median [IQR]	4 [1-7]
Ward type (*n,%*)	
Surgical	280 (52.1)
Medical	257 (47.9)
Admission specialism (*n,%*)	
Otorhinolaryngology	93 (17.3)
Orthopedic Surgery	103 (19.2)
Renal Transplantation	102 (19.0)
General Internal Medicine	91 (16.9)
Plastic Surgery	54 (10.1)
Maxillofacial Surgery	29 (5.4)
Nephrology	34 (6.3)
Dermatology	28 (5.2)
Other (including Opthalmology and other subspecialisms)	3 (0.6)
Last measurement before discharge (*n,%*)	
Admission	307 (57.2)
Day 5	172 (32.0)
Day 10	48 (8.9)
Day ≥15	10 (1.9)

Appendix Table A.2. Changes in nutritional status during hospital stay (longitudinal) per ward type

Appendix Table A.2.1. *Changes in nutritional status during hospital stay (longitudinal) on surgical wards*

PG-SGA Category admission	Change in PG-SGA Category	PG-SGA Category pre-discharge	N (%) within PG-SGA subgroup
Stage A	*No change*	Stage A	18 (78.3)
	Deteriorated	Stage B	4 (17.4)
		Stage C	1 (4.3)
Stage B	*Improved*	Stage A	0 (0.0)
	No change	Stage B	3 (75.0)
	Deteriorated	Stage C	1 (25.0)
Stage C	*Improved*	Stage A	-
		Stage B	-
	No change	Stage C	-
Total *N = 27*	*Improved*		0 (0.0)
	No change		21 (77.8)
	Deteriorated		6 (22.2)

Appendix Table A.2.2. *Changes in nutritional status during hospital stay (longitudinal) on medical wards*

PG-SGA Category admission	Change in PG-SGA Category	PG-SGA Category pre-discharge	N (%) within PG-SGA subgroup
Stage A	*No change*	Stage A	22 (64.7)
	Deteriorated	Stage B	10 (29.4)
		Stage C	2 (5.9)
Stage B	*Improved*	Stage A	6 (31.6)
	No change	Stage B	8 (42.1)
	Deteriorated	Stage C	5 (26.3)
Stage C	*Improved*	Stage A	0 (0.0)
		Stage B	4 (36.4)
	No change	Stage C	7 (63.6)
Total *N = 64*	*Improved*		10 (15.6)
	No change		37 (57.8)
	Deteriorated		17 (26.6)

PART B

MALNUTRITION AND MUSCLE STATUS IN KIDNEY TRANSPLANT RECIPIENTS