Clinical Nutrition 40 (2021) 4738–4744

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

Original article

Prevalence of patients “at risk of malnutrition” and nutritional routines among surgical and non-surgical patients at a large university hospital during the years 2008–2018

Eli Skeie [a, b, *], Kari Sygnestveit [b, c], Roy M. Nilsen [b, d], Stig Harthug [a, b], Anne Mette Koch [b], Randi J. Tangvik [b, e]

[a] Department of Clinical Medicine, University of Bergen, Bergen, Norway
[b] Department of Research and Development, Haukeland University Hospital, Bergen, Norway
[c] Norwegian National Advisory Unit on Disease-related Undernutrition, Oslo University Hospital, Oslo, Norway
[d] Faculty of Health and Social Sciences, Western Norway University of Applied Sciences, Bergen, Norway
[e] Mohn Nutrition Research Laboratory, Department of Clinical Science, University of Bergen, Bergen, Norway

ARTICLE INFO

Article history:
Received 7 December 2020
Accepted 28 May 2021

Keywords:
Malnutrition
Nutritional strategy
Nutritional status
Nutritional support
Diagnostic coding

SUMMARY

Background & aims: Being “at risk of malnutrition”, which includes both malnutrition and the risk to be so, is associated with increased morbidity and mortality in both surgical and non-surgical patients. Several strategies and guidelines have been introduced to prevent and treat this, but the effects are scarcely investigated. This study aims to evaluate the long-term effects of these efforts by examining trends concerning: 1) the prevalence of patients «at risk of malnutrition» and 2) the use of nutritional support and diagnostic coding related to malnutrition over an 11-year period in a large university hospital. Moreover, we wanted to investigate if there was a difference in trends between surgical and non-surgical patients.

Methods: From 2008 to 2018, Haukeland University Hospital, Norway, conducted 34 point-prevalence surveys to investigate the prevalence of patients «at risk of malnutrition», as defined by Nutritional Risk Screening 2002, and the use of nutritional support at the hospital. Diagnostic coding included ICD-10 codes related to malnutrition (E43, E44 and E46) at hospital discharge, which were extracted from the electronic patient journal. Trend analysis by calendar year was investigated using logistic regression models with and without adjustment for age (continuous), gender (male/female) and Charlson Comorbidity Index (none, mild, moderate or severe).

Results: The number of patients included in the study was 18 933, where 52.1% were male and the median (25th, 75th percentile) age was 65 (51, 76) years. Of these, 5121 (27%) patients were identified to be «at risk of malnutrition». Fewer surgical patients (21.2%) were «at risk of malnutrition», as compared to non-surgical patients (30.9%) ($p < 0.001$). Adjusted trend analysis did not identify any change in the prevalence of patients «at risk of malnutrition» from 2008 to 2018. The percentage of patients «at risk of malnutrition» who received nutritional support increased from 61.6% in 2008 to 71.9% in 2018 ($p < 0.001$), with a range from 55.6 to 74.8%. This trend was seen for both surgical and non-surgical patients ($p < 0.001$ for both). Similarly, dietitians were more involved in the patients’ treatment (range: 3.8–16.7%), and there was increased use of ICD-10 codes related to malnutrition during the study period (range: 13.0–41.8%) ($p < 0.001$). These trends were seen for both surgical patients and non-surgical patients ($p < 0.001$), despite use being less common for surgical patients, as compared to non-surgical patients ($p < 0.001$).

Conclusions: This large hospital study shows no apparent change in the prevalence of patients «at risk of malnutrition» from 2008 to 2018. However, more patients «at risk of malnutrition», both surgical and non-surgical, received nutritional support, treatment from a dietitian and a related ICD-10 code over the

Abbreviations: BMI, Body mass index; ESPEN, European Society for Clinical Nutrition and Metabolism; ICD, International Classification of Diseases; NRS 2002, Nutritional Risk Screening 2002.

* Corresponding author. Helse Bergen, Haukeland Univsersitetssjukehus, Forskings- og utviklingsavdelinga, Seksjon for fag og utdanning, Postboks 1400, 5021, Bergen, Norway.
E-mail address: eli.skeie@helse-bergen.no (E. Skeie).

https://doi.org/10.1016/j.clnu.2021.05.029

study period, indicating improved nutritional routines as a result of the implementation of nutritional guidelines and strategies.

1. Introduction

Patients «at risk of malnutrition» are defined as those who are malnourished or at risk of being so [1], but the terms “at risk of malnutrition” and “malnutrition” are often merged. Patients “at risk of malnutrition” are identified by a validated screening tool, such as the Nutritional Risk Screening 2002 (NRS 2002) [2]. Patients «at risk of malnutrition» have a higher morbidity and mortality [3–5], in addition to increased health care cost [6], as compared to those who are not. The condition is frequently observed across all hospital units, and its prevalence has been studied in relation to disease categories, wide categories of age and BMI, and numbers of diagnoses [7]. However, its prevalence among surgical, as compared to non-surgical, patients is less investigated.

In 1999, the Council of Europe made a network to work systematically towards the integration of nutrition in patient treatment care [8], and in 2003 the European Society for Clinical Nutrition and Metabolism (ESPEN) published guidelines regarding screening for «at risk of malnutrition» [9]. These actions, together with a request from the Patients' Board regarding the integration of nutritional assessment and treatment into patient care and better hospital food for patients, resulted in a local nutritional strategy at Haukeland University Hospital, Norway, in 2006 [10]. This led to the Norwegian Ministry of Health's guidelines regarding how to prevent and treat malnutrition (2009) [11] and the classification of malnutrition as a priority in the Western Norway Regional Health Authority's safety programme [12] and national programme In Safe Hands (2015) [13]. The measures in In Safe Hands are as follows: 1) identify those who are at risk for malnutrition; 2) conduct nutritional assessment on patients «at risk of malnutrition»; 3) give sufficient nutritional support to patients «at risk of malnutrition»; and 4) pass on the information. Patients identified to be «at risk of malnutrition» by NRS 2002 classifies to the ICD-10 code E46 in Norway, and should according the Norwegian guidelines be treated [13,14].

As a part of the local nutrition strategy, Haukeland University Hospital started a quality improvement project in 2008 that aimed to monitor the prevalence of patients «at risk of malnutrition», as well as monitor and improve the clinical nutrition practice, by conducting regular point-prevalence surveys among hospitalised patients. Analysis from the first two years of these surveys demonstrated an improved screening performance, but no change in the percentage of patients «at risk of malnutrition» or number of those who received nutritional support [15]. However, it is well-known that implementation of guidelines takes time [16]. We wanted to investigate if there has been a change in the trend of the prevalence of patients «at risk of malnutrition», its corresponding treatment strategies and use of diagnostic coding at discharge during an 11-year period. Moreover, we wanted to study if the trends differ between surgical and non-surgical patients.

2. Methods

2.1. Study sample

The study included patients 18 years and older screened for being «at risk of malnutrition» from 34 point-prevalence surveys at Haukeland University Hospital, Norway, during the period 31.01.2008–13.09.2018. These surveys were mandatory for somatic departments and repeated two to four times per year [15]. Patients who were terminal, pregnant or having bariatric surgery were not screened for being «at risk of malnutrition». Duplicates are included, as the study aims to picture the hospital's daily patient composition.

2.2. Ethics

The Regional Committee for Medical and Health Research Ethics approved the request to use these data without signed consent from the patients (approval number 2018/904). Information about the surveys are available for the public at the Haukeland University Hospital's webpage [17]. The study is in accordance with the Declaration of Helsinki.

2.3. Clinical data

The point-prevalence surveys were conducted on a predefined Thursday. NRS 2002 was used to identify patients «at risk of malnutrition», which is the same screening tool used in the daily nutritional practice at Haukeland University Hospital. Therefore, regular lectures and computer-based training regarding how to fulfil NRS 2002 are available for the health care professionals at the hospital. First, the registrar (nurse, nurse assistant or physician) at the wards answered “yes” or “no” to the four introductory questions regarding low BMI (<20.5 kg/m^2), recent weight loss, recently reduced food intake and critical illness [2]. “Yes” to one or more of these four questions leads to the final screening, which is based on more in-depth questions regarding the patient's nutritional status (score 0–3) and the severity of the patient's disease in light of nutritional requirements (score 0–3), as well as one additional score if the patient is older than 70 years. A total score $\geq$3 in the final screening identifies the patient to be «at risk of malnutrition», which per definition also includes those who are malnourished. In addition, the registrar answered questions regarding nutritional support (none, planned (not specified), menu modification, oral nutrition supplement, enteral nutrition or parenteral nutrition) and whether a dietitian was involved in the patient care (“yes” or “no”). These data were recorded in a professional data retrieval system developed by Webport (Webport AS, Grimstad, Norway).

Diagnostic coding related to malnutrition included the use of the International Classification of Diseases, 10th version, (ICD-10) codes E43 (unspecified sever protein-energy undernutrition), E44 (protein-energy undernutrition of moderate and mild degree) and E46 (unspecified protein-energy undernutrition) at discharge. These data were assigned from the hospital's patient administrative system. The same system was used to find information about diagnoses and whether the patient was surgical (based on the existence of surgery-related procedure codes). Physical status was evaluated by the Charlson Comorbidity Index (CCI); 1–2 scores were defined as mild, 3–4 as moderate and $\geq$5 as severe physical status [18].

2.4. Statistical analysis

Patient and nutritional characteristics were quantified using descriptive statistics. To test for differences in characteristics between surgical and non-surgical patients, we used the Mann–Whitney U test for continuous data and the chi-square test

for categorical data. To examine trends in the prevalence of patients «at risk of malnutrition», use of nutritional support and ICD-10 codes, we used binary logistic regression models. The model-based prevalence estimates, adjusted for age (continuous), gender (male/female), and Charlson Comorbidity Index none, mild, moderate or severe (categorical) were presented in graphical format together with the observed estimates. The trend analyses were performed for the total sample as well as for surgical and non-surgical patients. To examine if trends were different in surgical and non-surgical patients, we compared models with and without the time-by-group interaction term using the likelihood ratio test. We performed the analysis in the IBM SPSS Statistics and R 3.6.2 [19] for Windows, and p-values below 0.05 were considered as statistically significant.

3. Results

3.1. General and nutritional characteristics

Of the 26 358 patients admitted to wards that participated in the 34 point prevalence surveys, 18 933 (71.8%) were included in the current study after excluding those who met the exclusion criteria and were not screened for being «at risk of malnutrition» for unknown reasons (Fig. 1). The patients and nutritional characteristics of the study sample are described in Table 1 and Table 2, respectively. Overall, 9866 (52.1%) were men, and the median (25th, 75th percentile) age, BMI and length of stay was 65 (51, 76) years, 25.0 (22.1, 28.4) kg/m^2 and 8.0 [4,18] days, respectively. In total, 7582 (40.0%) were surgical patients. The surgical patients tended to be younger, have fewer diagnoses, a lower Charlson Comorbidity Index, and a shorter length of stay compared to non-surgical patients (Table 1).

Twenty-seven percent of the total study sample, 21.2% of the surgical patients and 30.9% of the non-surgical patients were identified to be «at risk of malnutrition» (Table 2). Surgical patients had a higher median BMI and had a less frequently reduced dietary intake and/or weight loss during the last weeks prior to the survey, as compared to non-surgical patients (Table 2). There were no overall differences in the proportion receiving nutritional support between surgical and non-surgical patients (Table 3). However, surgical patients received more advanced nutritional support, such as enteral and parenteral nutrition, whereas menu modification and oral nutritional supplements were more often used among the non-surgical patients. Moreover, fewer surgical patients «at risk of malnutrition» received nutritional consultation from a dietitian (6.1%) compared to non-surgical patients (9.6%) ($p < 0.001$), and fewer surgical patients «at risk of malnutrition» (20.1%) had received an ICD-10 code related to their nutritional status at discharge, as compared to non-surgical patients (22.8%) ($p < 0.001$) (Table 3).

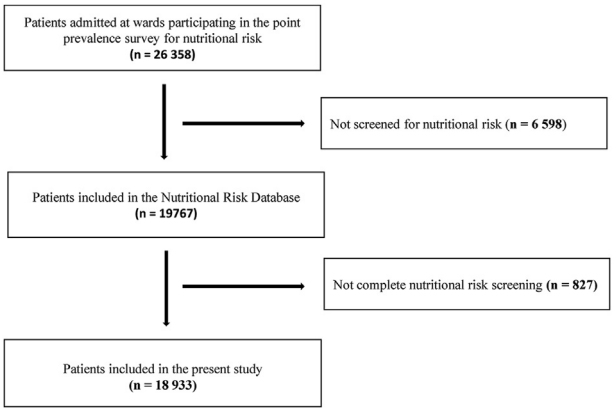

Fig. 1. Flow chart of study population.

3.2. Trends in the prevalence of patients «at risk of malnutrition»

The prevalence of patients «at risk of malnutrition» varied from 21.7% to 30.0% during the 11-year period. The proportion of patients «at risk of malnutrition» among surgical patients varied between 15.0% and 27.5%, and between 26.4% and 33.9% among non-surgical patients. Crude trend analysis demonstrated a reduction of the prevalence of patients «at risk of malnutrition» for the total study population (observed values: 30.3% (2008) - 23.3% (2018)), as well as for surgical patients (observed values: 27.5% (2008) - 15.1% (2018)) and non-surgical patients (observed values: 31.8% (2008) - 28.4% (2018)). Of note, these associations were no longer apparent in the adjusted analysis (data not shown).

3.3. Trends in nutritional support

Trend analysis demonstrated an increased percentage of patients «at risk of malnutrition» receiving nutritional support during the 11-year period (observed values: 61.6% (2008) - 71.9% (2018)), with a range from 55.6 to 74.8% ($p < 0.001$) (Fig. 2). This increasing trend was seen both for surgical and non-surgical patients, with a range from 49.7 to 77.2% among surgical patients (observed values: 62.1% (2008) - 72.5% (2018)), and from 57.1 to 73.5% among non-surgical patients (observed values: 61.3% (2008)–71.6% (2018)) ($p < 0.001$ for both). However, these trends did not differ between surgical and non-surgical patients ($p = 0.88$). Use of all types of nutritional support increased during the study period, except for parenteral nutrition among non-surgical patients at nutritional risk (data not shown). Patients «at risk of malnutrition» receiving nutritional support, compared with those not receiving nutritional support, had a lower median (25, 75 percentile) age (70 (57, 79) vs 71 (58, 80) years ($p = 0.04$)) and a higher median (25, 75 percentile) BMI (20.6 (18.4, 24.6) vs 20.4 (19.0, 25.0) kg/m^2 ($p = 0.01$)). Moreover, they had a longer median (25, 75 percentile) length of hospital stay (15.0 (7.5, 30.0) vs 9.0 (4.0, 17.0) days ($p < 0.001$). Additionally, they more often answered "yes" regarding having a reduced dietary intake and weight loss (74.6% vs. 54.0% ($p < 0.001$) and 58.9% vs 47.7% ($p < 0.001$), respectively), and scored higher for the severity of disease and the degree of impaired nutritional status ($p < 0.001$ for both). The involvement of a dietitian for patients «at risk of malnutrition» also increased during the study period, with a range from 3.8 to 16.7% (observed values: 5.0% (2008) – 16.7% (2018)) ($p < 0.001$) (Fig. 2). This increasing trend was seen both for surgical patients and non-surgical patients, with a range between 1.9 and 11.2%, and 4.0–20.1%, respectively ($p < 0.001$ for both) (Fig. 2). Trends did not differ between surgical and non-surgical patients ($p = 0.11$).

3.4. Trends in ICD-10 codes related to malnutrition

The use of ICD-10 codes related to malnutrition showed a non-linear association with time, indicating that more patients were diagnosed by ICD-10 codes both early and late (after 2013) during the study period ($p < 0.001$) (Fig. 2). A similar non-linear association was seen for both surgical patients and non-surgical patients ($p < 0.001$ for both), with a range from 12.7 to 34.2%, and from 12.1 to 45.9%, respectively (Fig. 2). However, the observed associations were less exponential for surgical patients, as compared to non-surgical patients ($p < 0.001$) (Fig. 2).

Table 1
Patient characteristics of the study sample.

	Total	Surgical patients	Non-surgical patients	P-value[d]
	n = 18 933	n = 7582	n = 11 351	
Male[a]	9866 (52.1)	3883 (51.2)	5983 (52.7)	0.04
Age, years[b]	65 (51, 76)	64 (50, 74)	66 (52, 77)	<0.001
Age ≥ 70 years[a]	7571 (40.0)	2688 (35.5)	4883 (43.3)	<0.001
Charlson Comorbidity Index, score[a]				<0.001
0	7888 (41.7)	4048 (53.4)	3840 (33.8)	
1–2 (mild)	7139 (37.7)	2440 (32.2)	4699 (41.4)	
3–4 (moderate)	1634 (8.6)	484 (6.4)	1150 (10.1)	
≥5 (severe)	2272 (12.0)	610 (8.0)	1662 (14.6)	
Length of stay[b,c]	8 (4, 18)	8 (4, 15)	9 (4, 20)	<0.001

[a] n (%).
[b] Median (25, 75 percentile).
[c] Missing data: n = 80.
[d] P-values for differences between surgical and non-surgical patients were calculated by using Mann–Whitney U test for continuous variables and chi-square tests for categorical variables.

Table 2
Nutritional characteristics of the study population.

	Total	Surgical patients	Non-surgical patients	P-value[c]
	n = 18 933	n = 7582	n = 11 351	
BMI (kg/m^2)[a]	25.0 (22.1, 28.4)	25.6 (22.8, 29.0)	24.5 (21.7, 27.9)	<0.001
Categories of BMI (kg/m^2)[b]				<0.001
<18.5 (underweight)	1197 (6.3)	322 (4.2)	875 (7.7)	
18.5–24.9 (normal weight)	7421 (39.2)	2704 (35.7)	4717 (41.6)	
25–29.9 (overweight)	6096 (32.2)	2682 (35.4)	3414 (30.1)	
≥30 (obese)	3246 (17.1)	1487 (19.6)	1759 (15.5)	
Initial NRS 2002-screening[b]				
Is the patient's BMI <20.5 kg/m^2? (yes)	2771 (14.6)	812 (10.7)	1959 (17.3)	<0.001
Has the patient lost weight within the last 3 months? (yes)	4171 (22.1)	12.02 (15.9)	2979 (26.2)	<0.001
Has the patient had a reduced dietary intake in the last week? (yes)	4882 (25.8)	1481 (19.5)	3401 (30.0)	<0.001
Is the patient severely ill? (yes)	2321 (12.3)	1059 (13.9)	1267 (11.2)	<0.001
Patients «at risk of malnutrition» [b]	5121 (27.0)	1610 (21.2)	3511 (30.9)	<0.001

BMI, Body Mass Index. Missing information for BMI (n = 11), Information regarding dietary intake (n = 27), Information regarding weight loss (n = 41), and Information regarding severely ill or not (n = 39) in the study sample.
[a] Median (25, 75 percentile).
[b] n (%).
[c] P-values for differences between surgical and non-surgical patients were calculated by using Mann–Whitney U test for continuous variables and chi-square test for categorical variables.

Table 3
Nutritional support and use of ICD-10 codes related to malnutrition among patients «at risk of malnutrition».

	Total	Surgical patients	Non-surgical patients	P-value[b]
	n = 5121	n = 1610	n = 3511	
Patients receiving or planning on receiving nutritional support[a]	3350 (65.4)	1061 (65.9)	2289 (65.2)	0.76
Type of nutritional support[a]				
Planned (not specified)	425 (8.3)	112 (7.0)	313 (8.9)	0.02
Menu modification	901 (17.6)	232 (14.4)	669 (19.1)	0.003
Oral nutrition supplements	934 (18.2)	228 (14.2)	706 (20.1)	<0.001
Enteral nutrition	571 (11.2)	251 (15.6)	320 (9.1)	<0.001
Parenteral nutrition	519 (10.1)	238 (14.8)	281 (8.0)	<0.001
Dietitian involved[a]	435 (8.5)	98 (6.1)	337 (9.6)	<0.001
ICD-10 codes (E43, E44 or E46)[a] related to malnutrition	1125 (22.0)	323 (20.1)	802 (22.8)	<0.001

Missing data for information regarding nutritional support (n = 63).
[a] n (%).
[b] P-values for differences between surgical and non-surgical patients were calculated by using chi-square tests for categorical variables.

4. Discussion

The present study showed no change in the prevalence of patients «at risk of malnutrition» during the period from 2008 to 2018, for neither surgical nor non-surgical patients. However, there was an increased use of nutritional support, treatment by a dietitian, and a related use of ICD-10 code at discharge during the same period. Of note, despite the same number of surgical and non-surgical patients «at risk of malnutrition» receiving nutritional support, surgical patients had a dietitian involved in their nutritional care or a related ICD-10 code at discharge less frequently compared to non-surgical patients.

Patients generally stay for a relatively short time at the hospital, and preventing and treating the «at risk of malnutrition» usually requires a period much longer than the anticipated length of stay. Just as the condition is not treated in one day, it does not develop in

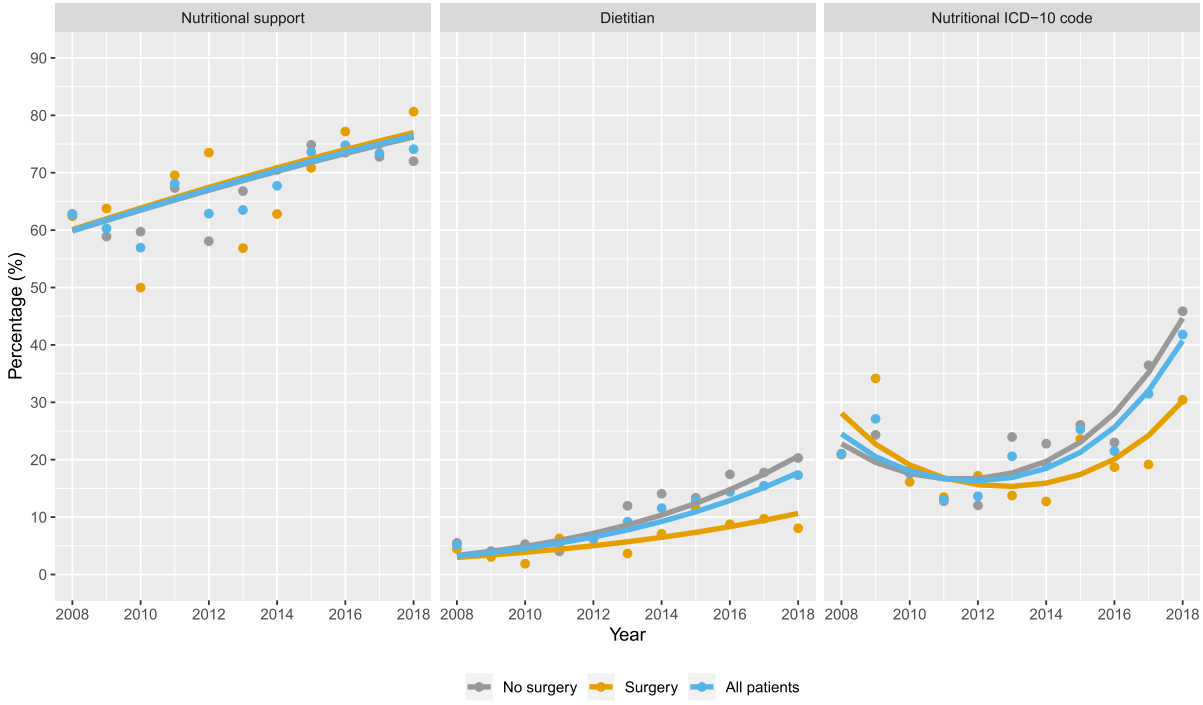

Fig. 2. Trend for use of nutritional support, a dietitian and related ICD-10 code among patients « at risk of malnutrition» in the period from 2008 to 2018 for the total study population (n = 5121, blue colour), surgical patients (n = 1610, orange colour) and non-surgical patients (n = 3511, grey colour). Dots represent observed percentages, whereas lines represent estimated percentages from logistic regression models, adjusted for age, gender and Charlson Comorbidity Index (at their means for age and gender, and by categorical value [1] for Charlson Comorbidity Index). Calendar year was included in the regression models as a linear term for nutritional support and dietitians, and as quadratic polynomial terms for nutritional ICD-10 code.

one day. Thus, the possibility to decrease the percentage of «at risk of malnutrition» may depend more on factors outside rather than inside the hospital. Nutritional care is both the hospitals' and the primary health care's responsibility, and thus, the Norwegian patient safety programme, In Safe Hands, has developed three action packages regarding how to prevent and treat malnutrition: one for hospitals, one for nursing homes and one for home services. Of note, both the In Safe Hands' action package for hospitals and the National Guideline for Prevention and Treatment of Malnutrition have focused on patients admitted to hospitals. However, most patients have one or more meetings as outpatients prior to admission, which is have the potential to detect «at risk of malnutrition». Thus, outpatients with a high risk of malnutrition should be screened for being «at risk of malnutrition», which is one of the aims in Haukeland University Hospital's revised nutritional strategy [10]. Moreover, the strategy stated that a dietitian should also be accessible for these patients.

It has previously been described that hospital units where dietitians are regularly present have more nutritional knowledge and routines than units without a dietitian [20]. If the hospital does not have an overall strategy to maintain this expertise, this contact may be arbitrary. Despite the percentage increasing, the overall analysis demonstrated that, on average, only 8.5% of the patients «at risk of malnutrition» received treatment from a dietitian during the 11 years. Reasons for this may include both lack of awareness of the dietitians' knowledge and services, and the limited availability of a dietitian for some of the bed-posts.

According to ESPEN, the studies conducted to investigate the effect of nutritional support among surgical patients have evidence of low quality, partly due to their not excluding patients who were not « at risk of malnutrition» [21]. Thus, ESPEN highlights the need for randomised controlled nutritional intervention studies for surgical patients «at risk of malnutrition» [21]. For medical inpatients, a recent systematic review and meta-analysis found a greater beneficial effect on important clinical outcomes (improved survival, lower rates of non-elective hospital readmission, higher energy and protein intake and increased body weight) concerning nutritional support to those who were «at risk of malnutrition» in studies published after 2014, as compared to before 2014. In addition to having higher quality and lower bias, the newer trails also differed with regard to the nutritional interventions used, with a higher quality of protein and a more individualised, patient-specific approach [22]. EFFORT, a recent randomised controlled study, demonstrated that non-surgical patients «at risk of malnutrition» at hospitals who received personalised nutritional support from a dietitian had a lower rate of readmission, mortality and costs, as compared to hospitalised patients «at risk of malnutrition» receiving treatment as usual [23]. Similar control groups are also used in other studies [22], demonstrating that even when «at risk of malnutrition» is identified, not all received nutritional support. This was also evident in our study, where an average of 34.9% of patients «at risk of malnutrition» over the 11-year period, and at least 25% per year, did not receive any nutritional support. The trend of younger age, longer length of stay and a more impaired nutritional status among those who were «at risk of malnutrition» and received nutritional support as compared to those who did not receive nutritional support, was also demonstrated in a recent Swizz cohort study among medical patients [24].

Notably, despite the terms «at risk of malnutrition» and malnutrition are often merged, not all of those identified to be «at risk of malnutrition» by NRS 2002 will necessarily be defined as malnourished according to the new Global Leadership in Malnutrition's (GLIM) criteria [25]. These criteria were published in 2019, and are based on a two-step approach starting with screening for

«at risk of malnutrition», and secondly to assess for malnutrition and its severity. The current study does not have all data needed for the second step, and is thus not able to identify how many of the patients «at risk of malnutrition» that are malnourished according to the GLIM criteria. Nevertheless, all patients identified to be «at risk of malnutrition» by NRS 2002 classifies to the ICD-10 code E46 in Norway, and should according to the Norwegian guidelines, be treated [14,26].

Despite the fact that for over 80 years weight loss has been a known risk factor for postoperative complications [27], a recent study conducted with data from the Norwegian Registry for Gastrointestinal Surgery demonstrated that 5317 patients (45%) in the database missed information regarding preoperative weight loss [28]. This indicates that malnutrition is a neglected problem among surgical patients, just as it was demonstrated to be in 1977 [29]. This may explain why a well-designed, randomised controlled nutritional intervention study, such as the EFFORT-study, has not yet been conducted for surgical patients.

ICD-10 codes are used to report diseases and health conditions. They are the foundation for the identification of health trends [30] and picture the patient composition of diseases and scope of treatment given at hospitals for the health authorities. This information is necessary for the planning of future healthcare and weighing of rates used in activity-based financing, which is the foundation for the financing of Norwegian health care [31]. Since patients «at risk of malnutrition» impose negative clinical outcomes, including death, it is crucial to commence nutritional support as early as possible. Such intervention generates costs, and thus the diagnosis «at risk of malnutrition» needs to be coded [32]. A mismatch between patients «at risk of malnutrition» and the use of related ICD-10 codes leads to a misleading picture of the prevalence of patients «at risk of malnutrition» and resources it requires for health authorities. In addition, since the ICD-10 codes convey information between health care services, a lack of code may lead to reduced health outcomes and increased health costs. The Norwegian National Advisory Unit on Disease Related Undernutrition aims to ensure that at least 90% of all patients «at risk of malnutrition» receive a malnutrition related ICD-10 code (E43, E44 or E46) at discharge [33]. We found that despite an increased use of ICD-10 codes related to malnutrition, each year at least 50% of the patients «at risk of malnutrition» do not receive this at discharge. A study from Switzerland used the «at risk of malnutrition» -related ICD-10 codes from hospital discharge databases to report the prevalence of patients «at risk of malnutrition» over a 16-year period. They demonstrated that the prevalence increased from 0.32% in 1998 to 3.97% in 2014, but with large variations within regions [34].

The fact that not all patients «at risk of malnutrition» received nutritional treatment or an ICD-10 code at discharge indicates that there is still room for improvement concerning the implementation of nutritional guidelines. Implementation of guidelines is more complex than developing them. This is, among other things, due to more involved parties, blurred responsibility, and varied local circumstances and proprieties [35]. In Norway, the national programme In Safe Hands went from being a programme with earmarked promotions and funds to a part of the Department of Quality Improvement and Patient Safety at the Norwegian Ministry of Health in 2019. For hospitals, this means that the management receives a greater responsibility for maintenance of the improvement work and its implementation in clinical practice.

4.1. Strengths and limitations

The current study analyses a large study sample and uses clear definitions of «at risk of malnutrition», nutritional support and related ICD-10 codes. Other strengths of the study include staff training for «at risk of malnutrition» screening and mandatory registration with point prevalence surveys over an 11-year period at a university hospital.

There is a potential for bias in the study, as many people are involved in the registration and the register is incomplete. However, NRS 2002 has been previously demonstrated to have high sensitivity and specificity [36], and more than 70% of the eligible patients were registered in the registry. The last 30% were not included due to exclusion criteria of NRS 2002 (patients younger than 18 years, being terminal or pregnant, or having bariatric surgery) or unknown reasons. An important limitation of this study is the lack of detailed information about nutritional support, including whether the patients' energy and protein needs actually were met.

4.2. Clinical relevance

Preventing malnutrition is essential for patients, health care professionals and hospital management, due to the subsequent impact on the patients' health and health care system's costs and use of resources. This study demonstrates that the «at risk of malnutrition» screening as a part of local and national guidelines and strategies led to an increased use of nutritional support and related diagnostic coding for patients «at risk of malnutrition», but no change in the prevalence of patients «at risk of malnutrition». Moreover, these data may be used as quality indicators to evaluate the success of the local nutrition strategy and national programme In Safe Hands.

5. Conclusion

In conclusion, the treatment of patients «at risk of malnutrition» has improved during the 11 years with point prevalence surveys; however, there is still a need to improve the implementation of nutritional guidelines, particularly for surgical patients. The motivation for this may depend on better evidence of nutritional support in this patient group.

Statement of authorship

Eli Skeie: conceptualisation, methodology, formal analysis, writing – original draft, review & editing, visualisation, project administration. **Kari Sygnestveit**: writing – review & editing, project administration. **Roy M. Nilsen**: writing – review & editing, project administration, visualisation. **Stig Harthug**: conceptualisation, writing – review & editing, supervision. **Anne Mette Koch:** conceptualisation, writing – review & editing, supervision. **Randi J. Tangvik**: conceptualisation, writing – review & editing, supervision, project administration. All authors gave final approval of the version to be submitted.

Funding sources statements

This work was supported by Helse Vest RF [grant number 912214].

Conflicts of interest

The authors declare that they do not have any conflict of interest.

Acknowledgements

We are grateful to all the patients and health professionals who contributed to the data collection. Moreover, we thank Elizabeth Nordeide for help with establishing the Malnutrition registry and Håkon Ersland for data management.

References

[1] Cederholm T, Barazzoni R, Austin P, Ballmer P, Biolo G, Bischoff SC, et al. ESPEN guidelines on definitions and terminology of clinical nutrition. Clin Nutr 2017;36(1):49–64.
[2] Kondrup J, Rasmussen HH, Hamberg O, Stanga Z, Ad Hoc EWG. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clin Nutr 2003;22(3):321–36.
[3] Felder S, Lechtenboehmer C, Bally M, Fehr R, Deiss M, Faessler L, et al. Association of nutritional risk and adverse medical outcomes across different medical inpatient populations. Nutrition 2015;31(11–12):1385–93.
[4] Thibault R, Makhlouf AM, Kossovsky MP, Iavindrasana J, Chikhi M, Meyer R, et al. Healthcare-associated infections are associated with insufficient dietary intake: an observational cross-sectional study. PLoS One 2015;10(4):e0123695.
[5] Tangvik RJ, Tell GS, Eisman JA, Guttormsen AB, Henriksen A, Nilsen RM, et al. The nutritional strategy: four questions predict morbidity, mortality and health care costs. Clin Nutr 2014;33(4):634–41.
[6] Khalatbari-Soltani S, Marques-Vidal P. The economic cost of hospital malnutrition in Europe; a narrative review. Clin Nutr ESPEN 2015;10(3):e89–94.
[7] Tangvik RJ, Tell GS, Guttormsen AB, Eisman JA, Henriksen A, Nilsen RM, et al. Nutritional risk profile in a university hospital population. Clin Nutr 2015;34(4):705–11.
[8] Beck AM, Balknas UN, Furst P, Hasunen K, Jones L, Keller U, et al. Food and nutritional care in hospitals: how to prevent undernutrition–report and guidelines from the Council of Europe. Clin Nutr 2001;20(5):455–60.
[9] Kondrup J, Allison SP, Elia M, Vellas B, Plauth M, Educational, et al. ESPEN guidelines for nutrition screening 2002. Clin Nutr 2003;22(4):415–21.
[10] Helse Bergen HF. Helse Bergen sin ernæringsstrategi. Available from: https://helse-bergen.no/om-oss/helse-bergen-sin-erneringsstrategi-2017-2021#strategi-fra-2006-revidert; 2017.
[11] Heslsedirektoratet. Nasjonale faglige retningslinjer for forebygging og behandling av underernæriing. 2009. Available from: https://www.helsedirektoratet.no/retningslinjer/underernaering/Forebygging%20og%20behandling%20av%20underern%C3%A6ring%20%E2%80%93%20Nasjonal%20faglig%20retningslinje.pdf/_/attachment/inline/a69263ff-b40e-4d23-a7c6-67acce28a88e:48ba11770eaa7f7a1d18145aa0e1f30086ca5dcd/Forebygging%20og%20behandling%20av%20underern%C3%A6ring%20%E2%80%93%20Nasjonal%20faglig%20retningslinje.pdf.
[12] Helse Vest RHF. Sak 12215 Program for pasienttryggleik i Helse Vest - status per november 2015. 2015. Available from: https://helse-vest.no/seksjon/styresaker/Documents/2015/10.12.2015/Sak%2012215%20Program%20for%20pasienttryggleik%20i%20Helse%20Vest%20-%20status%20per%20november%202015.pdf.
[13] The Norwegian Directorate of Health. Forebygging av underernæring - Pasientsikkerhetsprogrammet. 2018. Available from: https://pasientsikkerhetsprogrammet.no/om-oss/innsatsomrader/ernaering.
[14] The Norwegian Directorate of Health. Nasjonale faglige retningslinjer for forebygging og behandling av underernæring. 2009. Available from: https://www.helsedirektoratet.no/retningslinjer/underernaering/Forebygging%20og%20behandling%20av%20underern%C3%A6ring%20%E2%80%93%20Nasjonal%20faglig%20retningslinje.pdf/_/attachment/inline/a69263ff-b40e-4d23-a7c6-67acce28a88e:48ba11770eaa7f7a1d18145aa0e1f30086ca5dcd/Forebygging%20og%20behandling%20av%20underern%C3%A6ring%20%E2%80%93%20Nasjonal%20faglig%20retningslinje.pdf.
[15] Tangvik RJ, Guttormsen AB, Tell GS, Ranhoff AH. Implementation of nutritional guidelines in a university hospital monitored by repeated point prevalence surveys. Eur J Clin Nutr 2012;66(3):388–93.
[16] Flottorp Sa E. Implementation research: science for improving practice. J Epidemiol 2013;23(2):187–96.
[17] Helse Bergen HF. Ti års oppfølging av underernæring og ernæringsbehandling. 2020. Available from: https://helse-bergen.no/avdelinger/forskings-og-utviklingsavdelinga/ti-ars-oppfolging-av-underernering-og-erneringsbehandling.
[18] Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chron Dis 1987;40(5):373–83.
[19] R Core Team. R: A language and enviornment for statstical computing. Vienna, Austria: R Foundation for Statistical Compting; 2015. Available from: www.R-project.org/.
[20] Thoresen L, Rothenberg E, Beck AM, Irtun O, Scandinavian Nutrition G. Doctors and nurses on wards with greater access to clinical dietitians have better focus on clinical nutrition. J Hum Nutr Diet 2008;21(3):239–47.
[21] Weimann A, Braga M, Carli F, Higashiguchi T, Hubner M, Klek S, et al. ESPEN guideline: clinical nutrition in surgery. Clin Nutr 2017;36(3):623–50.
[22] Gomes F, Baumgartner A, Bounoure L, Bally M, Deutz NE, Greenwald JL, et al. Association of nutritional support with clinical outcomes among medical inpatients who are malnourished or at nutritional risk: an updated systematic review and meta-analysis. JAMA Netw Open 2019;2(11):e1915138.
[23] Schuetz P, Fehr R, Baechli V, Geiser M, Deiss M, Gomes F, et al. Individualised nutritional support in medical inpatients at nutritional risk: a randomised clinical trial. Lancet 2019;393(10188):2312–21.
[24] Kaegi-Braun N, Mueller M, Schuetz P, Mueller B, Kutz A. Evaluation of nutritional support and in-hospital mortality in patients with malnutrition. JAMA Netw Open 2021;4(1):e2033433.
[25] Cederholm T, Jensen GL, Correia M, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition - a consensus report from the global clinical nutrition community. Clin Nutr 2019;38(1):1–9.
[26] The Norwegian Directorate of Health. Tiltakspakke for forbygging og behandling av underernæring (sykehus). Available from: https://pasientsikkerhetsprogrammet.no/om-oss/innsatsomrader/ernaering/_/attachment/inline/80302130-98eb-4c67-a439-293bf4856066:d0438f00f6268ebd5a68954b07e82d090ef9968f/tiltakspakke-for-forebygging-og-behandling-av-underernaering-i-sykehus.pdf; 2018.
[27] Studley HO. Percentage of weight loss: a basic indicator of surgical risk in patients with chronic peptic ulcer. 1936. Nutr Hosp 2001;16(4):141–3. discussion 0-1.
[28] Skeie E, Tangvik RJ, Nymo LS, Harthug S, Lassen K, Viste A. Weight loss and BMI criteria in GLIM's definition of malnutrition is associated with postoperative complications following abdominal resections - results from a National Quality Registry. Clin Nutr 2020;39(5):1593–9.
[29] Hill GL, Blackett RL, Pickford I, Burkinshaw L, Young GA, Warren JV, et al. Malnutrition in surgical patients. An unrecognised problem. Lancet 1977;1(8013):689–92.
[30] World Health Organization. International classification of diseases. 11th Revision. 2020. Available from: https://www.who.int/classifications/icd/en/.
[31] The Norwegian Directorate of Health. Innsatsstyrt finansiering (ISF) - regelverk. 2020. Available from: https://www.helsedirektoratet.no/tema/finansiering/innsatsstyrt-finansiering-og-drg-systemet/innsatsstyrt-finansiering-isf.
[32] Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition - an ESPEN consensus statement. Clin Nutr 2015;34(3):335–40.
[33] Norwegian National Advisory Unit on Disease Related Undernutrition. Kompetansespredningsplan 2020–2030. 2020. cited 2020. Available from: https://oslo-universitetssykehus.no/fag-og-forskning/nasjonale-og-regionale-tjenester/nasjonal-kompetansetjeneste-for-sykdomsrelatert-underernering-nksu/om-kompetansetjenesten#kompetansespredningsplan.
[34] Khalatbari-Soltani S, de Mestral C, Marques-Vidal P. Sixteen years trends in reported undernutrition. Clin Nutr 2019;38(1):271–8.
[35] Field MJ, Lohr KN, editors. Guidelines for clinical practice: from development to use. Washington (DC); 1992.
[36] Kyle UG, Kossovsky MP, Karsegard VL, Pichard C. Comparison of tools for nutritional assessment and screening at hospital admission: a population study. Clin Nutr 2006;25(3):409–17.