

ORIGINAL RESEARCH

Malnutrition and nutritional care practices in hospital wards for older people

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Abstract

Aims. This paper is a report of a study conducted to gain a better insight into the current nutritional care practices in Belgian hospital wards for older people, and to study the association between these practices and the prevalence of malnutrition.

Background. In 1999, the Council of Europe assessed nutritional care practices and support in 12 European countries and showed them to be sparse and inconsistent. At the time of research, no studies had described the association between nutritional care practices and malnutrition prevalence in Belgium.

Methods. In 2007, a cross-sectional survey was carried out in a representative sample of Belgian hospital wards for older people. In total, 2094 patients from 140 wards for older people were included.

Results. The overall prevalence rate of malnutrition in wards for older people was 31.9%. Nutritional care practices such as nutritional screening and assessment, use of a standardized screening instrument and a nutritional protocol were suboptimal. Multilevel analysis revealed that ward characteristics explained for 9.1% whether a patient was malnourished or not. None of the registered nutritional care practices could explain a patient's individual risk.

Conclusion. Malnutrition is a frequently occurring problem on hospital wards for older people. Increased consciousness among healthcare professionals and hospital policy makers of the importance of nutritional care will contribute to further improvement in care quality.

Keywords: geriatric hospital wards, healthcare professionals, hospital malnutrition, nursing, nutritional care, older people

Introduction

Malnutrition continues to be a major healthcare problem, particularly in older hospitalized patients. Two recently conducted nationwide prevalence surveys in the Netherlands and Germany reported malnutrition prevalence rates among older hospitalized patients ranging from 32% to 56% (Pirlich *et al.* 2006, Meijers *et al.* 2009). The broad range of these figures may be the result of differences in methodology and definitions used of nutritional care.

For the purpose of this study, we used the definition of malnutrition developed by Chen *et al.* (2001). They defined malnutrition in older people as faulty or inadequate nutritional status; undernourishment characterized by insufficient dietary intake, poor appetite, muscle wasting and weight loss.

Older people are especially vulnerable to malnutrition as they frequently have multiple pathologies and impairments, and poor nutritional intakes (Stratton *et al.* 2003).

Malnutrition has important consequences, such as increased morbidity and mortality, longer hospital stays, and elevated costs for patients and society (Amaral *et al.* 2007, Kubrak & Jensen 2007). Therefore, it is vital that hospital wards for older people have a nutritional care policy to prevent and/or treat malnutrition. In Belgium, a National Food and Health Plan (NVGP-B) was established to increase the health status of the population (Nationaal Voedings-en Gezondheidsplan 2005). The NVGP-B advised hospitals to appoint a nutritional support team and team leader whose task was to develop and implement a hospital-wide nutritional policy. These recommendations were not obligatory for the Belgian hospitals.

Background

As early identification and treatment of malnutrition generally improve patient outcomes and also appear to be cost-effective (Stratton *et al.* 2003, Kruijenga *et al.* 2005), a nutritional care policy is indispensable. Nutritional care practices of hospitals have been inventoried in several studies. In 1999, the Council of Europe reviewed the practices of nutritional care and support in 12 European countries based on a questionnaire. The review was then extended by an electronic database search (Beck *et al.* 2002). The results showed that routine nutritional risk screening and assessment were generally not performed at admission or during hospitalization. Additionally, the use of nutritional support for undernourished or at-risk patients was sparse, inconsistent and often applied only to special patients or patients who were severely undernourished. Ten per cent to 50% of the hospitals had a nutritional support team, but most

hospitals in the majority of the countries lacked a nutritional steering committee (Beck *et al.* 2002). A recent Dutch prospective study taking place in the general medical wards of a teaching hospital investigated the practice of diagnosing and treating malnutrition by doctors, medical students and nurses prior to, during and after hospitalization (Bavelaar *et al.* 2008). In only 15.3% of the patients, medical doctors carried out a nutritional assessment in the first 72 hours after admission, nurses in 29.9% of their patients and medical students in 52.8% of their patients. Nutritional interventions were applied in less than 40% of all malnourished patients. The Netherlands gathered data on nutritional care practices as part of its annual measurement of the prevalence of care problems nationwide (Meijers *et al.* 2009). In 40.3% of hospital patients, a nutritional screening was performed. A screening instrument was applied in <50% of the screened hospital patients. Furthermore, less than half of the malnourished patients received nutritional treatment. Meijers *et al.* (2009) also collected data on nutritional quality indicators on both ward and institution levels. At ward level, almost 40% of hospitals wards had a caregiver specialized in malnutrition working on the ward who was using prevention and treatment guidelines. In more than half of the wards, patients were weighed at admission. Approximately 70% of the wards documented nutritional interventions in the patient records and almost half of the wards focused on mealtime ambience. Mowe *et al.* (2006) questioned doctors and nurses in Denmark, Sweden and Norway about nutritional routines and attitudes (Mowe *et al.* 2006). Less than one-third of the participants screened the nutritional status of all patients in their department as a standard procedure during admission. Only 14% of the participants answered reported that a nutritional regime was always recorded in the patient record.

Several authors have searched for possible explanations for these findings. Major barriers to adequate nutritional care practices may be a lack of prioritization, interest, nutritional knowledge among healthcare professionals, or clearly defined responsibilities, as well as negative attitudes towards nutritional care (Perry 1997, Rasmussen *et al.* 1999, Beck *et al.* 2002, Mowe *et al.* 2008). Staffing may also impact practices (Sochalski 2004, Kalisch 2006) and may influence the barriers to adequate nutritional care (Figure 1).

Despite the availability of research studies such as those mentioned above, in Belgium, there is an absence of data on nutritional care practices. Additionally, to our knowledge, no studies examined the relationship between nutritional care practices and malnutrition prevalence (Figure 1). Understanding the relationship between these two variables could lead to the more efficient allocation of healthcare resources and may consequently improve patient outcomes.

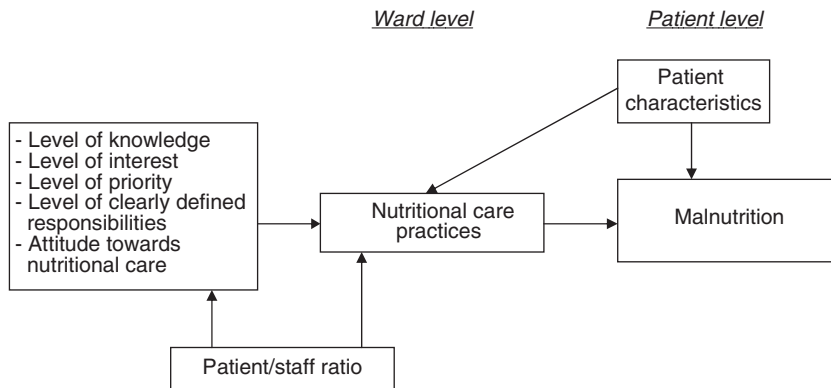


Figure 1 Hypothesized model.

The study

Aims

The aim of this study was twofold: to gain a better insight into the current nutritional care practices in Belgian hospital wards for older people and to study the association between the prevalence of malnutrition and the nutritional care characteristics in these wards.

Methodology

A nationwide cross-sectional prevalence study was performed.

Sample

The prevalence study was performed in Belgian hospital wards for older people between 16 May and 15 June 2007. All Belgian general and teaching hospitals with geriatric wards were invited to participate in the study. Patients were only included in the study if they were 75 years or older and gave their informed consent. To ensure the representativeness of the data, we included in the analysis only wards where at least ten patients were screened.

Data collection

Data were collected on both patient level and ward level. The patient data included the nutritional status of older people, their age, origin and length of hospital stay. Additionally, information was collected on the patient risk factors of swallowing, tasting or digestion difficulties, delirium, pneumonia and malignant disease (Kondrup *et al.* 2003b, Suominen *et al.* 2005). All data were extracted from the patients' nursing/medical records and collected by the staff nurse, nurse-assistant or ward dietician. These healthcare workers

were asked to indicate if the risk factor was present using a pre-specified questionnaire. Nausea, vomiting and diarrhoea were used as indicators of digestion difficulties.

The patient's nutritional status was evaluated using the short form of the Mini Nutritional Assessment (MNA-SF). The full Mini Nutritional Assessment (MNA) has been extensively validated and is recommended by the European Society of Parenteral and Enteral Nutrition (ESPEN) for the detection of malnutrition among hospitalized older people (Vellas *et al.* 1999, Guigoz *et al.* 2002, Kondrup *et al.* 2003a, Green & Watson 2006). The MNA comprises 18 items subdivided into four categories: anthropometric assessment, general assessment, dietary assessment and subjective assessment. However, Rubenstein *et al.* (2001) considered the completion of the full MNA tool too time-consuming in a geriatric screening situation, and developed the MNA-SF, which is highly correlated with the full MNA (Rubenstein *et al.* 2001, Wikby *et al.* 2008). The maximum score on the MNA-SF is 14. If a patient is recognized as at risk for malnutrition by the MNA-SF (score < 12), then the remaining 12 items of the full MNA must be assessed. Patients with an MNA score of lower than 17 are considered malnourished, while patients with a score between 17 and 24 are identified as at risk for malnutrition. A score of 12 or higher on the MNA-SF or 24 or higher on the full MNA indicates that the patient is well-nourished (Rubenstein *et al.* 2001, Kondrup *et al.* 2003a).

Ward data comprised information on the characteristics of the nutritional care practices in the ward, including nutritional assessment, weighing, calculating BMI, making a referral to a nutritional team, making a referral of a nutrition protocol, using a standardized nutritional screening instrument, using a form for nutritional intake, menu choice and presence of a dining-room. The first four questions had five answering options related to the percentage of patients. These answering options were (1) no, (2) yes for <25% of the patients, (3) yes for 25–50% of the

patients, (4) yes for >50–75% of the patients and (5) yes for >75% of the patients. The latter six questions were yes or no questions. A standardized questionnaire was developed to record these data. The content validity of this standardized questionnaire and the Dutch and French translations of the MNA were evaluated by a double Delphi procedure (McKenna 1994). The expert panel consisted of 11 experts in nutrition and/or older people: a clinical nurse nutrition specialist, three head nurses of wards for older people, an infection control nurse, a dietician, two professors in geriatric medicine, a professor of gastroenterology, a gastroenterologist and a lecturer in geriatric care. Four experts were French-speaking and seven were Dutch-speaking. The expert panel reached complete consensus after the second Delphi round.

Additionally, data on the number of beds and on nursing staff of the wards were collected.

Procedure

Before the start of the study, the research team informed and trained all supervisors (nurses, dieticians, or other healthcare professionals) of the participating wards to execute the survey. The main purpose of this training session was to maximize the accuracy and uniformity of the use of the MNA and the correct screening of the ward characteristics. Each supervisor received an information guide on the MNA, which supported the supervisors in instructing their colleagues who assisted them in collecting the data.

The paper questionnaires (patient data and ward data) were sent by post to the nurse director of each hospital. The nurse directors distributed the questionnaires to the participating wards and collected them after completion. Patient data were registered by a nurse, nurse-assistant or dietician of the ward. The ward-level data were recorded by the team leader of the ward. The completed questionnaires were sent by post to the researchers and then automatically scanned and converted into an SPSS database.

The software package TeleForm, version 10.1 (Cardiff Software, Cambridge, UK) was used to develop the questionnaires.

Ethical considerations

The study procedure was approved by the ethics committee (No. B67020071952) of the University Hospital and of each participating hospital. Prior to the data collection, written informed consent was requested from all patients. If the patient was unable to give his consent, a relative was asked to give written informed consent.

Data analysis

Descriptive data are presented in frequencies and percentages or means and standard deviations. As the data are hierarchically structured (patients within wards), multilevel analysis was used, allowing the researchers to enter measurements on different levels separately and simultaneously in the analysis.

The multilevel regression model (Hox 2002) was applied with malnutrition on the patient level as outcome and predictor variables on both patient and ward level.

Several consecutive models were tested. The multilevel analysis started with an intercept-only model (null model) that included no predictor variables. The next model tested only the patient-level predictors as fixed effects. Subsequently, several models were tested with the patient-level predictors and one ward-level predictor added as fixed effects sequentially. Finally, a model with patient-level predictors and all ward-level predictors with significance levels of <0.20 in the previous models was tested. This was the final multilevel model.

All statistical analyses were performed with the software package SPSS version 15.0 (SPSS Inc, Chicago, IL, USA), except for the multilevel analyses. These analyses were performed with the software package SAS 9.1 (SAS Institute Inc, Cary, NC, USA). The Glimmix procedure was applied as it fits generalized linear mixed models where the response variable is not normally distributed. The Kenward–Roger method was used to compute the degrees of freedom for the test of fixed effect. The deviance was calculated as a fit statistic of the model (−2 residual log pseudo-likelihood). This deviance should decrease when predictor variables are added to the model.

Results

In total, 2329 patients from 178 wards for older people were screened. Thirty-eight wards including 235 patients were excluded from the analyses as less than ten patients were screened on those wards. The average age ($t = 0.254$, d.f. = 2327, $P = 0.800$) and BMI ($t = 1.054$, d.f. = 2327, $P = 0.292$) were not significantly different between included and excluded wards. There was also no significant difference in gender (Fisher's Exact test, $P = 0.542$) or the percentage of malnutrition (Fisher's Exact test, $P = 0.511$) between included and excluded wards.

Descriptive patient and ward data

In total, 2094 patients from 140 wards for older people were included in the analysis. The study population consisted of

70.8% women. Ages ranged from 75 to 102 years and the mean age was 83.8 years ($SD = 5.2$). Prior to their admission to the ward, 63.9% of older people lived at home or in a service flat, 15.3% stayed in a nursing home and 20.8% in another hospital ward. The median length of stay at the time of the survey was 14 days (interquartile range = 6–27 days). Twelve per cent of the patients had swallowing difficulties, 5.3% tasting difficulties, 16.9% digestion problems, 10.6% delirium, 8.3% malignant disease and 9.2%, pneumonia.

The overall prevalence rate of malnutrition in the wards for older people was 31.9%. The proportion of older people with an increased risk for malnutrition was 36.2%, and the proportion of well-nourished was 31.9%. Large differences in prevalence figures between the wards were identified, ranging from 0% to 90.9%.

A ward for older people had on average 28 beds (min. 20–max. 55). The average proportion of nurses and nurse assistants per bed was 0.56 (min. 0.38–max. 0.84) full time equivalent (FTE). The average proportion of registered nurses with a Bachelor's degree per bed was 0.20 FTE (min. 0.03–max. 0.61); for registered nurses with a post-secondary school degree, it was 0.24 FTE (min. 0–max. 0.48). The average proportion of registered nurses with a Bachelor's degree on the total nursing staff was 0.34 (min. 0.07–max. 0.84).

Table 1 shows the ward level variables used in this study. The majority of the wards (55.7%) did not undertake any nutritional assessment at admission and in 45% of the wards, no nutritional assessment was carried out during the total hospital stay of the older people. Almost 30% of the wards did not measure the weight of their patients at

admission and 70% of the wards did not calculate the BMI of the patients.

Almost 70% of the wards did not use a standardized nutritional screening instrument. Of the wards using a screening instrument, 14.3% used the MNA, 5.7% applied the MUST (Malnutrition Universal Screening Tool), 5% the NRS 2002 (Nutrition Risk Screening 2002), 3.6% the MNA-SF, and 2.9% used the SNAQ (Short Nutritional Assessment Questionnaire). In 86.4% of the wards, a nutrition protocol was not available. A form to register nutritional intake was available in 81.4% of the wards. Fifty-one per cent of the wards had a nutritional support team available. More than 70% of the wards had a dining room where older people can take their meals. In 72.9% of the wards, there was a menu choice or the possibility to individualize the menu.

Multilevel analysis

Malnutrition was entered in the multilevel analysis as a binary variable: 'malnutrition' versus 'well-nourished or at risk of malnutrition'. Some of the independent variables were dichotomized in the majority (> 50%) and minority ($\leq 50\%$) of the patients. In the null model, the ward level variance (the variance estimate of ward level residual errors) was 0.329 ($SE = 0.078$). Based on this ward level variance, an intra-class correlation (ICC) of 0.091 was calculated, which indicates that 9.1% of the variance in malnutrition can be explained by the grouping structure of the wards. The deviance in the null model was 9200.3. Model 1, with only the patient variables, shows that the higher the age, the more chance patients had to be

Table 1 Nutritional care practice on the wards for older people ($N = 140$)

	No	< 25% of the patients	25–50% of the patients	> 50–75% of the patients	> 75% of the patients
Nutritional assessment at admission	55.7 (78)	5.0 (7)	2.9 (4)	8.6 (12)	27.9 (39)
Nutritional assessment during hospital stay*	45.0 (63)	8.6 (12)	5.0 (7)	8.6 (12)	32.9 (46)
Weight at admission	29.3 (41)	5.0 (7)	4.3 (6)	15.0 (21)	46.4 (65)
Calculating body mass index	70.0 (98)	5.0 (7)	2.1 (3)	6.4 (9)	16.4 (23)
		No	Yes		
Availability of a nutritional support team		51.4 (72)	48.6 (68)		
Availability of a nutrition protocol		86.4 (121)	13.6 (19)		
Using standardized nutritional screening instrument		68.6 (96)	31.4 (44)		
Using form for nutritional intake		18.6 (26)	81.4 (114)		
Menu choice		27.1 (38)	72.9 (102)		
Presence of a dining-room		28.6 (40)	71.4 (100)		

Results are presented in percentages (n).

*Inclusive at admission.

malnourished (regression coefficient = 0.034, SE = 0.010, $P < 0.001$). Older people who resided in a nursing home before their admission to the hospital ward were more likely to be malnourished compared with older people coming from home or a service flat (regression coefficient = 1.399, SE = 0.142, $P < 0.001$). The longer the time period that older people were admitted to the ward, the more risk they had to be malnourished (regression coefficient = 0.009, SE = 0.002, $P < 0.001$). The deviance decreased from 9200.3 to 8946.8 in Model 1.

In consecutive models, ward characteristics were added one by one (Table 2). Only those ward variables with a P value < 0.20 were included in the final model. The proportion of nursing staff per bed (regression coefficient = 1.630, SE = 0.926, $P = 0.08$) and using a form to register nutritional intake (regression coefficient = -0.326 , SE = 0.185, $P = 0.08$) were the only variables that met the criteria to be included in the final model. The deviance of each added ward predictor is presented in Table 2.

Table 2 Parameter estimates of the multilevel model with malnutrition as dependent variable and ward characteristics as explanatory variables added one by one after adjusting for the individual level predictors age, origin, and length of hospital stay ($N = 140$ elderly wards, 2094 patients)

Ward characteristics	Regression coefficient (SE)	F value	P value	Deviance
Presence of a dining room		0.11	0.74	8950.8
Yes	–			
No	$-0.052 (0.156)$			
Availability of a nutritional support team		0.21	0.65	8871.2
Yes	–			
No	$0.063 (0.138)$			
Using form for nutritional intake		3.11	0.08	8952.1
Yes	–			
No	$-0.326 (0.185)$			
Menu choice		0.11	0.90	8954.5
Choice between several menus	–			
Only limited alterations possible	$0.079 (0.1717)$		0.64	
No choice	$0.026 (0.168)$		0.88	
Measure weight		1.59	0.21	8952.7
Majority of the elderly	–			
Not at all or minority of the elderly	$0.179 (0.142)$			
Using standardized nutritional screening instrument		0.00	0.97	8950.8
Yes	–			
No	$-0.005 (0.149)$			
Availability of a nutrition protocol		0.15	0.70	8950.4
Yes	–			
No	$-0.076 (0.196)$			
Calculation BMI		0.12	0.73	8950.7
Majority of the elderly	–			
Not at all or minority of the elderly	$0.057 (0.165)$			
Nutritional assessment at admission		0.66	0.42	8951.5
Majority of the elderly	–			
Not at all or minority of the elderly	$-0.115 (0.142)$			
Nutritional assessment during hospital stay*		0.29	0.59	8951.3
Majority of the elderly	–			
Not at all or minority of the elderly	$-0.075 (0.140)$			
Number of beds	$-0.004 (0.015)$	0.09	0.77	8955.6
Proportion of nursing staff per bed	$1.63 (0.926)$	3.08	0.08	8949.1
Proportion level 1 nurses per bed	$0.681 (0.724)$	0.88	0.35	8947.9
Proportion level 2 nurses per bed	$0.383 (0.825)$	0.22	0.64	8947.6
Proportion level 1 among total nursing staff	$0.232 (0.480)$	0.23	0.63	8948.4

SE, standard error; BMI, body mass index.

*Inclusive at admission

Table 3 Parameter estimates of the final multilevel model with malnutrition as dependent variable ($N = 140$ elderly wards, 2094 patients)

Ward characteristics	Regression coefficient (SE)	F value	P value
Age	0.035 (0.010)	12.34	< 0.001
Length of hospital stay	0.009 (0.0021)	19.44	< 0.001
Source patient		50.13	< 0.001
Other hospital ward			
Home/service flat	-0.073 (0.1541)		0.63
Nursing home	1.344 (0.1901)		< 0.001
Using form		2.59	0.11
nutritional intake			
Yes			
No	-0.297 (0.185)		
Proportion of nursing staff per bed	1.480 (0.928)	2.54	0.11

SE, standard error.

The results of the parameter estimates of the final multilevel model are reported in Table 3. Besides the significance of the patient variables, no ward characteristics were found to be significantly related to malnutrition. The deviance of this final multilevel model was 8954.

The same multilevel analysis was executed in which the patient risk factors of swallowing difficulties, tasting difficulties, digestion difficulties, delirium, pneumonia and malignant disease were taken into account (Kondrup *et al.* 2003b, Suominen *et al.* 2005). This analysis resulted in very similar findings.

Discussion

Study limitations

Several limitations of the present study need to be acknowledged. First, this is a cross-sectional study in which data on nutritional status and nutritional care practices of the wards were collected at the same time. Therefore, no causal relationships can be identified. To identify which nutritional care practices influence malnutrition, longitudinal studies are needed. Secondly, many healthcare professionals were involved in the data collection. As this was a nationwide study, this data collection procedure was most appropriate. To minimize the risk of variation, all ward supervisors followed a standardized training about the use of the MNA. Thirdly, data on nutritional care characteristics were self-reported data and therefore may possibly be overestimated. Finally, the data on nutritional care characteristics are limited. Information on some additional factors could give

a more complete view of the nutritional care practices of the wards. Based on international nutrition guidelines, the following factors may be of interest: repeating nutritional screening, monitoring weight evolution, measuring food intake, having an individualized nutritional care plan for patients at risk for malnutrition and following-up on this plan (ESPEN 2006, NICE 2006).

Discussion of results

This national cross-sectional study attempted to gain an insight into the nutritional care practices in Belgian hospital wards for older people and to explore the association between the prevalence of malnutrition and nutritional care practices of wards for older people. This study showed that based on the MNA, almost one-third (31.9%) of the older patients were malnourished, which is in accordance with recent European figures on older hospital patients (Suominen *et al.* 2005, Pirlich *et al.* 2006, Meijers *et al.* 2008).

In Belgium, this was the first large-scale study focusing on the nutritional care practices on hospital wards for older people. Unfortunately, the results on these nutritional care practices are worrying as they reflected a rather low quality of nutritional care. An assessment of nutritional care practices and support in 12 European countries performed by the Council of Europe in 1999 revealed that the use of nutritional risk screening and assessment, and of nutritional support and counselling was sparse and inconsistent (Beck *et al.* 2003). The present study shows that one decade later, nutritional care practices in Belgian wards for older people is suboptimal. Similarly, several recent studies in other European countries also demonstrated poor figures on nutritional care practices like using a nutritional screening instrument, performing nutritional assessments, and using a nutritional protocol (Mowe *et al.* 2006, Bavelaar *et al.* 2008, Meijers *et al.* 2009).

It is striking that those basic nutritional care practices advised by international guidelines (ASPEN 2005, ESPEN 2006) are apparently still not common practice in European hospitals. It is obvious that increasing consciousness of the importance of nutritional care practices among healthcare professionals and policy makers is needed to address the problem of malnutrition (Arvanitakis *et al.* 2008, Meijers *et al.* 2009). Before implementing changes to nutritional care practices based on the available evidence, various barriers should be considered. These may include a lack of knowledge, prioritization, interest or clearly defined responsibilities, poor facilities for implementation, nurses lacking authority within the organization, or attitudes towards nutritional care. These barriers may partly explain these low figures on adequate nutritional care practices (Perry

What is already known about this topic

- Older people are particularly vulnerable to malnutrition as they frequently have multiple pathologies and impairments, and poor nutritional intakes.
- Malnutrition has important consequences, such as increased morbidity and mortality, extended hospital stays, and high costs for patients and society.
- In general, nutritional care practices are inadequately performed.

What this paper adds

- Malnutrition is a frequently occurring health problem in Belgian hospital wards for older people.
- Nutritional care practices such as nutritional screening and assessment, use of a standardized screening instrument and a nutritional protocol are suboptimal in Belgian hospital wards for older people.
- Ward characteristics explained for 9.1% whether patients in a ward for older people were malnourished or not.

Implications for practice and/or policy

- Healthcare professionals and policy makers should be aware of the importance of nutritional care practices in health care.
- Longitudinal studies are needed to study the impact of nutritional care practices on the incidence of malnutrition in hospital wards for older people.
- The effectiveness of ward-tailored and patient-tailored nutritional care practices should be assessed.

1997, Nilsson Kajermo *et al.* 1998, Rasmussen *et al.* 1999, Beck *et al.* 2002, Grimshaw *et al.* 2004, Mowe *et al.* 2008).

The multilevel analysis, through which the association between malnutrition prevalence and nutritional care practices was studied, indicated that 9.1% of variance in malnutrition could be attributed to the grouping structure of ward characteristics, which was shown to be considerable. In other words, the ward that a patient is admitted to plays a role in the likelihood of malnourishment. However, none of the registered nutritional care practices could explain the individual risk of malnutrition. It is remarkable that nutritional care practices, such as nutritional assessment, measuring weight, using a standardized nutritional screening instrument, availability of a nutritional team, or having a nutritional protocol were not associated with malnutrition prevalence. Nevertheless, several studies showed that these

nutritional care practices have a positive effect on the nutritional status of a patient (Stratton *et al.* 2003, Kruizenga *et al.* 2005). In those studies, packages of nutritional care measures were studied. This could probably clarify why a positive effect was found. In the current study, the different elements of nutritional care were studied separately.

Additionally, the proportion of nursing staff per bed and the proportion of educational level of nursing staff per bed were not associated with malnutrition prevalence. Nonetheless, various studies showed better patient outcomes with more highly educated nurses at the bedside, or with a higher proportion nursing staff per patient (Aiken *et al.* 2002, 2003, Rafferty *et al.* 2007). However, the patient outcome malnutrition was rarely studied from this perspective.

Different explanations are plausible for the absence of any association between nutritional care practices and malnutrition, and between nurse staffing characteristics and malnutrition. A first possible explanation is the use of a cross-sectional design. As discussed above, an important limitation of cross-sectional studies is that exposure and outcome are measured at the same time. Consequently, it is not possible to sort out what occurred first (Polit & Beck 2008). Older people could have been malnourished at admission. A second explanation could relate to the case mix of participating wards. Differences in malnutrition prevalence rates may be due to variability in case mix. Thus, some wards may have higher prevalence rates despite adequate nutritional care practices, higher proportions of nursing staff per patient or more highly educated nurses. However, we also performed the multilevel analysis including possible patient risk factors for malnutrition (swallowing and taste difficulties). The results remained unchanged. A third plausible explanation is that we did not collect data on the content of the nutritional care protocol used in the wards for older people. Therefore, we could not determine whether the protocol used was evidence-based, and we did not have any information on therapeutic actions based on the nutritional screening or assessment. Furthermore, other nutritional care practices on which we have no data might help explain the observed variance in malnutrition. As mentioned earlier, repeating nutritional screening, monitoring weight evolution, measuring food intake, having an individualized nutritional care plan for patients at risk for malnutrition and following up this individualized nutritional care plan may be of relevance. These items should be explored in further detail.

Another explanation for the absence of any association between nurse staffing characteristics and malnutrition is the possibility that different intermediating factors are involved in this relationship. As mentioned in our hypothesized model, the patient/staff ratio may have an impact on nutritional care

practices, which, in turn, may impact malnutrition (Figure 1). Nurse staffing characteristics may have an indirect relationship with the nutritional status of the patients. Other intermediating factors between nurse staffing characteristics and malnutrition prevalence are barriers for adequate nutritional care practices, including lack of prioritization, interest, and clearly defined responsibilities.

The result of the multivariate analysis probably implies that a generic approach for nutritional care in hospital wards for older people is not effective for the individual patient. An interesting challenge for the wards may be to tailor nutritional care practices to individual patients while identifying barriers for each specific ward. This strategy might improve nutritional care practices and patient outcomes as tailored implementation of other interventions or guidelines has already shown to have potential positive effects (Shaw *et al.* 2005, van Os-Medendorp *et al.* 2008).

This was the first study to examine the association between malnutrition prevalence and nutritional care practices or characteristics. Further research is needed to clarify our results. We advise undertaking longitudinal interventional studies in which nutritional care practices are tailored and monitored, and in which changes in malnutrition prevalence are observed.

Conclusion

Internationally, malnutrition is a considerable problem in hospital wards. The use of nutritional care practices like nutritional screenings and assessments, employing a standardized screening instrument, or using a nutritional protocol, are suboptimal in hospitals. An increased consciousness of the importance of nutritional care among healthcare professionals and hospital policy makers will contribute to further improvement of the quality of nutritional care. The chance of being malnourished can be explained for 9.1% by the admission to a specific ward for older people. None of the registered nutritional care practices could explain individual risk of malnutrition. To study the impact of nutritional care practices of wards on malnutrition, longitudinal incidence studies are needed. A standardized approach that allows adaptation to the individual patient of nutritional care within a hospital ward for older people may be a more adequate strategy. The effectiveness of ward-tailored and patient-tailored nutritional care practices should be assessed.

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Conflicts of interest

No conflict of interest has been declared by the authors.

Author contributions

KV, SV, MG and TD were responsible for the study conception and design, and obtained funding. IB and ML performed the data collection. KV, EC, IB and TD performed the data analysis. KV, EC, IB, SV, ML, MG and TD were responsible for the drafting of the manuscript. KV, EC and TD made critical revisions to the paper for important intellectual content. EC provided statistical expertise. SV provided administrative, technical or material support. MG and TD supervised the study.

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