Original Article

Nutrition status of hospitalized patients in the first decade of Chinese nutritionDay survey: Assessment using the ESPEN and GLIM criteria

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Background and Objectives: This study aimed to investigate nutritional status of hospitalized Chinese patients according to the Global Leadership Initiative on Malnutrition (GLIM) and the European Society of Clinical Nutrition and Metabolism (ESPEN) criteria and to identify the effects of nutritional characteristics and nutritional support on clinical good outcome. **Methods and Study Design:** Inpatients participated in Chinese nutritionDay 2010-2020 surveys were included. Malnutrition was defined according to the ESPEN and GLIM criteria after being risk evaluated by Malnutrition Universal Screening Tool (MUST). Cumulative incidence curves were plotted for 30-day good outcomes in patients according to the ESPEN and GLIM criteria. Cox regression models were used to determine the factors associated with good outcomes in the univariate and multivariable analyses. **Results:** The prevalence of malnutrition defined by the GLIM criteria (22.8%) was higher than that defined by the ESPEN criteria (16.2%). Patients with malnutrition defined by the ESPEN and GLIM criteria had a significantly prolonged median length of hospital stay (LOS) after nutritionDay compared with non-malnutrition patients (8 days vs. 6 days, $p < 0.001$). Inpatients defined as nutritionally at-risk by the MUST or malnutrition defined by the ESPEN criteria and the GLIM criteria, and patients with pre-operative conditions, decreased mobility, prolonged LOS over three weeks before nutritionDay, as well as those receiving nutritional support had a reduced chance of good outcome. **Conclusions:** The patients with nutritional risk or malnutrition and those who received nutritional support were significantly associated with decreased good 30-day outcomes, highlighting the necessity for standardized nutrition training in the healthcare setting.

Key Words: GLIM criteria, ESPEN criteria, malnutrition, good outcome, nutritionDay

INTRODUCTION

Malnutrition, prevailing from 20% to 60% in the hospital setting, is a serious worldwide public health problem, which can be caused by compromised intake, impaired absorption, or metabolic disorders, and is known to be associated with adverse clinical outcomes.[1-3] Therefore, awareness and knowledge regarding malnutrition diagnosis should be constantly monitored and improved upon.

As a global issue in clinical settings, European Society for Clinical Nutrition and Metabolism (ESPEN) developed a diagnostic system that mainly focuses on low body mass index (BMI), unintentional weight loss, and low fat-free mass index (FFMI) in 2015 and is frequently used to identify malnutrition.[4] However, malnutrition is also associated with compromised intake, impaired absorption, and acute and chronic diseases, which must be considered in the updated diagnostic criteria.[5,6] Hence, Global Leadership Initiative on Malnutrition (GLIM) developed a two-step approach to identify malnutrition based on phenotypic criteria (non-volitional weight loss, low BMI, or reduced muscle mass) and etiologic criteria (reduced food intake, assimilation, or inflammation).[7] Nevertheless, a consensus on the diagnosis of malnutrition requires additional validation studies and feedback. Thus far, several studies have been carried out to compare the GLIM and ESPEN criteria in specific populations, such as patients with cancer or in internal medicine wards,[8-10] but fewer in hospitalized patients within varied departments.

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Moreover, malnutrition defined by these criteria is associated with poor prognosis,[11-12] whereas evidence for malnutrition diagnostic detailed characteristics mapping with good clinical outcome expected by patients and medical staff is scarce. Indicators which are associated with clinical good outcome, particularly the effects of nutritional characteristics and nutritional support on clinical good outcome need to be verified.

Therefore, the purpose of this study was to (1) quantify the prevalence of malnutrition using the ESPEN and GLIM criteria and (2) identify the effects of nutritional characteristics and nutritional support on clinical good outcome in hospitalized patients based on Chinese nutritionDay 2010-2020 surveys.

METHODS

Study population

In general, nutritionDay study is a global scientific program conducted on a specific day in every November. It has taken place worldwide to investigate nutrition-related information in health care institutions including of hospital wards, intensive care units (ICU), and nursing homes.[13] Participating facilities are provided with information and standardized questionnaires annually through the nutritionDay website (www.nutritionday.com). China has taken part into nutritionDay study since 2010 with a host participant in Jingling Hospital, the voluntary participation of hospitals has expanded from a single centre to 20 centres until the end of 2020.[14] Before each annual survey, local staff members were instructed on how to collect patient data and enter it online. This study was approved by the Ethical Committee of the Medical University of Vienna (EK407/2005) and the Ethics Committee of the Jinling Hospital and amended annually (approval code 2022DZKY-067-01; date of approval 22 June 2022).[14]

Data collection

Patient demographic characteristics including nutrition history and care data were collected. Nutritional risk and malnutrition were not directly collected and assessed on nutritionDay from 2010 to 2020. However, relevant questions regarding weight change, disease condition, and food intake in the database allowed us to evaluate patients' overall nutritional statuses.[14] The 30-day follow-up started on each nutritionDay and ended at the earliest of the following outcomes: rehabilitation, discharged home, still in the hospital, transferred or death. Good clinical outcome was defined as rehabilitation and home discharge.[14]

Merging procedure

The questionnaires were updated to nutritionDay 2.0 in 2016 based on the 2006–2015 questionnaire,[15] so we merged similar items in the 2010–2015 and 2016–2020 cohorts in the preliminary stage of data processing. To reduce complexity, hospital departments with fewer than 60 patients (endocrinology, emergency, burn surgery, otolaryngology, internal medicine, stomatology and trauma) were grouped in "Others" on department distribution.[14] Patient conditions were merged into eight main categories: cancer, neurological disease, digestive disease, endocrine/nutritional/metabolic disease, cardiovascular disease, respiratory disease, genitourinary disease, and others.[14]

Malnutrition diagnosis

Malnutrition was defined by the ESPEN and GLIM criteria after being risk assessed by Malnutrition Universal Screening Tool (MUST).[16] Overall risk categories of MUST were classified into three levels: low risk (MUST score = 0), medium risk (MUST score = 1), and high risk (MUST score ≥ 2). Levels of medium and high risk were defined as at risk of malnutrition.[14] In this study, malnutrition assessed by the ESPEN criteria (Supplementary Table 1) was diagnosed by either BMI < 18.5 kg/m² or unintentional weight loss combined with the indicated age-specific BMI levels.[4] Additionally, malnutrition defined by the GLIM criteria included at least one phenotype criterion derived from patient's weight loss or low BMI and one etiologic criterion with less food intake or acute disease/ injury or chronic comorbidities.[7,14,15]

Statistical analysis

All statistical analyses were performed by R version 4.2.1. For descriptive analyses, the values were presented as count and percentage or a median with interquartile range (IQR) as appropriate. Chi-square or Fisher's exact tests were used to compare the proportion of good outcomes between the independent groups.[14] Among these, significant variables with $p < 0.05$, and the variables of survey years, sex, and departments considered as covariates, were included in the Cox regression model to determine factors associated with good outcomes. Significant variables with $p < 0.05$ in the univariate analysis were included in the multivariable models: model I contained individual risk factors without MUST, ESPEN and GLIM criteria; model II contained MUST criteria added to model I without defined variables including BMI, weight change within last three months, major lesion types and food intake last week; model III contained ESPEN criteria added to model I without defined variables including BMI, weight change within last three months, major lesion types, food intake last week and MUST criteria; and model IV included GLIM criteria added to model I without defined variables including BMI, weight change within last three months, major lesion types, food intake last week, MUST criteria, eating on nutritionDay and comorbidity. Hazard ratios (HRs) were estimated using 95% confidence intervals (CIs). Cumulative incidence curves were plotted for 30-day good outcomes according to the ESPEN and GLIM criteria. Differences in median days after nutritionDay between groups were tested using the log-rank test. A p-value of < 0.05 was defined as statistical significance.

RESULTS

Demographics of the hospitalized patients

Patients' demographics are described in Supplementary Table 2. 5821 hospitalized patients were enrolled in this study. The majority of inpatients were from Jinling Hospital (42.2%). Demographics of sex, age and BMI have been reported in our previous study.[14] ICU stay was reported in 14.1% of the patients. Approximately 12.4% of

Table 1. Nutritional characteristics of hospitalized patients

Characteristic	No. of Patients	No. of Patients (%)
Malnutrition defined by ESPEN	5821	
Yes	944	16.2
No	4346	74.7
Undefined	531	9.1
Nutritional support	5821	
Yes	1963	33.7
No	3206	55.1
Unknown or missing	652	11.2
Nutritional support form	1963	
ONS	102	5.2
EN	379	19.3
PN	528	26.9
Multi-forms	954	48.6
Food intake in the previous week	5821	
More than normal or normal	3825	65.7
Less than normal	1878	32.3
Missing	118	2.0
The main reason for eating nothing on nutritionDay	1638	
Decreased appetite	225	13.7
Forbidden to eat	901	55.0
Other reasons	353	21.6
Missing	159	9.7

EN, Enteral nutrition; ESPEN, European Society of Clinical Nutrition and Metabolism; ONS, Oral nutritional supplements; PN, Parenteral nutrition.
Values as numbers (%) for descriptive analyses

the patients reported feeling "poor" and "very poor" in self-rated health. Most patients were admitted to departments of general surgery (45.4%) or gastroenterology and hepatology (17.2%). The major lesion types were primarily related to the digestive organs (38.7%) or cancer (25.2%).

Nutrition-related characteristics

The nutritional characteristics of the patients are shown in Table 1. The prevalence of nutritionally at-risk according to the MUST (MUST score ≥ 1) and malnutrition defined by the GLIM criteria have been reported previously.[14] Malnutrition based on the ESPEN criteria was diagnosed in 944 of 5821 patients (16.2%). The malnutrition rate was higher in the general surgery, geriatric, and respiratory medicine departments (20.1%, 17.5%, and 29.4%, respectively, according to ESPEN; 27.4%, 31.7%, and 35.3% according to GLIM). The prevalence of malnutrition according to department is shown in Figure 1.

Nutritional support was provided to 1963 inpatients (33.7%), the majority of whom received multi-form (n = 954, 48.6%) with any of the artificial nutrition including protein/energy supplements (ONS), enteral nutrition (EN) and parenteral nutrition (PN). Approximately 98.0% of all patients provided information on their food intake during the previous week and 32.3% had eaten less than normal. On nutritionDays, more than half of the patients (n = 3372, 57.9%) did not eat a full meal,[14] 1638 patients (28.1%) ate nothing and in which more than half of the patients (n = 901, 55.0%) were not allowed to eat (Table 1).

Malnutrition criteria mapping with good outcome

Diagnostic flowcharts of the malnutrition criteria with 30-day good outcome are presented in Figure 2. Based on the ESPEN criteria, 4346 patients were defined as non-malnourished, with 88.9% having good outcomes (n =3864). Of the patients with malnutrition (n = 944, 16.2%) diagnosed by the ESPEN criteria, 348 patients had a BMI < 18.5 kg/ m^2, and 79.0% had good outcomes (n = 275); 234 patients were identified by weight loss, and 80.8% had good outcomes (n = 189); and 362 patients were identified both by BMI < 18.5 kg/m^2 and by weight loss, and 78.7% had good outcomes (n = 285).

These results are more complicated with the GLIM criteria, which require at least one phenotypic and one etiologic criterion. Of the malnourished patients diagnosed by the GLIM criteria, 645 patients were identified by one phenotypic criterion (weight loss or lower BMI), and one etiologic criterion (less food intake or with inflammation), and 80.3% (n = 518) had good outcomes. For 113 patients identified by phenotypic criteria of both weight loss and lower BMI, and etiologic criteria of both less food intake and with inflammation, 80.5% (n = 91) had good outcomes. However, for the 244 patients identified by two phenotypic criteria (weight loss and lower BMI) and one etiologic criterion (less food intake or with inflammation), 77.0% (n = 188) had good outcomes.

Median length of hospital stay (LOS) after nutritionDay

The association of malnutrition diagnosis and clinical outcome in terms of 30-day good outcome is shown by cumulative incidence curves (Figure 3). Non-malnutrition patients had a median LOS of 6 days after nutritionDay, whereas those assessed as malnutrition by ESPEN and GLIM[14] showed a median LOS of 8 days after nutritionDay ($p < 0.001$). Moreover, patients with malnutrition according to the ESPEN criteria, who were diagnosed mainly by weight loss, showed significantly prolonged median LOS after nutritionDay compared with non-

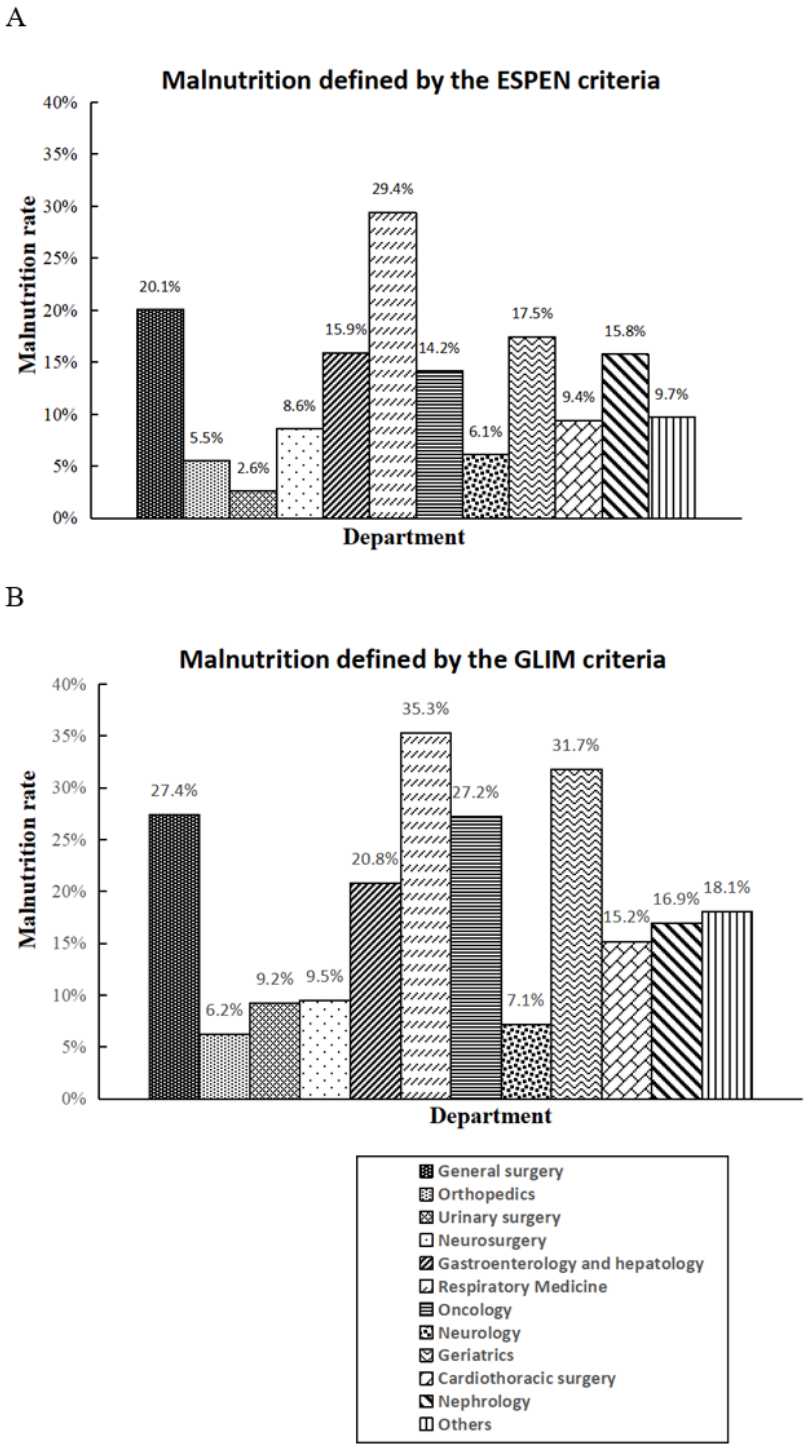

Figure 1. The prevalence of malnutrition defined by the ESPEN criteria (A) and the GLIM criteria (B) with departments in Chinese hospitals. ESPEN, European Society of Clinical Nutrition and Metabolism; GLIM, Global Leadership Initiative on Malnutrition.

malnutrition patients (9 days vs. 6 days, $p < 0.001$). Likewise, patients with malnutrition confirmed by two phenotypic criteria (weight loss and lower BMI) and one etiologic criterion (less food intake or with inflammation) using the GLIM criteria showed a significantly longer median LOS after nutritionDay compared with non-malnutrition patients (9 days vs. 6 days, $p < 0.001$).

Good outcome

A total of 5768 patients with 30-day outcomes (99.1%) were included in the analysis. When variables of survey years, sex, and departments were included as covariates in the Cox regression models, the univariate analysis showed that LOS before nutritionDay, mobility, self-rated health, nutritional support, risk of malnutrition defined by the MUST, and malnutrition defined by the ESPEN/GLIM criteria were significantly related to 30-day outcomes. Similar trends were found in the multivariable analyses (Table 2). Patients with nutritional risk or malnutrition defined by the MUST (HR 0.85, 95% CI [0.80–0.91], $p < 0.001$), ESPEN (HR 0.83, 95% CI [0.77–0.91], $p < 0.001$), and GLIM criteria (HR 0.84, 95% CI [0.78–0.90], $p < 0.001$) had decreased chance of a good outcome in multivariable analyses. Likewise, patients with pre-operative conditions and with LOS ≥ 21 days before nutritionDay also had a significantly lower chance of

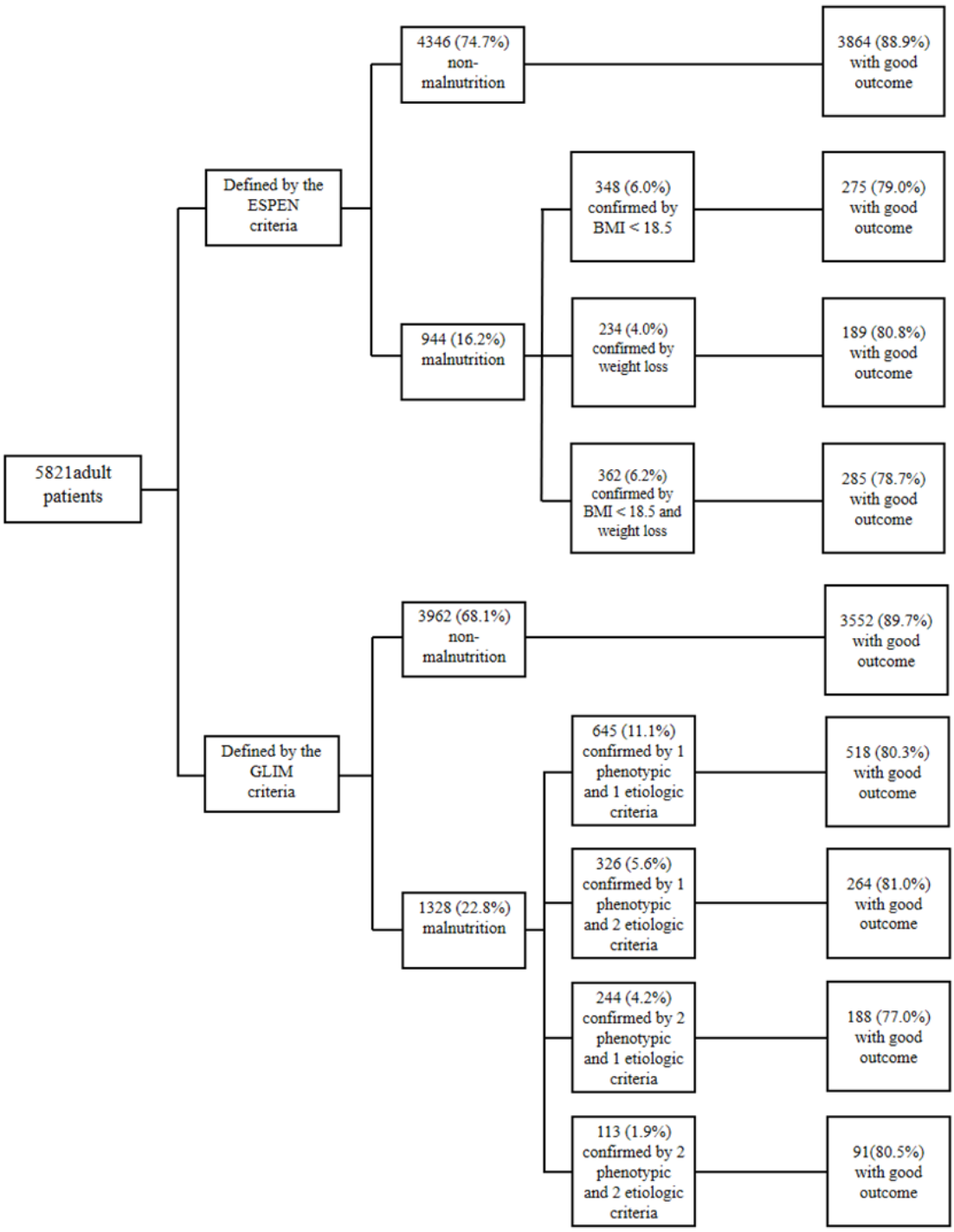

Figure 2. Diagnostic flow chart of the ESPEN criteria and the GLIM criteria mapping with 30-day good outcome. BMI, Body mass index; ESPEN, European Society of Clinical Nutrition and Metabolism; GLIM, Global Leadership Initiative on Malnutrition

good outcome. Decreased mobility was strongly associated with reduced good outcomes, especially for patients who walked with assistance and were bedridden, compared with those who were able to walk unaided. Notably, patients with nutritional support had decreased chance of good outcomes especially in those with EN (HR 0.56, 95% CI [0.48–0.64], $p < 0.001$) and with PN (HR 0.76, 95% CI [0.68–0.86], $p < 0.001$), compared to patients without nutritional support.

DISCUSSION

This is the first study to present the association between different malnutrition diagnostic detailed criteria and good clinical outcomes among multi-centre hospitalized patients. In the current study, we systematically demonstrated the nutritional status of the 2010–2020 nutritionDay China cohort of inpatients and offered evidence of the associations between the MUST, ESPEN, and GLIM malnutrition diagnostic schemes and 30-day good outcome. The results showed that the prevalence of malnutrition as defined by the GLIM criteria was higher than that defined by the ESPEN criteria. Inpatients with malnutrition defined by the ESPEN and GLIM criteria had significantly prolonged median LOS after nutritionDay compared with non-malnutrition status, especially prolonged in those patients with weight loss. Besides,

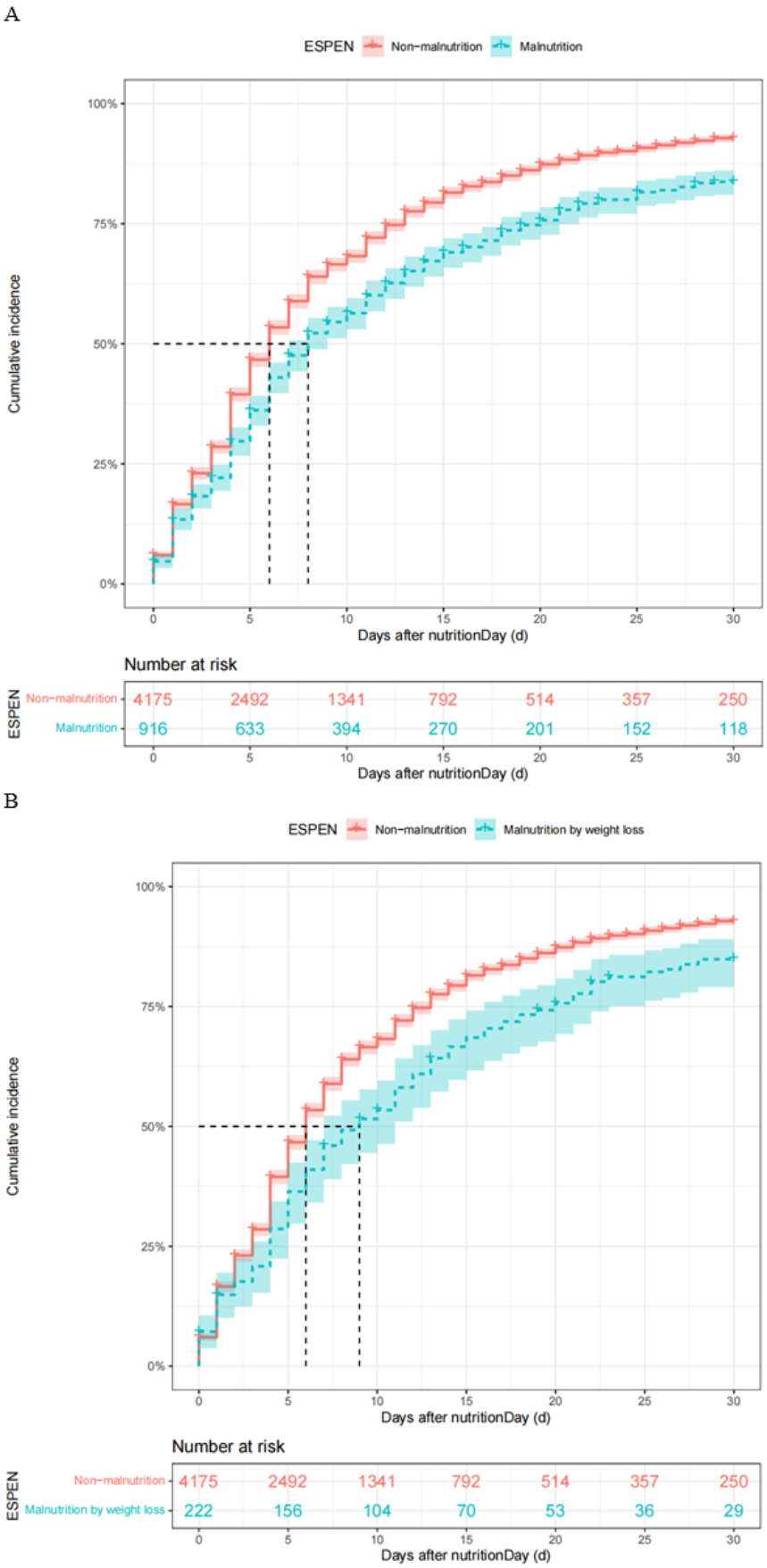

Figure 3. Cumulative incidence of good outcome within 30 days after nutritionDay according to the ESPEN and GLIM criteria. (A) Nutritional status defined by the ESPEN criteria; Patients with non-malnutrition vs. Patients with malnutrition: 6 days (6-6) vs. 8 days (7-9), $p < 0.001$. (B) Nutritional status defined by the ESPEN criteria; Patients with non-malnutrition vs. Patients with malnutrition defined by weight loss: 6 days (6-6) vs. 9 days (7-11), $p < 0.001$. (C) Nutritional status defined by the GLIM criteria; Patients with non-malnutrition vs. Patients with malnutrition defined by 1E + 2P: 6 days (6-6) vs. 9 days (8-11), $p < 0.001$. Missing data were excluded. Differences between groups were tested using the log-rank test. Areas in shades indicate 95%CI. ESPEN, European Society of Clinical Nutrition and Metabolism; GLIM, Global Leadership Initiative on Malnutrition; P, phenotypic criterion; E, etiologic criterion.

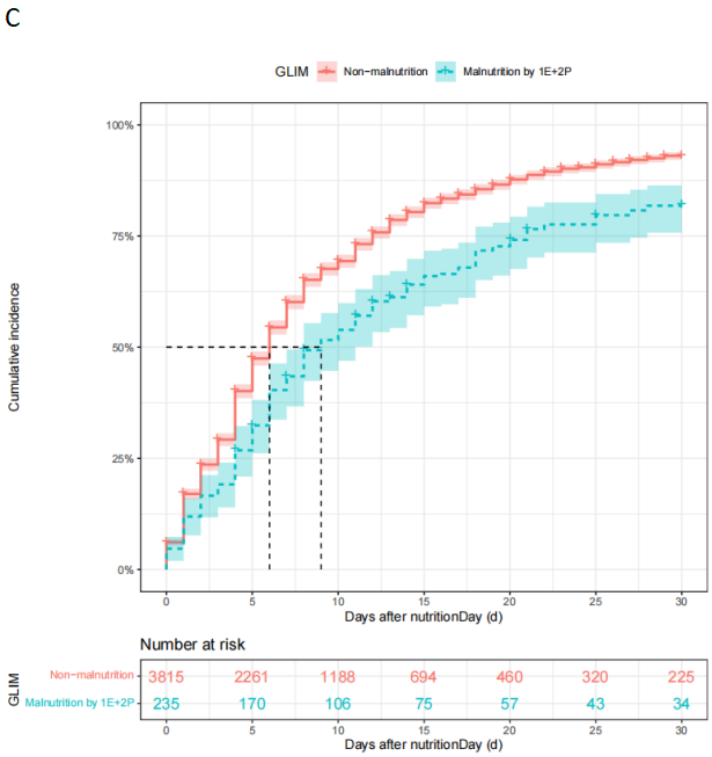

Figure 3. (cont.) Cumulative incidence of good outcome within 30 days after nutritionDay according to the ESPEN and GLIM criteria. (A) Nutritional status defined by the ESPEN criteria; Patients with non-malnutrition vs. Patients with malnutrition: 6 days (6-6) vs. 8 days (7-9), $p < 0.001$. (B) Nutritional status defined by the ESPEN criteria; Patients with non-malnutrition vs. Patients with malnutrition defined by weight loss: 6 days (6-6) vs. 9 days (7-11), $p < 0.001$. (C) Nutritional status defined by the GLIM criteria; Patients with non-malnutrition vs. Patients with malnutrition defined by 1E + 2P: 6 days (6-6) vs. 9 days (8-11), $p < 0.001$. Missing data were excluded. Differences between groups were tested using the log-rank test. Areas in shades indicate 95%CI. ESPEN, European Society of Clinical Nutrition and Metabolism; GLIM, Global Leadership Initiative on Malnutrition; P, phenotypic criterion; E, etiologic criterion.

nutritionally at-risk and malnutrition defined by the MUST, ESPEN, and GLIM criteria, patients with prolonged LOS before nutritionDay, decreased mobility, preoperation, and nutritional support were risk factors for a 30-day good outcome.

Among the Chinese nutritionDay 2010-2020 cohort of hospitalized patients, the prevalence of malnutrition based on the GLIM criteria (22.8%) was higher than that based on the ESPEN criteria (16.2%). Previous reports, including a comparison between the ESPEN and GLIM criteria, also revealed that the prevalence of malnutrition defined by the GLIM criteria was typically higher than that defined by the ESPEN criteria.[10,17,18] A re-analysis of a published prospective observational study reported that the prevalence of malnutrition, as defined by the GLIM criteria, was 20.5% in the Chinese population.[19] Among the hospitalized patients with haematological malignancies, the prevalence of GLIM-defined malnutrition was 25.8%.[20] Even in post-acute care patients in the geriatric unit, the prevalence of malnutrition according to the ESPEN criteria ranges from 19.3% to 20.2%.[21,22] The higher prevalence of malnutrition as defined by the GLIM criteria might be due to its updated diagnostic assessment, which includes both phenotypic and etiologic criteria, whereas the ESPEN criteria primarily focus on a BMI < 18.5 kg/m^2 or weight loss with lower BMI in this study which are limited indicators of phenotypic criteria.[4,7]

Malnutrition rates were higher in general surgery (20.1% and 27.4%, defined by the ESPEN and GLIM criteria, respectively) and geriatrics (17.5% and 31.7%, defined by the ESPEN and GLIM criteria, respectively) departments, which is consistent with findings from previous studies.[23,24] Strikingly, the highest malnutrition rates in this study were found in respiratory medicine departments, with a prevalence of 29.4% and 35.3% according to the ESPEN and GLIM criteria, respectively. Nearly 50% of inpatients with chronic obstructive pulmonary disease have evidence of malnutrition, which is one of the most common diseases in respiratory medicine.[25] Accordingly, we found that patients with respiratory disease as the major lesion type also had a malnutrition rate > 20%, as assessed using both criteria. Especially with the impact of the COVID-19 pandemic, the issue of malnutrition and nutrition management of hospitalized patients has received more attention,[26,27] not only for improving the medical care of inpatients but also to achieve a good outcome, including rehabilitation or discharge home earlier.

The relationship between malnutrition and clinical outcomes observed in our study has been focused on the association between malnutrition diagnosis and median LOS after nutritionDay. In terms of good outcomes, inpatients identified as at-risk and with malnutrition, as defined by the MUST, ESPEN, and GLIM, had significantly increased median LOS after nutritionDay, compared to the low-risk and non-malnutrition status groups. Those with malnutrition identified by weight loss with the ESPEN criteria, or by two phenotypic criteria and one etiologic criterion of the GLIM criteria, there was a median LOS of 9 days after nutritionDay, which was significantly

Table 2. Cox regression analyses of good outcome within 30 days after nutritionDay

Variables	Univariate analysis	Multivariable analyses	
		Model I[†]	Model II[‡]
	HR [95% CI]	HR [95% CI]	HR [95% CI]
Mobility			
Walk without assistance	Reference	Reference	Reference
Walk with assistance	0.81 [0.75-0.89]***	0.89 [0.82-0.98]*	0.90 [0.82-0.98]*
Bedridden	0.66 [0.59-0.74]***	0.73 [0.65-0.83]***	0.74 [0.65-0.83]***
Missing	0.97 [0.85-1.11]	1.02 [0.88-1.19]	1.02 [0.88-1.19]
Operation condition			
Non-surgical	Reference	Reference	Reference
Preoperative	0.94 [0.87-1.02]	0.82 [0.75-0.89]***	0.83 [0.76-0.90]***
Postoperative	1.22 [1.14-1.32]***	1.34 [1.24-1.44]***	1.34 [1.24-1.44]***
Undefined or missing	1.03 [0.62-1.69]	0.97 [0.58-1.61]	0.89 [0.54-1.48]
LOS before nutritionDay			
0-6 days	Reference	Reference	Reference
7-13 days	0.98 [0.92-1.05]	1.00 [0.93-1.07]	1.00 [0.93-1.07]
14-20 days	0.93 [0.84-1.03]	0.96 [0.86-1.06]	0.96 [0.86-1.06]
≥ 21 days	0.56 [0.51-0.63]***	0.63 [0.56-0.70]***	0.63 [0.56-0.71]***
Missing	0.81 [0.69-0.96]*	0.79 [0.67-0.94]**	0.82 [0.70-0.97]*
Nutritional support			
No	Reference	Reference	Reference
ONS	0.62 [0.50-0.77]***	0.73 [0.58-0.91]**	0.72 [0.57-0.89]**
EN	0.48 [0.43-0.55]***	0.56 [0.48-0.64]***	0.55 [0.48-0.64]***
PN	0.69 [0.62-0.77]***	0.76 [0.68-0.86]***	0.76 [0.68-0.85]***
Multi-forms	0.72 [0.66-0.78]***	0.78 [0.72-0.85]***	0.78 [0.71-0.85]***
Unknown or missing	0.92 [0.84-1.01]	0.99 [0.89-1.10]	0.99 [0.90-1.10]
At risk of malnutrition defined by MUST			
No	Reference		Reference
Yes	0.75 [0.71-0.80]***		0.85 [0.80-0.91]***
Undefined	0.92 [0.83-1.02]		0.95 [0.85-1.05]
Malnutrition defined by ESPEN			
No	Reference		
Yes	0.70 [0.65-0.76]***		
Undefined	0.96 [0.87-1.06]		
Malnutrition defined by GLIM			
No	Reference		
Yes	0.70 [0.66-0.76]***		
Undefined	0.93 [0.85-1.03]		

HR, Hazard ratio; CI, Confidence interval; LOS, length of hospital stay; BMI, body mass index; MUST, Malnutrition Universal Screening Tool; ESPEN, European Society for Clinical Nutrition and Metabolism; GLIM, Global Leadership Initiative on Malnutrition

[†]Model I: Individual risk factors without MUST, ESPEN and GLIM.

[‡]Model II: MUST added to model I without defined variables including of BMI, weight change within last 3 months, major lesion types and food intake last week.

[§]Model III: ESPEN added to model I without defined variables including of BMI, weight change within last 3 months, major lesion types, food intake last week and MUST.

[¶]Model IV: GLIM added to model I without defined variables including of BMI, weight change within last 3 months, major lesion types, food intake last week, MUST, eating on nutritionDay and comorbidity.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All data are presented as HRs and 95% CIs.

Table 2. Cox regression analyses of good outcome within 30 days after nutritionDay (cont.)

Variables	Multivariable analyses	
	Model III[§]	Model IV[¶]
	HR [95% CI]	HR [95% CI]
Mobility		
Walk without assistance	Reference	Reference
Walk with assistance	0.89 [0.82-0.97]*	0.89 [0.82-0.97]*
Bedridden	0.73 [0.65-0.83]***	0.72 [0.63-0.81]***
Missing	1.01 [0.87-1.18]	1.01 [0.88-1.17]
Operation condition		
Non-surgical	Reference	Reference
Preoperative	0.83 [0.76-0.90]***	0.82 [0.76-0.89]***
Postoperative	1.34 [1.24-1.45]***	1.31 [1.21-1.41]***
Undefined or missing	0.85 [0.51-1.41]	1.01 [0.61-1.68]
LOS before nutritionDay		
0-6 days	Reference	Reference
7-13 days	1.00 [0.93-1.07]	0.99 [0.92-1.07]
14-20 days	0.95 [0.85-1.06]	0.95 [0.85-1.06]
≥ 21 days	0.63 [0.56-0.71]***	0.63 [0.56-0.70]***
Missing	0.82 [0.69-0.97]*	0.80 [0.68-0.95]**
Nutritional support		
No	Reference	Reference
ONS	0.70 [0.56-0.88]**	0.72 [0.58-0.89]**
EN	0.56 [0.49-0.64]***	0.56 [0.49-0.64]***
PN	0.76 [0.67-0.85]***	0.75 [0.67-0.84]***
Multi-forms	0.77 [0.71-0.84]***	0.78 [0.71-0.85]***
Unknown or missing	0.99 [0.89-1.10]	0.98 [0.88-1.08]
At risk of malnutrition defined by MUST		
No		
Yes		
Undefined		
Malnutrition defined by ESPEN		
No	Reference	
Yes	0.83 [0.77-0.91]***	
Undefined	0.97 [0.88-1.07]	
Malnutrition defined by GLIM		
No		Reference
Yes		0.84 [0.78-0.90]***
Undefined		0.97 [0.87-1.07]

HR, Hazard ratio; CI, Confidence interval; LOS, length of hospital stay; BMI, body mass index; MUST, Malnutrition Universal Screening Tool; ESPEN, European Society for Clinical Nutrition and Metabolism; GLIM, Global Leadership Initiative on Malnutrition

[†]Model I: Individual risk factors without MUST, ESPEN and GLIM.

[‡]Model II: MUST added to model I without defined variables including of BMI, weight change within last 3 months, major lesion types and food intake last week.

[§]Model III: ESPEN added to model I without defined variables including of BMI, weight change within last 3 months, major lesion types, food intake last week and MUST.

[¶]Model IV: GLIM added to model I without defined variables including of BMI, weight change within last 3 months, major lesion types, food intake last week, MUST, eating on nutritionDay and comorbidity.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All data are presented as HRs and 95% CIs..

longer than that in non-malnutrition patients. These findings reveal that phenotypic criteria, including weight-related indicators, may play a key role in clinical outcomes. A nutritionDay 2007–2015 report found that weight loss before admission needs to be considered when providing tailored nutritional care for patients.[28]

This study also demonstrates a close relationship between inpatient characteristics and good outcomes. Results from models II to IV showed that patients identified as nutritionally at-risk or those with malnutrition defined by MUST, ESPEN, and GLIM had significantly decreased good outcomes, which were consistent with previous studies.[14,29,30] Among the four models, post-operative patients showed significantly increased good outcomes, whereas patients with decreased mobility, and LOS ≥ 21 days before nutritionDay had a significantly lower chance for good outcomes. These findings were consistent with Latin America results for nutritionDay, which showed that walk with assistance and bedridden, as well as prolonged hospital stay before nutritionDay were significant risk factors on mortality while post-surgery decreased the risk for mortality.[31] It is noteworthy that patients with nutritional support also demonstrated decreased good outcomes, which is in sharp contrast to guidelines that recommend that patients being nutritionally at-risk or with malnutrition should receive a nutritional care plan and nutrition interventions can improve their outcomes.[32] Taking account that cross sectional data cannot determine a causal association between treatment and outcome, this may be due to a range of complications caused by total parenteral nutrition,[33] and the close relationship between malnutrition and intensive treatment,[34] as well as the nutritional support choice reported in a single year of nutritionDay surveys in China,[23,24] which could also decrease the chance of the good outcomes of early rehabilitation or discharge. Moreover, nutrition issues are not only related to medical departments but also to the health care system. Although studies have indicated a gradual standardization of nutritional interventions in the Chinese hospital setting,[35] good outcomes for inpatients require well nourished status of patients-self, as well as appropriate and standardized nutritional support applied by trained medical staff more broadly in the healthcare setting.

The integration analysis of the Chinese nutritionDay survey evaluated inpatients' nutritional status according to the ESPEN and GLIM criteria and presented the association between malnutrition and clinical outcomes. The nutritionDay methodology is used worldwide and can contribute to increase malnutrition awareness and promote the implementation of appropriate nutritional care in a variety of healthcare settings. The major limitation of this study is that malnutrition evaluation merely based on screening tools and diagnosis criteria with nutritionDay questionnaires retrospectively instead of actual evaluation of the participants. Therefore, further studies on nutritional status and prognosis for each in-patient are required with more comprehensive assessment including of muscle mass and laboratory data to augment the contents of nutritionDay survey itself.

Conclusion

In hospitalized patients of nutritionDay China surveys, the prevalence of malnutrition as defined by the GLIM criteria was higher than that defined by the ESPEN criteria. With weight loss as a phenotypic criterion in both diagnostic systems, the median LOS after nutritionDay was prolonged if malnutrition was present. In addition, patients with pre-operation, decreased mobility, prolonged LOS days over three weeks before nutritionDay, and with nutritional support had significantly decreased incidence of good outcomes in this study. As a result of the ten years of data analysis from the Chinese nutritionDay project, we recommend that there should be appropriate nutritional interventions to address malnutrition in hospitalized patients to improve their clinical outcomes, and the systematic regular nutritional management training for medical staff is urgently needed.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

The authors declare that they have no conflicts of interest.

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