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Risk factors of malnutrition and length of stay in Chinese inpatients: Results from NutritionDay in China

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Running title: The survey of Nutrition Day 2019 in China

Deshuai Song MD^{1†}, Li Zhang PhD^{1,2†}, Yupeng Zhang MD², Sitong Liu BD², Ruting Shen BD², Wei Zhou PhD³, Xiaoyan Yang PhD³, Yao Cui MD⁴, Hengfang Zhao MD⁵, Yanjin Chen MD⁶, Yan Chang MD⁶, Yanru Shi MD⁶, Xiaojie Bian PhD⁷, Shuli Guo MD⁸, Wei Chen PhD⁸, Jianchun Yu PhD⁸, Jieliang Xu MD⁹, Xiaolan Zhang MD¹⁰, Jia Song MD¹⁰, Lianzhen Chen PhD¹¹, Jianxiong Wu PhD¹¹, Xinying Wang MD, PHD¹

¹Department of General Surgery, Jinling Hospital, Southern Medical University, Nanjing, China

²Department of General Surgery, Jinling Hospital, Nanjing University, Nanjing, China

³Department of General Surgery, Sir Run Run Shaw Hospital, Zhejiang University, Zhejiang, China

⁴Department of Nutrition, Pizhou Hospital, Xuzhou Medical University, Xuzhou, China

⁵Department of Gastroenterology, Affiliated Hospital of Northwest University, Northwest University, Xian, China

⁶Department of traditional Chinese medicine, Tianjin Integrative Medicine Hospital, Nankai University, Tianjin, China

⁷Department of Pharmacy, Nanjing Drum Tower Hospital, Nanjing University, Nanjing, China

⁸Department of Parenteral and Enteral Nutrition, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

⁹Department of Nutrition, Jiangning Hospital, Nanjing Medical University, Nanjing, China

¹⁰Department of Nutrition, Second Hospital of Hebei Medical University, Hebei Medical University, Shijia Zhuang, China

¹¹Department of surgery, National Cancer Center/Cancer hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, China

[†]Both authors contributed equally to this manuscript

Corresponding Author: Dr Xinying Wang, Department of General Surgery, Jinling Hospital, Nanjing University, 305 East Zhongshan Road, Nanjing, 210002, China. Tel: +86-025-8086-1429. Email: wangxinying@nju.edu.cn

ABSTRACT

Background and Objectives: NutritionDay is a yearly global point-prevalence study of malnutrition or nutritional risk in hospitals. We aimed to provide a comprehensive nutritional survey of hospitalized patients and analyze the risk factors of malnutrition and prolonged hospitalization in Chinese inpatients. **Methods and Study Design:** The international daylong cross-sectional survey was performed on November 07th, 2019. Ten hospitals were invited to participate in this NutritionDay survey. Nutritional risk was identified by nutritional risk screening 2002, and malnutrition was identified by the ESPEN criteria. We measured the incidence of malnutrition and nutritional risk. And we analysed risk factors for malnutrition and length of stay in Chinese hospitalized patients. **Results:** 875 hospitalized patients from 6 departments were included in the analysis. The malnutrition rate was 11.6% and the incidence of nutritional risk was 17.8%. It was analyzed that tumor load, end-stage disease, motility, self-rated health, types of oral medicine, and food intake during the past week were independent risk factors for malnutrition or nutritional risk. 56.2% (118/210) of patients at nutritional risk or malnutrition received extra nutritional support, whereas 22.5% (88/391) well-nourished patients did. Moreover, nutrition status, ever stayed in ICU and self-rated health were associated with prolonged length of stay. **Conclusions:** In a word, the prevalence of malnutrition or nutritional risk was about 29.4%. Patients with malnutrition or nutritional risk had a higher transfer rate, lower rehabilitation rate and longer hospital stays. The attention to malnutrition patients needs to be further strengthened.

Key Words: NutritionDay, malnutrition, nutritional risk, nutritional support, length of hospital stay

INTRODUCTION

Malnutrition has imposed a threat on public health, especially hospitalized patients. Malnutrition is associated with longer hospital length of stay (LOS) and higher readmission rates.^{1,2} The incidence of malnutrition was 10–50% of hospitalized patients by previous studies.^{3,4} The results from nutritionDay showed that the overall prevalence of malnutrition risk was 32.7% in the United States. And patients who have diminished meal intake experience increased mortality risk.⁵ Our 2016 nutritionDay survey in Chinese hospitals showed that malnutrition rate was 29.6%.⁶ Zheng H' study indicated that nutrition status was associated with age, nutritional support, and food intake, which was closely related to patients' clinical outcomes from China.⁷

Although there have been some nutritional surveys in China, malnutrition is often neglected in treatment due to unawareness nutritional screening and assessment in most hospitals. Along with the attention to the harm of malnutrition, nutritional support was supplied to an increasing number of hospitalized patients. However, it still has a big gap between guideline recommendations and practical work. The clinical nutritional support is still poorly regulated in China. 41.8% of patients at nutritional risk or already diagnosed with malnutrition did not receive any form of nutritional support, whereas 34.0% well-nourished patients did from the results of nutritionDay 2016 in China.^{6,8}

NutritionDay is a yearly global point-prevalence study of malnutrition or nutritional risk in hospitals. After years of development, it has become the most extensive cross-sectional survey in the field of nutrition.⁹ The aim of nutritionDay worldwide is to improve knowledge and awareness of malnutrition in health care institutions and to overall enhance the quality of nutritional care. We conducted the nutritionDay survey in China. We aimed to find the potential risk factors associated with malnutrition and the association between nutritional status and outcomes in hospitalized patients in China. At the same time, we wonder if nutritional support becomes more regulated in comparison to past years.

MATERIALS AND METHODS

Study population

Through participating in the nutritionDay activities, we collected questionnaire data from 10 hospitals in China. Per unit investigated at least 8 hospitalized patients which met a patient participation rate of at least 60%. Exclusion criteria :(1) Age <7 years old; (2) the ICU patients;(3) delirious and unable to fill in the questionnaire by himself or with assistance; (4) hospitalized patients admitted and discharged during the same calendar day; (5) patients who refused to sign the informed consent.

Data collection

We downloaded 4 standardized questionnaires from the official website of nutritionDay (www.nutritionday.org). The contents of the four general questionnaires are as follows: (1) hospital and unit of being joined questionnaire: hospital structure and nutritional team information; (2) basic information, diagnosis, nutritional intervention, comorbidity and social contacts; (3) patient questionnaire: body weight changes in the past 3 months, food intake of the week before admission and survey the same day, mobility and so on; (4) the follow-up

questionnaires include clinical outcome, prognosis and readmission plan on 1 month after nutritionDay.

Ethics

The NutritionDay research was approved by the ethical committee of the medical university of Vienna. The project was also approved by the Jinling hospital's ethics committee (Chinese host hospital) (2019NZKY-029-01). All the participants received an informed consent before the survey. They can withdraw the survey at any time.

Definitions

Nutritional risk was defined as a score ≥ 3 by nutrition risk screening 2002 (NRS2002). Malnutrition was diagnosed according to the European Society of Parenteral Enteral Nutrition (ESPEN) consensus statement: BMI $< 18.5 \text{ kg/m}^2$ regardless of age; weight loss (unintentional) $> 5\%$ over the last 3 months combined with either BMI $< 20 \text{ kg/m}^2$ if < 70 years of age, or $< 22 \text{ kg/m}^2$ if ≥ 70 years old.¹⁰ Nutritional support was defined as an additional supplement of oral nutritional supplementation (ONS), enteral nutrition (EN) or parenteral nutrition (PN).¹¹

Statistical analysis

Patient baseline characteristics were reported as percentages for categorical variables and as mean \pm standard deviations or medians for continuous variables as appropriate. The paired sample T test was used for inter-group comparison of data with normal distribution and homogeneity of variance, while the rank-sum test was used for inter-group comparison of data with non-normal distribution. And the chi-square tests were used to compare the proportion of malnutrition between independent groups. Binary logistic regression was used to analyze the risk factors of malnutrition or nutrition risk. The Cox proportional hazards regression model was used to identify the risk factors associated with LOS. 95% confidence intervals (CI) were used to describe the odds ratios (OR) or hazard ratios (HR). It was considered statistically significant ($p < 0.05$). All data was analyzed by IBM SPSS 25.0.

RESULTS

Basic characteristics of hospitalized patients

Patients' detailed basic characteristics are shown in Table 1. There were 518 males (59.3%) and 355 females (40.7%). The mean age was 58.19 ± 15.32 years old, and BMI was $23.52 \pm 3.72 \text{ kg/m}^2$. Most of them were from the department of gastroenterology (44.7%), and

oncology (28.6%). Meanwhile, the main lesion types were concentrated on digestive organs (n=410, 42.9%). About 37.7% of the hospitalized patients required surgical intervention.

Patients' nutritional characteristics

Patients' nutritional characteristics were detailed in Table 2. The prevalence of malnutrition was 11.6%, and the nutritional risk rate was 17.8%. 74 patients (8.7%) were underweight (<18.5 kg/m²). 32.9% of patients had weight loss, most of them lost weight unconsciously. The food intake in the past week indicated that: about 26.3% of the patients ate less than their normal intake. More than half of the patients did not eat full lunch on the NutritionDay. 35.5% of them ate ever little lunch. Parenteral nutrition was the main form (36.5%) within patients receiving additional nutritional support in Figure 2.

Risk factors for malnutrition or nutrition risk

Table 3 showed risk factors for malnutrition or nutrition risk. The univariate analysis showed that it was significant such as age ($p=0.03$), tumor load ($p<0.001$), ICU stay ($p<0.001$), end-stages of disease ($p<0.001$), motility ($p<0.001$), food intake last week ($p<0.001$), the number of drugs ($p=0.003$), self-rated health ($p<0.001$) between well-nourished and malnutrition or nutrition risk. The above variables were included as independent variables in the multivariate analysis: tumor load ($p<0.001$), end-stages of disease ($p=0.026$), motility ($p=0.007$), food intake last week ($p<0.001$), the number of drugs ($p=0.01$), self-rated health ($p=0.042$) were independent risk factors of malnutrition or nutrition risk in hospitalized patients in China.

The relationship between nutrition status and 30-day prognosis

The association between nutrition status and 30-day outcome was shown in Figure 1. The cross tabs with chi-square of Independence analyses showed that compared to well-nourished patients, patients with malnutrition or nutrition risk presented a higher transfer rate (7.9% vs. 2.8%, $p=0.002$), lower rehabilitation rate (13.3% vs. 21.5%, $p=0.009$). There was no significant difference in mortality (0.0% vs. 0.4%, $p=0.100$), hospital stay rate (5.8% vs. 2.8%, $p=0.061$) and discharge rate (72.9% vs. 72.5%, $p=0.930$).

Risk factors associated with LOS

The log-rank test showed that there was a statistically significant difference by BMI classifications ($p<0.001$), nutrition status ($p<0.001$), previous operation history ($p=0.016$), ever stayed in ICU ($p=0.006$), motility ($p=0.040$), self-rated health ($p<0.001$) and weight

change within last 3 months ($p=0.056$). Then, all variables above were enrolled in the multivariable cox regression model. Analysis result showed nutrition status ($p<0.001$), ever stayed in ICU ($p=0.036$) and self-rated health ($p=0.031$) were independent factors of prolonged LOS of hospitalized patients. These details were shown in table 4.

Nutritional therapy of Chinese hospitals in 2019

The results revealed that 34.0% patients with well-nourished received improper nutritional support in 2016. Thankfully, this proportion fell to under 22.5% in 2019. However, only 56.2% received nutritional support among patients at nutritional risk or malnutrition. As for the nutritional support routes: PN (36.45%), EN (21.50%), ONS (18.22%), combination of multiple nutritional interventions (23.83%). The results were shown in Figure 2.

DISCUSSION

This is an annual NutritionDay survey among hospitalized patients since 2010 in China.¹² The results showed that the prevalence of malnutrition or nutrition risk was about 29.4% in 2019. Tumor load, end-stage disease, motility, self-rated health, types of oral medicine, and food intake during the past week were independent risk factors for malnutrition or nutrition risk. Moreover, hospitalized patients with malnutrition or nutrition risk had a longer length of stay than well-nourished patients.

Gabriel Torbahn's study indicated nursing home residents were more likely to develop malnutrition who had poor meal intake, low BMI, severe cognitive impairment, immobility, and older age.² Fabian Graeb reported that patients with inadequate nutrition had significantly worse self-reported health statuses, were less able to walk on nutritionDay, had eaten little in the week before admission to hospital, and had an increased length of stay.⁸ Meanwhile, a German study found that geriatric patients were at higher risk of malnutrition or nutritional risk who had larger number of nights spent in the clinic in the last 12 months, higher number of daily drug intake and greater limitations in walking abilities.¹³ These were consistent with our findings. In this study, tumor load, end-stage disease, motility, self-rated health, types of oral medicine, and food intake during the past week were independent risk factors for malnutrition or nutritional risk. The reduction of food intake last week was recognized as an independent factor for malnutrition among Chinese hospitalized patients consistently. Our findings reconfirmed that self-rated health was another risk factor for malnutrition in this work, similarly to a previous study.^{6,14} Hence, we should pay enough attention to self-rated health of inpatients though it seemed a little subjective. The results of this study were

included in the GLIM (Global Leadership Initiative on Malnutrition) consensus, which fully demonstrated the close relationship between these factors and malnutrition.¹⁵

In this study, patients with poor nutritional status also spent longer in hospital, which is consistent with Charlene Wright's study in 2020. They found that malnutrition and reduced dietary intake were associated with longer hospital stays, frequent readmissions, and higher in-hospital mortality.¹⁶ Navarro's study found that it could reduce the readmission rate of inpatients by increasing the intake of patients.¹⁷ Our study found that ever stayed in ICU and self-rated health were independent factors of prolonged LOS in hospitalized patients. Inpatients with ICU history may have complex and severe conditions those should be paid more attention.

In our nutritioDay survey in 2010, 57.6% of malnourished patients received nutritional support therapy, while 36.6% of well-nourished patients received nutritional treatment.¹² In 2016, Sun investigated 8 hospitals in China, and the proportion of those with normal nutrition receiving nutritional intervention was reduced to 34.0%.⁶ In this study, 56.2% of inpatients with malnutrition or nutritional risk received nutritional therapy, a significant increase compared with 10 years ago, while the rate of well-nourished patients receiving nutritional therapy decreased to 22.5%. The ASPEN guidelines suggest that patients at nutritional risk or diagnosed with malnutrition should receive nutritional intervention and benefit from nutritional therapy.¹⁸ Patients at nutritional risk or already diagnosed with malnutrition should receive a nutrition care plan and these patients can benefit from nutritional therapy.^{19,20} At present, the proportion of well-nourished patients receiving unreasonable nutritional intervention is gradually decreasing in China, but there are still some inpatients with malnutrition/nutritional risk who have not received appropriate nutritional intervention, and there are still many unreasonable phenomena in the specific nutritional support treatment in clinical practice in Chinese hospitals. Nutritional support therapy is gradually being standardized in China, but the awareness among medical staff and standard specifications for medical nutritional support still needs to be improved.

We reported some limitations of this study. First, due to the uneven regional development, the sample size may not enough to be representative of the entire Chinese hospitalized population. Second, the sample sizes varied extremely in different hospitals and this may lead to a statistical bias. Last, hospitals valuing nutritional support were more likely to participate in the study, while some primary hospitals did not, so the actual situation may be more serious and require a larger study.

Conclusions

In a word, the prevalence of malnutrition or nutritional risk was about 29.4%. Patients of malnutrition or nutrition risk had a higher transfer rate, lower rehabilitation rate and longer hospital stays. Though there was a decline in the proportion of unsuitable nutritional interventions for well-nourished patients, the attention to malnutrition patients still needed to be further strengthened in China.

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AUTHOR DISCLOSURE

The authors declare no conflict of interest.

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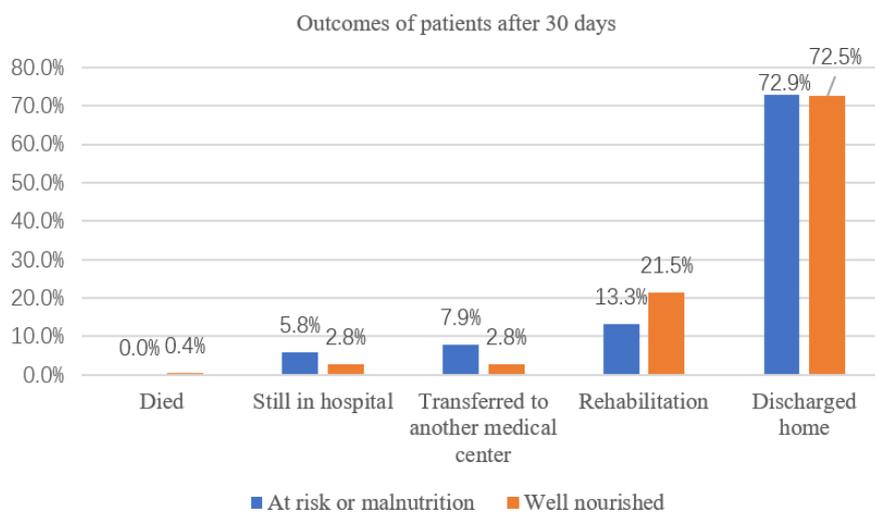


Figure 1. The relationship between nutrition status and 30-day prognosis.

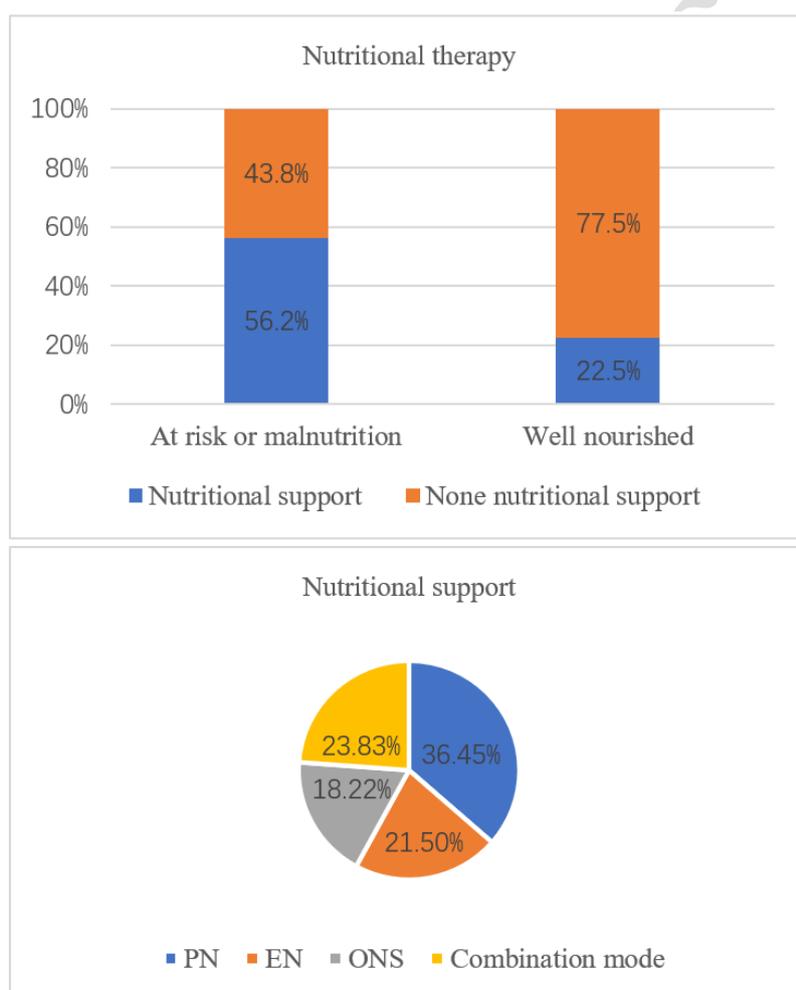


Figure 2. Nutritional therapy of Chinese hospitals in 2019.

Table 1. The basic characteristics of hospitalized patients

Variables	Number (Mean±SD)	Percentage
Hospital		
Jinling Hospital	188	21.5
Tianjin Integrative Medicine Hospital	182	20.8
Affiliated Hospital of Northwest University	103	11.8
Affiliated Pizhou Hospital of Xuzhou Medical University	78	8.9
Affiliated Jiangning Hospital of Nanjing Medical University	70	8.0
Sir Run Run Shaw Hospital of Zhejiang University	66	7.5
Nanjing Drum Tower Hospital	54	6.2
Peking Union Medical College	53	6.1
Second Hospital of Hebei Medical University	47	5.4
National Cancer Center/Cancer hospital	34	3.9
Unit		
Gastroenterology and hepatology	391	44.7
Oncology	250	28.6
Neurology	106	12.1
General surgery	92	10.5
Endocrinology	23	2.6
Pneumology	13	1.5
Sex		
Male	518	59.3
Female	355	40.7
Age, years	58.19±15.32	
Weight, kg	65.08±12.40	
Height, cm	166.07±7.89	
BMI, kg/m ²	23.52±3.72	
Major lesion types		
Digestive disease	410	46.9
Cancer	266	30.4
Neurological disease	77	8.8
Musculoskeletal/connective tissue diseases	29	3.3
Endocrine/nutritional/metabolic disease	23	2.6
Respiratory disease	11	1.3
Others	59	6.7
Ever stayed in ICU		
Yes	48	5.8
No	781	94.2
End-stage disease		
Yes	28	3.2
No	763	87.2
I don't know	84	9.6
Motility		
Walk without assistance	757	90.9
Walk with assistance	55	6.7
Bedridden	20	2.4
Self-rated health		
Very good	63	7.6
Good	287	34.6
Fair	410	49.5
Poor	65	7.8
Very poor	4	0.5
Number of drugs/day (801)		
0	250	31.2
1-2	336	41.9
3-5	142	17.7
>5	55	6.9
I don't know	18	2.3

Table 1. The basic characteristics of hospitalized patients (cont.)

Variables	Number (Mean±SD)	Percentage
Waiting for operation (771)		
No	480	62.3
Yes	291	37.7
Medical insurance (838)		
Yes, private insurance only	56	6.7
Yes, public insurance only	655	78.2
Yes, both	63	7.5
No	59	7.1
I prefer not to answer	5	0.5

Table 2. Patients' nutritional characteristics

Variables	Number	Percentage
Nutritional status	826	
Malnutrition	96	11.6
Nutrition risk	147	17.8
Well-nourished	517	62.6
I don't know	66	8.0
BMI, kg/m ²	855	
<18.5	74	8.7
18.5-23.9	408	47.7
>23.9	373	43.6
Nutritional support form	737	
Parenteral nutrition	78	10.6
Enteral nutrition	46	6.2
Oral nutritional supplementation	39	5.3
Multi-forms	51	6.9
Oral regular or special diet	439	59.6
I don't know	84	11.4
Weight change within last 3 months	827	
Yes, unintentionally	174	21.0
Yes, intentionally	98	11.9
Stable weight	432	52.2
weight gain	38	4.6
I don't know	85	10.3
Food intake last week	830	
More than normal	13	1.6
Normal	599	72.2
About 3/4 of normal	91	11.0
About half of normal	77	9.3
Less than a quarter to nearly nothing	50	6.0
Proportion of lunch eaten on NutritionDay	772	
Nearly all	312	40.4
Half	145	18.8
Quarter	41	5.3
Nothing	274	35.5

Table 3. Risk factors associated with malnutrition or nutritional risk

Variables	Univariate analysis		χ^2/t (<i>p</i>)	Multivariate analysis	
	Malnutrition or nutrition risk	Well-nourished		OR (95% CI)	<i>p</i>
Sex			1.067 (0.302)		
Male	138 (30.5%)	314 (69.5%)			
Female	105 (34.1%)	203 (65.9%)			
Age			5.42 (0.02)	0.828 (0.563-1.216)	0.335
≥ 65 years	97 (37.5%)	162 (62.5%)			
< 65 years	146 (29.1%)	355 (70.9%)			
Tumor load			27.95 (< 0.001)	0.497 (0.339-0.728)	< 0.001
Yes	123 (43.6%)	159 (56.4%)			
No	120 (25.1%)	358 (74.9%)			
Ever stayed in ICU			12.87 (< 0.001)	0.487 (0.229-1.035)	0.061
Yes	25 (55.6%)	20 (44.4%)			
No	212 (29.9%)	496 (70.1%)			
Previous operation history			3.22 (0.073)		
Yes	89 (36.5%)	155 (63.5%)			
No	150 (29.9%)	351 (70.1%)			
Operation after admission			1.96 (0.376)		
No	137 (31.6%)	297 (68.4%)			
Yes, emergency operation	35 (27.8%)	91 (72.2%)			
Yes, elective operation	47 (35.9%)	84 (64.1%)			
End-stage disease			27.77 (< 0.001)		0.026
Yes	18 (72.0%)	7 (28.0%)		Reference	
No	208 (29.5%)	496 (70.5%)		0.503 (0.218-1.162)	
I don't know	17 (54.8%)	14 (45.2%)		1.631 (0.169-5.666)	
Motility			36.28 (< 0.001)		0.007
Bedridden	8 (72.7%)	3 (27.3%)		Reference	
Walk without assistance	193 (28.6%)	483 (71.4%)		0.710 (0.139-3.624)	
Walk with assistance	36 (62.1%)	22 (37.9%)		0.258 (0.056-1.199)	
Food intake last week			47.87 (< 0.001)		< 0.001
More than normal	6 (46.2%)	7 (53.8%)		Reference	
Normal	135 (24.9%)	407 (75.1%)		0.318 (0.092-1.102)	
About 3/4 of normal	35 (43.2%)	46 (56.8%)		0.740 (0.198-2.763)	
About half of normal	38 (55.9%)	30 (44.1%)		1.356 (0.355-5.171)	
About a quarter to nearly nothing	21 (58.3%)	15 (41.7%)		2.019 (0.483-8.429)	

Table 3. Risk factors associated with malnutrition or nutritional risk (cont.)

Variables	Univariate analysis			Multivariate analysis	
	Malnutrition or nutrition risk	Well-nourished	χ^2/t (<i>p</i>)	OR (95% CI)	<i>p</i>
Number of drugs/day			15.75 (0.003)		0.01
0	52(22.3%)	181 (77.7%)		Reference	
1-2	116 (37.8%)	191 (62.2%)		0.874 (0.224-3.410)	
3-5	35 (28.2%)	89 (71.8%)		1.652 (0.434-6.284)	
>5	17 (35.4%)	31 (64.6%)		0.896 (0.224-3.589)	
I don't know	5 (33.3%)	10 (66.7%)		0.629 (0.143-2.778)	
Self-rated health			26.89 (<0.001)		0.042
Very good	9 (16.4%)	46 (83.6%)		Reference	
Good	58 (23.4%)	190 (76.6%)		0.316 (0.020-5.053)	
Fair	140 (37.1%)	237 (62.9%)		0.532 (0.037-7.655)	
Poor	27 (44.3%)	34 (55.7%)		0.891 (0.063-12.603)	
Very poor	3 (75.0%)	1 (25.0%)		0.710 (0.048-10.425)	

Table 4. Risk factors associated with LOS

Variables	LOS, days		Univariate analysis		Cox regression analysis	
	Median	<i>Q1-Q3</i>	<i>p</i>	HR (95%CI)	<i>p</i>	
Sex						
Male	12.0	10.7-13.3	0.152			
Female	14.0	11.9-16.1				
Age, years			0.981			
<65	12.0	10.6-13.4				
≥65	14.0	12.3-15.7				
BMI, kg/m ²			<0.001		0.687	
<18.50	24.0	18.9-29.0				
18.50-23.90	12.0	10.0-14.0				
>23.90	12.0	10.8-13.2				
Nutritional status			<0.001	0.545 (0.442-0.673)	<0.001	
Malnutrition or Nutrition risk	22.0	18.9-25.1				
Well-nourished	11.0	10.1-11.9				
Previous operation history			0.016			
Yes	17.0	13.5-20.6				
No	12.0	10.9-13.1				
Ever stayed in ICU			0.006	0.662 (0.451-0.973)	0.036	
Yes	25.0	23.7-26.3				
No	12.0	10.9-13.1				
Motility			0.040			
Walk without assistance	12.0	10.9-13.1				
Walk with assistance	17.0	9.9-24.1				
Bedridden	36.0	22.0-50.0				
Food intake last week			0.193			
More than normal	14.0	11.7-16.3				
Normal	12.0	10.9-13.1				
About 3/4 of normal	19.0	10.2-27.8				
About half of normal	21.0	13.3-28.7				
About a quarter to nearly nothing	14.0	10.4-17.6				
Self-rated health			<0.001		0.031	
Very good	15.0	9.7-20.3		Reference		
Good	11.0	9.8-12.2		1.509 (1.060-2.149)	0.023	
Fair	14.0	11.0-17.0		1.170 (0.827-1.655)	0.375	
Poor	12.0	9.2-14.8		1.372 (0.871-2.161)	0.173	
Weight change within last 3 months			0.056			
Weight gain	12.0	8.8-15.2				
Stable weight	12.0	10.6-13.4				
Weight loss	16.0	11.9-20.1				
I don't know	17.0	12.2-21.8				