Clinical Report

Nutritional risk, malnutrition (undernutrition), overweight, obesity and nutrition support among hospitalized patients in Beijing teaching hospitals

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The purpose of this study was to test the suitability of Nutritional Risk Screening 2002 (NRS 2002) among hospitalized patients and to determine the prevalence of nutritional risk, undernutrition, overweight, obesity, nutritional support and the changes of nutritional risk from admission to discharge or over a two-week period. A prospective descriptive design was used to describe patients' data collected at three Beijing teaching hospitals. A total number of 1500 consecutive patients, who met the inclusion criteria on admission and provided informed consent, were enrolled. The NRS 2002 was completed by 97.7% of all patients in this study. The overall prevalence of nutritional risk was 27.3%, the prevalence of undernutrition, overweight and obesity was 9.2%, 34.8%, and 10.2%, respectively at admission. Only 24.9% of patients who were at nutritional risk received nutritional support while 6% of non-risk patients received nutritional support. The overall prevalence of nutritional risk changed from 27.3% to 31.9% ($p < 0.05$), and the prevalence of undernutrition, overweight and obesity changed from 9.2% to 11.7% ($p < 0.05$), from 34.8% to 31.8% ($p > 0.05$) and from 10.2% to 8.6% ($p > 0.05$), respectively during hospitalization. Nutritional Risk Screening 2002 was a feasible nutritional risk screening tool in selected Beijing teaching hospitals. The prevalence of nutritional risk observed was nearly 30%. Inappropriate use of nutritional support was observed in hospitalized patients. The prevalence of nutritional risk increased in surgical patients during hospitalization.

Key Words: Nutritional Risk Screening 2002 (NRS 2002), nutritional risk in hospitalized patient, malnutrition (undernutrition) in hospitalized patient, overweight in hospitalized patient, obesity in hospitalized patient

INTRODUCTION

Undernutrition and nutritional risk are common problems in hospitalized patients.[1-4] Previous studies have reported that patients experienced both weight loss[5-7] and reduction in nutritional intake[5,7,8] during hospitalization. In Denmark, a clinical study conducted by Kondrup, et al. [8] reported that nearly 14 out of 740 patients developed a state of nutritional risk during their hospital stay. It is clear that malnourished patients are at higher risk for infection, organ failure, decreased wound healing, and suboptimal response to regular medical treatment.[9] In order to minimize the occurrence of these negative outcomes, patients who experience undernutrition or who are at significant risk for this should be evaluated to determine their needs for nutritional support.[10,11] Additional randomized clinical trials have found that only patients in a state of undernutrition benefited from nutritional support.[11,12] Lack of appropriate nutritional support during hospitalization may worsen patients' nutritional status.[5] Therefore, it is necessary to identify patients who are at nutritional risk when they are admitted to the hospital.

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Reports on the prevalence of undernutrition and nutritional risk from the literature had wider range.[1-4] This variability has been attributed to three major factors: first, an absence of standardized definitions of undernutrition and nutritional risk;[13] second, a lack of a gold-standard for the screening and assessment of nutritional status; and last heterogeneous populations or types of institutions. The term nutritional risk is defined by the European Society for Clinical Nutrition and Metabolism (ESPEN) as "the chances of a better or worse outcome from disease or surgery according to actual or potential nutritional and metabolic status".[14] This nutritional indicator is related to clinical outcomes. The indication for nutritional support is that the patient is identified as at nutrition risk, as defined by the Nutritional Risk Screening 2002 (NRS 2002).[12] Nutritional Risk Screening 2002 is a new screening method based on 128 randomized controlled clinical trials, which has been recommended by ESPEN.[15] However, there was no formalized guideline recommending a screening tool in China when this study was carried out.

The purpose of this study was to test the suitability of NRS 2002 in three selected Beijing teaching hospitals; to investigate both the prevalence of nutritional risk and nutritional support; and to evaluate changes in nutritional status during hospitalization from admission to discharge or over a two-week period of hospitalization. The findings from this study provided evidence supporting the use of the NRS 2002 as a nutritional screening tool and to describe the provision of nutritional support in the hospital setting.

MATERIALS AND METHODS

Subjects and methods

This clinical investigation was carried out in the following wards, Nephrology, Respiratory, Gastrointestinal, Thoracic surgery, and General surgery of Peking Union Medical College Hospital, Beijing Friendship Hospital and Beijing University People's Hospital. These three teaching hospitals are affiliated with three different medical universities in Beijing. Patients admitted consecutively to these wards were eligible for this study if they met the following inclusion criteria. The patient's age was between 18-80 years; well oriented to place and time; scheduled to stay at least one night in the hospital; spoke/understood Chinese; and provided informed consent to participate in the study.

A prospective descriptive design was used to test the suitability of using the NRS 2002, the prevalence of nutritional risk, the application of nutritional support, and changes in nutritional risk in Beijing teaching hospitals.

Data collection

The names of newly admitted patients were obtained from the admissions staff. The investigator contacted nurses who were caring for the patients and asked if they would ask eligible patients whether they would like to learn about a study on nutritional screening. If the patient agreed to hear about the study, the investigator would introduce herself to the patient, and describe the purpose of the study, and obtain informed consent from those interested in participating in the study. Then, the investigator interviewed patients about the extent to which they had recently experienced weight loss and food intake reduction. The investigator weighed and measured the patients with the same standard scale. Patients' weight and height were measured before meals in the morning. Patients were wearing a hospital gown with shoes off when they were measured. The height of the patient was measured to the nearest 0.5 cm, and body weight was recorded to the nearest 0.5 kg. The diagnosis on admission, the results of biomedical indicators and the types of nutritional support being delivered were also collected from the patients' medical record. The investigator continued to visit patients and measured and collected those data until two weeks after admission or until the time of patient discharge.

The NRS 2002 is recommended by ESPEN as a screening tool to detect undernutrition and nutritional risk in patients within the hospital setting.[16] This tool has been implemented based on the assumption that the indications for nutritional support are the severity of undernutrition and the increased requirements for nutrients or stress-metabolism, as reflected by the severity of disease. There are four key components of the NRS 2000 screening tool: Body Mass Index (BMI), weight loss, food intake, and severity of disease. The scale consists of a nutritional status score, a severity of disease score and an age adjustment for patients aged ≥70 years (+1).[16] An individual with an NRS 2002 score that is ≥3 is classified as at nutritional risk. The predictive validity of the NRS 2002 has been documented by applying it to a retrospective analysis of 128 randomized controlled trials (RCTs) on nutritional support, which has revealed that RCTs with those patients fulfilling the risk criteria had a higher likelihood of a positive clinical outcome from nutritional support than those RCTs of patients who did not fulfill with these criteria.[15] The content validity was maximized by the involvement of an ESPEN ad hoc working group under the auspices of the ESPEN Educational and Clinical Practice Committee in the literature based validation. The reliability was validated by inter-observer variation between nurse, dietitian or physician with a K=0.67.[12] Its practicability was shown by the findings that 99% of 750 newly admitted patients could be screened using this tool.[8]

BMI is used to classify underweight, overweight, and obesity. Based upon a Chinese working group for obesity,[17] the condition of BMI < 18.5, or albumin (ALB) < 30g/L if BMI was not available was defined as undernutrition in this study. For the Chinese, the normal range of BMI is 18.5 ≤ BMI < 24.0. If BMI is ≥ 24.0 but <28.0, or BMI ≥ 28.0, these ranges correspond to the status of overweight or obesity respectively. In this study, we adopted these standards to classify the undernutrition, overweight and obesity in hospitalized patients.

Nutrition support was assessed using a self-developed checklist, which included types and contents of nutrition, e.g. oral diet, enteral nutrition (EN), parenteral nutrition (PN) that contained a combination of carbohydrates, amino acids and lipids.

This study protocol was approved by the Research Ethics Committee of each of the hospitals participating in the study (Registration No. S-054). Clinical Trials Registration number is NCT 00289380.

Statistical analysis

Statistical analyses were performed with SPSS (Statistical Package for Social Sciences, Chicago, IL, USA), version 12.0. A p value <0.05 was considered statistically significant. Descriptive statistics were used to describe the frequency and percentage of patients being able to complete the NRS 2002 screening, the frequency and percentage of patients classified as at nutritional risk, undernutrition, overweight and obesity, and the frequency and percentage of use of EN, PN, or both EN and PN. The Chi-square test was performed to compare the prevalence of nutritional risk and undernutrition in those three selected Beijing teaching hospitals. A linear regression model was constructed to determine the contribution of each component of the NRS 2002 to nutritional risk change. Paired t test and Student's t test were used for continuous variables, such as laboratory values, weight loss, length of stay, etc. to determine the difference in these parameters from admission to two weeks after admission or until discharge within the medical and surgical department.

RESULTS

Demographic Data

Overall 1,500 consecutive patients met the inclusion criteria upon admission and were recruited into the study. Of these patients, 841 (56.1%) were male and 659 (43.9%) were female. Nine hundred patients were enrolled from the medical department and 600 patients were from the surgical department. The average age was 54.7 years (SD 16.3 years). Among these patients, 34.1% were older than 65 years. The average length of hospital stay from admission to discharge or two-weeks was 11.9 days (SD 3.1 days). The mean length of hospital stay in medical patients was 12.1 days (SD 2.9 days), which was significantly longer than that of patients in the surgical department (11.5±3.4 days) (t = 3.70, p < 0.001). Five patients died in the hospitals, and 23 patients were discharged before the time of the discharge interview. The patients' diagnoses and the range of scores for severity of disease are summarized in Table 1.

Biomedical variables

In Table 2, we have described the biomedical variables: ALB, white blood cells (WBC), lymphocytes (LY), and hemoglobin (HB) when patients were admitted to the hospital and upon their discharge or two-weeks after admission. The mean values of the laboratory tests observed were all within the normal ranges.

The suitability of NRS 2002

The NRS 2002 was completed by 97.7% of the total sample, 96.8% of the medical patients and 99.2% of the surgical patients.

The prevalence of nutritional risk

The prevalence of nutritional risk at admission among the entire sample of patients, medical patients and surgical patients was 27.3%, 26.3% and 28.0%, respectively. This information is shown in the Table 3. The prevalence of nutritional risk in different wards is summarized in figure 1. Among the different wards upon admission, the highest prevalence of nutritional risk was in the gastrointestinal ward (36.7%) while the lowest was observed in the nephrology ward (18.7%). The prevalence of nutritional risk in those patients 65 years or older was 36.0%. This was significantly higher than that of patients younger than 65 years (22.9%) (X^2 = 29.2, p < 0.001). Detailed information concerning nutritional risk status is summarized in Table 4.

The prevalence of undernutrition, overweight and obesity

The classifications of undernutrition, overweight and obesity were based on the standard for BMI in the Chinese population (Table 5). Less than 10% of patients were in the category of undernutrition based on BMI or ALB upon admission. However, nearly 50% of patients were categorized as overweight or obese upon admission.

Nutritional support application

There were 1333 (88.9%) patients who did not receive nutritional support during hospitalization, including 863 (95.9%) patients in the medical department and 470 (78.3%) in the surgical department. Among all patients,

Table 1. Diagnosis and score range of disease severity of patients at-risk and not at-risk.

Diagnosis	At risk		Not at risk	
	n (%)	Score	n (%)	Score
Internal medicine				
Respiratory disease				
Chronic obstructive pulmonary disease	23 (5.6)	1-2	40 (3.7)	1
Pneumonia	13 (3.2)	1-2	42 (3.9)	1
Lung cancer	10 (2.4)	1	25 (2.3)	1
Asthma	2 (0.5)	1-2	14 (1.3)	1-2
Tuberculosis	7 (1.7)	1	12 (1.1)	1
Other respiratory disease	32 (7.8)	0-2	83 (7.6)	0-1
Gastrointestinal disorders				
Upper G.I. disorder	19 (4.6)	0-2	34 (3.1)	0-1
Lower G.I. disorder	20 (4.9)	0-1	53 (4.9)	0-1
Pancreatic disease	17 (4.1)	0-2	13 (1.2)	0-1
Hepatic disease	16 (3.9)	1	45 (4.1)	0-1
Biliary track disease	11(2.7)	1	29 (2.7)	0-1
Other G.I. disorders	26 (6.3)	0-2	15 (1.4)	0-1
Nephrology disorders				
Nephritis	7 (1.7)	1	54 (5.0)	0-1
Nephrotic syndrome	12 (2.9)	1	73 (6.7)	0-1
Renal failure	25 (6.1)	1-2	59 (5.4)	1
Other nephrology disorders	12 (2.9)	0-1	57 (5.2)	0-1
Surgery				
General surgery				
Major abdominal surgery	74 (18.0)	1-2	81(7.4)	1-2
Minor abdominal surgery	7(1.7)	0-1	47 (4.3)	0-1
Other major surgery	1(0.2)	1	12 (1.1)	0-2
Other minor surgery	5 (1.2)	0	48 (4.4)	0-1
Thoracic surgery				
Lungtectomy	15 (3.7)	1-2	108 (9.9)	0-1
Esophagogastrectomy	30 (7.3)	1-2	21 (1.9)	1-2
Other chest surgery	18 (4.4)	0-2	82 (7.5)	0-2
Chemotherapy	8 (2.0)	1	42 (3.9)	0-1

Table 2. The biomedical variables at admission and upon discharge (two-weeks after admission).

Lab value	All patients (N=1500)		Medical patients (n=900)		Surgical patients (n=600)	
	Admission	Discharge	Admission	Discharge	Admission	Discharge
ALB (g/L)	37.6±7.86	36.4±7.83*	35.0±8.11	34.9±7.43	41.3±5.79	38.6±7.87*
WBC (x109/L)	7.0±3.08	7.84±3.59*	7.18±3.40	7.24±3.36	6.71±2.54	8.69±3.72*
LY (x109/L)	1.75±0.83	1.68±0.89*	1.68±0.82	1.74±0.83*	1.87±0.83	1.58±0.98*
HB (g/L)	123±25.3	119.±22.7*	119±27.3	118±24.9*	128±21.1	121±19.0*

*$p<0.05$

Table 3. The prevalence of nutritional risk at admission or upon discharge (two-weeks after admission).

Department	Nutritional risk	Admission	Discharge	χ^2	p
All patients (N=1500)	At risk	410 (27.3%)	470 (31.9%)	7.53	0.006
	No risk	1090 (72.7%)	1002 (68.3%)		
Medical patients (n=900)	At risk	252 (28.0%)	272 (30.6%)	1.49	0.222
	No risk	648 (72.0%)	616 (69.4%)		
Surgical patients (n=600)	At risk	158 (26.3%)	198 (33.9%)	8.07	0.005
	No risk	442 (73.7%)	386 (66.1%)		

Table 4. Nutritional risk status at admission and upon discharge (two-weeks after admission).

	All patients (N=1500)		Medical patients (n=900)		Surgical patients (n=600)	
	Admission	Discharge	Admission	Discharge	Admission	Discharge
Weight (kg)	65.2±0.34	64.3±0.34*	65.4±0.46	64.4±0.46*	65.1±0.48	64.1±0.48*
BMI (kg/m2)	23.6±0.10	23.2±0.10*	23.6±0.14	23.3±0.14*	23.5±0.15	23.1±0.15*
Weight loss score (mean±SEM)	0.31±0.02	0.49±0.03*	0.37±0.03	0.55±0.04*	0.23±0.03	0.41±0.04*
Weight loss N(%)	346 (23.2%)	898 (62.9%)*	231 (25.8%)	527 (60.8%)*	115 (19.2%)	371 (66.1%)*
Ave. weight loss (mean±SEM)	5.34±0.23	6.23±0.24*	5.34±0.26	6.18±0.28*	5.34±0.47	6.34±0.48*
Food intake (mean±SEM)	0.33±0.02	0.38±0.01 *	0.38±0.02	0.28±0.02*	0.26±0.02	0.54±0.02*
Food intake N (%)	349 (23.3%)	506 (34.4%)*	232 (25.8%)	208 (23.4%)	117 (19.5%)	298 (51.0%)*
Nutritional status (mean±SEM)	0.68±0.03	0.93±0.03*	0.78±0.04	0.92±0.04*	0.54±0.04	0.96±0.04*
Severity of disease (mean±SEM)	0.93±0.01	0.81±0.01*	0.89±0.01	0.80±0.02*	0.98±0.03	0.82±0.03*
Nutritional risk (mean±SEM)	1.86±0.04	1.97±0.04*	1.91±0.05	1.95±0.05	1.80±0.06	1.98±0.06*

*$p<0.05$

Table 5. The prevalence of undernutrition, overweight and obesity.

	Overall patients (N=1500)		Medical patients (n=900)		Surgical patients (n=600)	
	Admission	Discharge	Admission	Discharge	Admission	Discharge
Undernutrition†	135 (9.2%)	167 (11.7%)*	86 (9.8%)	102 (11.8%)	49 (8.2%)	65 (11.5%)
Normal‡	675 (45.9%)	685 (47.9%)	390 (44.5%)	408 (47.1%)	285 (47.8%)	277 (49.2%)
Overweight§	512 (34.8%)	454 (31.8%)	305 (34.8%)	273 (31.5%)	207 (34.7%)	181(32.1%)
Obesity¶	150 (10.2%)	123 (8.6%)	95 (10.8%)	83 (9.6%)	55 (9.2%)	40 (7.1%)

* $p<0.05$; † BMI<18.5 or ALB<30g/L; ‡ 18.5≤ BMI<24.0; § 24.0≤ BMI<28.0; ¶ BMI≥28.0

Table 6. The relationship between nutritional risk and nutritional support.

Nutritional risk	Nutrition support	All patients (N=1500)	Medical patients (n=900)	Surgical patients (n=600)
NRS≥3 (At risk)	Use	102 (24.9%)	28 (11.1%)	74 (46.8%)
	No use	308 (75.1%)	224 (88.9%)	84 (53.2%)
	Total	410 (100%)	252 (100%)	158 (100%)
NRS<3 (No risk)	Use	65 (6.0%)	9 (1.4%)	56 (12.7%)
	No use	1025 (94.0%)	639 (98.6%)	386 (87.3%)
	Total	1090 (100%)	648 (100%)	442 (100%)

more PN (9.3%) was applied comparing to that of EN (0.9%), especially in the surgical department, where 19.8% received PN while only 0.7% received EN. This information is reported by risk status in Table 6. Figure 2 provides the application of nutritional support by risk status within the medical and surgical departments.

The average days of nutrition support among the entire sample of patients, medical patients, and surgical patients were 6.2 days (SD 3.7 days), 7.5 days (SD 4.5 days), and

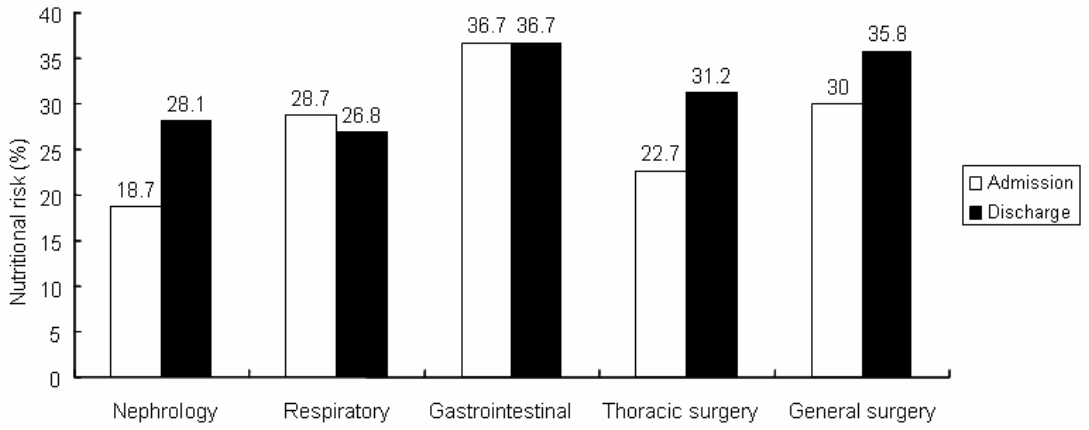

Figure 1. The prevalence of nutritional risk in different wards in Beijing teaching hospitals. All patients were screened at admission and upon discharge or two-weeks after admission. White bars showed the prevalence of nutritional risk at admission, and black bars showed the prevalence of nutritional risk upon discharge or two-weeks after admission.

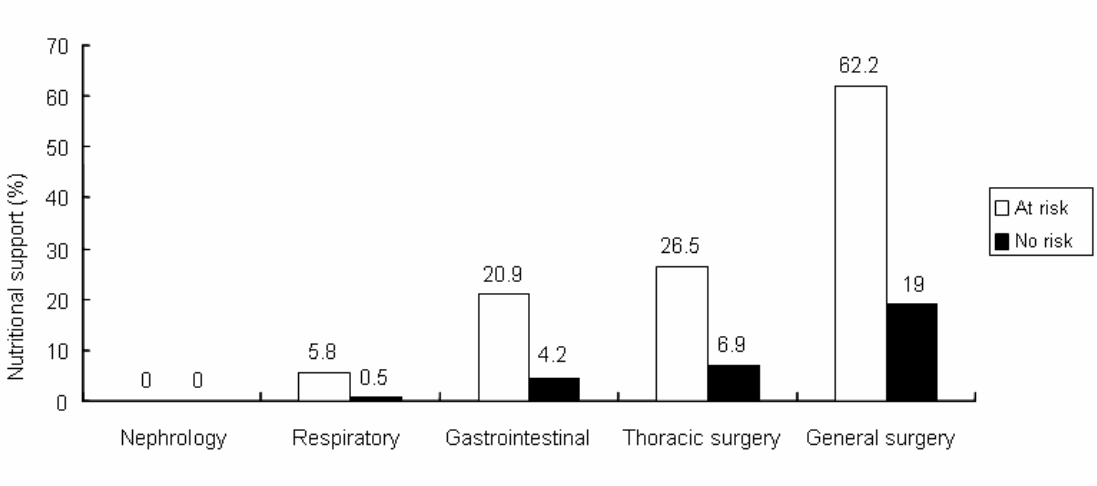

Figure 2. Nutritional support application in different wards in Beijing teaching hospitals. The rate of nutritional support application is shown. White bars showed the rate of nutritional support application when patients were at nutritional risk in each ward, and black bars showed the rate of nutritional support application among non-risk patients.

5.8 days (SD 3.3 days), respectively. For the duration of nutritional support, 41.1% of patients used nutritional support more than 7 days. For instance, in the medical department, 55.6% of patients received nutritional support for more than 7 days, while 36% of patients received it for less than 5 days. In the surgical department, only 37% of patients received nutritional support for more than 7 days while, 43% of patients received it for less than 5 days.

PN was defined as either partial or total nutrition administered intravenously in this study, which contained the combinations of carbohydrates, amino acids and lipids. Therefore, patients who only received amino acids or lipids were not classified as receiving nutritional support. Twenty-seven (1.8%) out of the entire sample of patients received only amino acids (19 patients, or 1.3% of total patients) or lipids (8 patients, and 0.5% of total patients).

Changes in nutritional risk during hospitalization

Findings from this study revealed a significant change in the prevalence of nutritional risk from admission to discharge or two weeks after admission in all patients. When we divided patients by medical or surgical department, only those in the surgical department demonstrated the same significant change (Table 3). Furthermore, a significant difference in the prevalence of nutritional risk was also observed in both the nephrology ward ($X^2 = 7.32$, $p = 0.007$) and thoracic surgery ward ($X^2 = 5.44$, $p = 0.02$) when patients were discharged from hospitals or two-weeks after admission (Figure 1).

There were 82 (5.5%) patients including 60 (6.7%) from the medical department and 22 (3.7%) from the surgical department, for whom the nutritional status changed from at nutritional risk on admission to non-risk upon discharge or two weeks after admission. Meanwhile, 147 (9.8%) patients including 83 (9.2%) from the medical department and 64 (10.7%) from the surgical department developed a state of nutritional risk during hospitalization.

In addition to the evaluation of the overall changes in nutritional risk, we also found significant changes in each component of the nutritional risk status shown in table 4. Body weight and BMI of the patients revealed significant changes during hospitalization. The mean body weight changed from 65.2 kg (SE 0.34) at admission to 64.3 kg

(SE 0.34) at discharge or two-weeks after admission ($p < 0.05$). When patients were admitted to the hospitals, the mean BMI was 23.6 kg/m^2 (SE 0.10). At discharge or two weeks after admission, the mean BMI was 22.2 kg/m^2 (SE 0.10) ($p < 0.05$).

On admission, the prevalence of self-reported weight loss defined by the NRS 2002 was 23.2% in the entire group of patients and 25.8% and 19.2% in the medical and surgical patients, respectively. At discharge or two weeks after admission, an overall 62.9% of the patients experienced weight loss within a three month period of time, of which 60.8% were medical- and 66.1% were surgical patients. A significant difference in the prevalence of weight loss was observed at both time points ($p < 0.05$). The average self-reported weight loss within three months was 5.34 kg (SE 0.24) when patients were admitted into hospitals, and 6.23 kg (SE 0.24) at the time of patients' discharge or two weeks after admission. The prevalence of weight loss during hospitalization was 55.6% in the entire sample of patients, including 52.6% and 60.1% of the medical and the surgical patients respectively. Of the patients, 32.0% experienced no change in body weight, and 12.4% of the patients gained weight during the hospitalization. Average weight loss during hospitalization was 2.29 kg (SD 2.54 kg) in the entire group of patients, 2.65 kg (SD 3.19 kg) and 1.83 kg (SD 1.16 kg) from medical and surgical patients, respectively.

With regard to reduction of food intake on admission, 23.3% of patients in the entire group experienced this while 25.8% of medical patients and 19.5% of surgical patients experienced this. Furthermore, the reduction of food intake at discharge was experienced by 34.4% in the entire group of patients, 23.4% of medical patients and 51.0% of surgical patients. This was a significant difference in the entire sample and in the surgical group ($p < 0.05$).

Upon admission, the mean score of severity of disease (according to NRS 2002 scoring system) was 0.93 (SE 0.01) in the entire group of patients and 0.89 (SE 0.01) in the medical patients and 0.98 (SE 0.03) in the surgical patients. Subsequently, the mean severity of disease was 0.81 (SE 0.01), 0.80 (SE 0.02) and 0.82 (SD 0.03) at discharge or two weeks after admission respectively. In conclusion, a significant difference was observed at either time period ($p < 0.05$).

A significant difference in the prevalence of undernutriton between admission and discharge (two-weeks after admission) was observed in the study ($p < 0.05$) (Table 5). Differences in laboratory data between the two investigation points were seen in the entire sample of patients and the surgical subgroup of patients ($p < 0.05$) (Table 2).

DISCUSSION

The majority of patients included in this study suffered from respiratory disease, gastrointestinal disorders or nephrology disorders. We chose these patients as study subjects because patients with these conditions would be expected to have a high proportion of nutritional complications. Similar to other studies, both medical and surgical patients were included.[2,6-8] Since the situation of hospitalized patients from the medical and surgical wards was quite different, the results from medical and surgical departments were discussed separately.

Suitability of NRS 2002

Results from this study indicated that a majority of patients in Chinese teaching hospitals could complete the NRS 2002 screening process. Patients from which BMI could not be obtained were classified in the group with incomplete NRS 2002 screening process. Therefore, the completion rate did not reach 100%. The suitability of NRS 2002 in this study was congruent with that of a previous study conducted by Chen, et al.[18] that also examined the suitability of NRS 2002 in hospitalized patients in one Chinese hospital. The study found that 139 out of 153 patients (90.8%) could be screened by the NRS 2002 for nutrition risk evaluation. The result was consistent with a comparative study between China and US hospitalized patients. The study showed 94.0% of patients in Beijing and 99.5% of patients in Baltimore were able to complete nutritional risk screening using NRS 2002[19]. Moreover, a similar finding was reported in the national survey that indicated that the NRS 2002 can be completed by 99.2% of hospitalized patients in China.[20] Similar reports were also shown in a study in Danish hospitals. In this study, BMI was measurable within 98.7% of patients, and the NRS 2002 was able to be completed by 93.5% of hospitalized patients.[7] Because the NRS 2002 requires patients to report changes in their weight and food intake, only patients who were well oriented in time and place were included in this study. This may have resulted in a selection that overestimated the suitability of the use of the NRS 2002. In the present study, it took about five minutes to interview a patient and to measure the body weight and height. Most patients were very cooperative and comfortable with the questions. Based on these findings we agreed that the NRS 2002 tool could be considered one of the simple tools to screen hospitalized patients.

The Prevalence of Nutritional Risk and Undernutrition

The prevalence of nutritional risk and undernutrition in hospitalized patients in this study was consistent with that reported in studies in Chinese, European and American Hospitals using the same parameters.[1,7,18-20] A cross-sectional study in 15 randomly selected departments in Danish hospitals showed that out of 590 patients, 39.9% were nutritionally at risk.[7] Kondrup, et al.[8] reported that the prevalence of nutritional risk in three levels of hospitals was 22%. The prevalence of nutritional risk was 51.0% at Johns Hopkins Hospital in the US.[19] The highest prevalence of nutritional risk was found in the gastrointestinal patients and the lowest was in the nephrology patients. The result was similar with the national investigation in China.[20] A possible reason might be that more gastrointestinal patients self-reported their weight loss (39.8%) and reduced food intake (33.0%) when admitted in the hospitals. A study conducted by Kondrup, et al.[8] demonstrated that BMI, recent weight loss, recent dietary intake and severity of disease were correlated with nutritional risk. Lower prevalence of nutritional risk in the nephrology ward compared to other wards might be because some patients were admitted to hospital only for the

procedure of kidney biopsy. A higher prevalence of nutritional risk was also observed in older aged patients, which was supported by previous studies.[21,22] In this study, this difference might have been even more pronounced however, a selection bias may have underestimated the effect of age. This is due to the exclusion of patients who were confused or unresponsive who might have had a high probability of being older and at nutritional risk. Therefore, the results of this study might underestimate the prevalence of nutritional risk in hospitalized patients.

Although some patients were in a normal or higher range of BMI, they still could be at nutritional risk. For example, 16.7% of all patients, 16.1% of medical patients and 17.5% of surgical patients, were observed at nutritional risk, but these patients were within the normal range or had high BMIs. This observation was consistent with the study reported by Rasmussen et al.[7] in Danish hospitals where about 25% of patients with BMI>20.5 were at nutritional risk. The results from this study are consistent with that of Kyle et al.[23] who suggest that simple anthropometric parameters underestimate the nutritional risk in hospitalized patients. Weight loss, reduction of food intake or severity of disease also could have contributed to the prevalence of nutritional risk in this study.[8] Therefore, using a combined instrument is better for nutrition screening.

Nutritional Support Application

This study found that only a small proportion of the patients received nutritional support, especially in the medical department. The results from this study were consistent with studies conducted in other countries. In Danish hospitals, one study showed that a nutrition plan was found in 14.2% of the records and 32.8% of patients at nutritional risk had a nutrition plan.[7] Another study carried out in 750 randomly selected patients found inadequate nutritional care in hospitals. This study reported that 22% of the patients were nutritionally at-risk, and that only 25% of these patients received an adequate amount of energy and protein.[8] A survey on current nutritional care in 12 Cuban hospitals indicated that 10.9% of the patients fulfilled an indication for nutritional intervention, and support was provided to less than 15.0% of them.[24] Results from the Brazilian national survey showed that although there was a high prevalence of malnutrition (48.1%), only a small minority of patients (7.3%) were treated.[2] The data from the US patients showed that only 14.7% of patients who were at nutritional risk used parenteral and enteral nutrition during hospital stay.[19]

In this study 6.0% of non-risk patients were given nutritional support including 12.7% of those in the surgical department. This finding was consistent with that of a multi-center investigation in China.[20]

More than half of patients who received nutritional support did not receive it for an adequate amount of time. This finding is consistent with that of a study conducted in Norway,[25] which found that 45% of patients received nutritional support for less than a week. And Bruun et al.[25] recommended that many of those requiring artificial nutrition should have received it for a longer period.

There are several possible reasons for inappropriate use of nutritional support, such as the lack of nutritional support for nutritional risk patients and the over-use of nutritional support for non-risk patients, and inadequate duration of treatment or nutrients. It could be that clinical practice is not evidence-based or that nutritional support is of a low priority. It also could be that the assignment of responsibility for nutritional support is unclear or the institutions lack clinical procedures and guidelines regarding nutritional support.[2,8] There were no written clinical guidelines or protocols on nutritional support at any of these hospitals when this study was conducted. However, a review revealed that a structured format such as a protocol could benefit in the delivery of nutritional support.[26] Therefore, a guideline or protocol needs to be in place and used in clinical practice. Studies have revealed that with a multidisciplinary team approach to nutritional support, patients received nutritional support, had enough energy, were well monitored, and suffered fewer complications.[27-29] This level of nutritional support improved patients' care and economic status.[30] However, there is no formalized nutritional support team in hospitals in China to date. The individual physician is responsible for nutritional problems according to their clinical experience. Meanwhile, the awareness of health professionals regarding the nutritional needs of hospitalized patients is very important. A study conducted by Waitzberg et al.[2] found that physician awareness of malnutrition was low, and nutrition therapy was under prescribed. However, training can help improve the awareness of health professionals on this issue.[31] Therefore, the education on nutrition support is very important for health care professionals.

Changes in Nutritional Risk during Hospitalization

A significant change in the prevalence of nutritional risk was found among the entire sample of patients during hospitalization from this study. The prevalence of nutritional risk increased in surgical patients. But no change was found in medical patients. This result was consistent with the comparative study between China and US medical patients where no significant difference was observed in the prevalence of nutritional risk from admission to discharge (two weeks after admission).[19] A study conducted by Kondrup et al.[8] in Denmark, using the same screening tool, reported that 14 out of 740 patients developed a state of nutritional risk during their hospital stay. A similar study using a different screening tool also indicated that 26% of mildly undernourished patients became moderately undernourished and 37% of the moderately undernourished patients became severely undernourished. No patient from the undernourished group moved up to the normal or overweight group.[6]

In order to identify the contributing factors for the change in nutritional risk, linear regression was performed with the categories of the severity of disease, BMI, weight loss and food intake, as the independent continuous variables and nutritional risk score as the dependent continuous variable. The coefficients for each independent variable in descending order were: weight loss 0.445; food intake 0.417; severity of disease 0.374; BMI 0.323. All components were correlated with nutritional risk change ($p < 0.05$).

CONCLUSION

NRS 2002 was feasible as a nutritional risk screening tool in Beijing teaching hospitals. Compared to other similar studies conducted in Chinese hospitals, this study has further demonstrated that the NRS 2002 is applicable as a screening tool to evaluate and examine the nutritional risk in hospitalized patients. The results revealed that baseline information can facilitate how health professionals measure the appropriateness of the application of nutritional support in their hospitals. It could also serve as a clinical reference for health care professionals to understand the importance of clinical guideline use in their practice, especially in nutritional support for the hospitalized patents. All hospitals should use the nutritional support guidelines to assist the clinical practice regarding both the application of nutrition risk screening and nutritional support. Systematic training should be considered to improve the awareness of nutrition problems among hospitalized patients.

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AUTHOR DISCLOSURES

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Clinical Report

Nutritional risk, malnutrition (undernutrition), overweight, obesity and nutrition support among hospitalized patients in Beijing teaching hospitals

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北京大型教学医院住院患者的营养风险、营养不良(不足)、超重、肥胖和营养支持现状的调查研究

本文是调研北京大型教学医院的住院患者营养风险、营养不良(不足)、超重、肥胖和肠外肠内营养支持现状和分析研究。前瞻性队列研究设计，计划经纶理委员会通过和有 NCT 登记号。在北京三家大型教学医院采用连续抽样，1500 名符合入组条件的住院患者知情同意后参加本研究。本研究中有 97.7%的住院患者可使用 NRS 2002 进行营养风险筛查。营养风险的发生率为 27.3%，营养不良(不足)、超重、肥胖的发生率分别为 9.2%、34.8% 和 10.2%。 有 24.9%存在营养风险的住院患者得到了肠外肠内营养支持，同时有 6%无营养风险的患者也接受了肠外肠内营养支持。住院期间患者的营养不良(不足)、超重、肥胖发生率的变化分别由 9.2% 到 11.7% ($p < 0.05$)，34.8% 到 31.8% ($p > 0.05$)，10.2% 到 8.6% ($p > 0.05$)。北京教学医院的住院患者营养风险的发生率近 30%，临床上存在肠外肠内营养的不合理应用。

关键词：营养风险筛查 NRS 2002、 营养风险、 住院患者营养不良(不足)、住院患者超重、 住院患者肥胖