

Association between indication for therapy by nutrition support team and nutritional status

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Abstract

The nutrition support team is a multidisciplinary team composed of medical doctors, registered nurses, pharmacists, and nutritionists, who evaluate the nutritional status of patients. The objective of this study was to determine the relationship between indications for nutrition support team therapy and the nutritional status of patients hospitalized in local major hospitals.

Patients who were referred to a nutrition support team from January to December 2016 were enrolled. Patients were classified into 4 age groups, and the weight categories were determined using body mass index (BMI). Four of 6 indications were used for referral to a nutrition support team. The required calories were estimated, and the nutritional status was classified into malnutrition or eutrophia, based on the estimation.

The proportion of elderly patients (37.0%) was higher than that of younger ones (28.3%). Patients with higher BMI had a relatively lower proportion of malnutrition. Patients receiving enteral nutrition had greater risk of malnutrition (adjusted odds ratio [aOR]=3.77, 95% confidence interval [CI]=2.71–5.24). Patients receiving parenteral nutrition (aOR=0.38, 95% CI=0.30–0.47) and treated in the intensive care unit (aOR=0.70, 95% CI=0.54–0.91) had lower risk of malnutrition. Patients with >3 indications for nutrition support team therapy had a lower risk of malnutrition than those with only 1 indication (aOR=0.54, 95% CI=0.37–0.77).

Parenteral nutrition was the most common indication for referral to nutrition support team therapy; however, enteral nutrition had the poorest nutritional status. Patients receiving enteral nutrition who are referred to a nutrition support team need an intensive nutrition support strategy.

Abbreviations: aOR = adjusted odds ratio, BMI = body mass index, CI = confidence interval, EN = enteral nutrition, ICU = intensive care unit, NST = nutrition support team, PN = parenteral nutrition.

Keywords: enteral nutrition, malnutrition, nutritional status, nutritional support, parenteral nutrition

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1. Introduction

Nutrition is a key factor for maintaining and promoting human health. Well-nourished people can more easily avoid diseases and recover faster from a disease. However, if nutrition is not properly provided, a person may experience health problems caused by nutritional imbalance, which may also adversely affect recovery. Previous studies have reported that >40% of hospitalized patients have risk factors associated with malnutrition, and that malnutrition worsened during hospitalization in approximately 75%.^[1] Moreover, malnutrition mainly occurs among elderly patients, those under intensive care, cancer patients, and those who have undergone brain surgery, even though adequate nutrition support is critical for the recovery of these patients.^[2]

The nutrition support team (NST) is a multidisciplinary team composed of medical doctors, registered nurses, pharmacists, and nutritionists, who evaluate the nutritional status of patients receiving enteral nutrition (EN) and parenteral nutrition (PN) and provide patients with the appropriate nutritional supply to expedite their recovery and prevent complications.^[3,4] The importance of the NST is increasing as numerous previous studies have reported that nutritional management through the systematic activities of a NST reduces complications and medical costs for hospitalized patients.^[5–7]

In South Korea, “Therapy by Nutrition Support Team” became an official health insurance claim term by official order of the Ministry of Health and Welfare in August 2014, and it is available for malnourished patients to maximize the therapeutic effect of nutritional therapy. In addition, the indications for NST

referral were established, and NSTs have operated based on these criteria. After it became possible to claim for NST therapy through the government health insurance, the importance of nutrition management in hospitalized patients has received greater attention. NSTs have been established and operate in >100 hospitals nationwide.^[8] However, there are insufficient studies evaluating the relationship between the indications for NST therapy and patient nutritional status.

Consequently, the objective of this study was to evaluate the relationship between the indications for NST therapy and nutritional status among patients who are hospitalized in local major hospitals and were referred to a NST.

2. Materials and Methods

2.1. Study participants

Participants were selected from among 2823 adult patients who were referred to the NST of Chosun University Hospital from January to December 2016. After excluding those with insufficient data for nutritional assessment, those who were hospitalized <3 days, and those hospitalized for testing or clinical studies, the data of 2132 participants were used. The data of referred patients were retrospectively analyzed using the electronic medical records and medical charts of NST patients. This study was conducted with the approval of the Clinical Research Ethics Committee, Chosun University Hospital (CHOSN 2018–01–008).

2.2. Classification methods

Patients were classified into 4 age groups (19–44, 45–64, 65–74, and ≥75 years). Weight categories were determined according to body mass index (BMI), calculated using patient height (cm), and body weight (kg), which were recorded in the medical admission chart, as follows: underweight (<18.5 kg/m²), normal weight (≥18.5 and <23.0 kg/m²), overweight (≥23.0 and <25.0 kg/m²), and obese (≥25.0 kg/m²). Clinical departments were classified into 3 categories. The allergy, immunology, cardiology, endocrinology, gastroenterology, hematology–oncology, infectious diseases, nephrology, rheumatology, and pulmonology departments were classified as the internal medicine division. The neurology and neurosurgery departments were classified as the neurology division. Thoracic surgery, general surgery, orthopedics, and plastic surgery were classified as the surgery division.

There are 6 indications for referral of a patient to an NST (Fig. 1). Among these 6, 4 indications (1–4) were used in this

study: blood albumin ≤3.0 g/dL, receiving EN, receiving PN, and being treated in an intensive care unit (ICU). Each indication received one point. Two indications were excluded from this study because all participants met indication 5 (NST therapy is deemed necessary according to the opinion of the medical practitioner in charge) and all participants were adults (indication 6: patient's weight is below the 5th percentile [pediatric only] of the growth curve).

The sum of EN and PN 1 day before prescribing therapy by an NST was used to classify the nutritional status. The required calories for each patient were estimated based on BMI: <18.5 kg/m², 35 kcal/kg; ≥18.5 and <23.0 kg/m², 30 kcal/kg; ≥23.0 and <25.0 kg/m², 25 kcal/kg; and ≥25.0 kg/m², 20 kcal/kg. Based on the estimation, each patient's nutritional status was classified as either malnutrition (<75% of required calorie intake) or eutrophia (≥75% of required calorie intake) according to a previous study.^[2]

2.3. Data analysis

The collected data were described using frequency analysis for categorical variables and descriptive statistics, such as mean and standard deviation, for continuous variables. The statistical analysis methods used were the chi-squared test and multiple logistic regression analysis to examine the relationship between indications for NST therapy and nutritional status adjusted for sex, age, BMI, clinical department, albumin level ≤3.0 g/dL, EN, PN, and ICU treatment. All statistical differences were determined with significance set at $p < 0.05$. IBM SPSS Statistics 21.0 (IBM Corp., Armonk, NY) was used for all analyses.

3. Results

3.1. Baseline characteristics and indications

Among the 2132 participants, 58.2% were men, mean age was 66.1±15.6 years, and mean BMI was 22.6±3.7 kg/m². NST therapy was requested most frequently (57.1%) by the internal medicine division. The most common indication for NST therapy was PN, followed by decreased albumin level, EN, and ICU treatment. A total 31.6% of participants had >2 indications for NST therapy (Table 1). A total 32.7% of cases were PN only, the most common indication, followed by decreased albumin only (24.1%). Among participants with >2 indications, most had an indication of PN (Table 2).

3.2. Differences according to nutritional status

A total 1592 participants (74.7%) who were referred for NST therapy were classified as having malnutrition. The proportion of man participants with malnutrition was slightly higher than that of women participants. Moreover, the proportion of malnourished elderly patients (≥75 years old; 37.0%) was higher than that of younger ones (28.3%). Patients with higher BMI (i.e., overweight and obese) had relatively lower proportions of malnutrition. With respect to clinical department, patients referred from the internal medicine division had the highest proportion (60.6%) of malnutrition (Table 3).

3.3. Relationship between NST indications and nutritional status

Multiple logistic regression analysis was conducted to evaluate the relationship between indications for NST therapy and

Indicated patients for the therapy by nutrition support team: if any one or more of the following conditions can be applied

- (1) Patient with serum albumin ≤ 3.0 g/dL
 - (2) Patient with enteral nutrition
 - (3) Patient with parenteral nutrition
 - (4) Patient in intensive care unit
 - (5) Patient on suspicion of malnutrition by physician in charge
 - (6) Child below 5 percentile on growth curve by weight
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Figure 1. Indications for therapy by a nutrition support team.

Table 1
Baseline characteristics of the study participants.

Variables	Total (n = 2132)
Demographics	
Men	1240 (58.2)
Women	892 (41.8)
Age, y	66.1 ± 15.6
BMI, kg/m ²	22.6 ± 3.7
Age groups, y	
19–44	214 (10.0)
45–64	648 (30.4)
65–74	527 (24.7)
≥75	743 (34.8)
Body weight status (BMI)	
Underweight (<18.5)	261 (12.2)
Normal weight (18.5–22.9)	949 (44.5)
Overweight (23–24.9)	430 (20.2)
Obese (>25)	492 (23.1)
Department	
Internal medicine	1218 (57.1)
Surgery	316 (14.8)
Neurology and neurosurgery	598 (28.0)
Indication for NST treatment	
Albumin	1017 (47.7)
Enteral nutrition	410 (19.2)
Parenteral nutrition	1220 (57.2)
Intensive care unit	331 (15.5)
Number of indications for NST treatment	
1	1458 (68.4)
2	518 (24.3)
≥3	156 (7.3)
Mean number of indications	1.4 ± 0.6

Values are number of patients (%) or mean ± standard deviation, unless otherwise indicated. Albumin, serum albumin ≤3.0g/dL; BMI=body mass index, NST=nutrition support team.

nutritional status, controlling for sex, age, BMI, and clinical department (Table 4). The results of the analysis showed that patients receiving EN had a higher risk of malnutrition (adjusted odds ratio [aOR]=3.77, 95% confidence interval [CI]=2.71–5.24). In contrast, patients receiving PN (aOR=0.38, 95% CI=0.30–0.47) and treated in the ICU (aOR=0.70, 95% CI=0.54–

Table 2
Indications for therapy by a nutrition support team among study participants.

Indications for NST treatment	Total (n = 2132)
Only albumin	514 (24.1)
Only EN	224 (10.5)
Only PN	698 (32.7)
Only ICU	22 (1.0)
Albumin + EN	56 (2.6)
Albumin + PN	262 (12.3)
Albumin + ICU	33 (1.5)
EN + PN	26 (1.2)
EN + ICU	31 (1.5)
PN + ICU	110 (5.2)
Albumin + EN + PN	21 (1.0)
Albumin + EN + ICU	56 (2.6)
Albumin + PN + ICU	83 (3.9)
EN + PN + ICU	4 (0.2)
EN + Albumin + PN + ICU	16 (0.8)

Values are number of patients (%). Albumin, serum albumin ≤3.0g/dL; EN=enteral nutrition, ICU=intensive care unit, NST=nutrition support team, PN=parenteral nutrition.

Table 3
Association between patient characteristics and nutritional status.

	Malnutrition* (n = 1592)	Eutrophia* (n = 540)	P-value (P-trend)
Sex			
Men	949 (59.6)	291 (53.9)	.020
Women	643 (40.4)	249 (46.1)	
Age, y			
19–44	146 (9.2)	68 (12.6)	.001 (<.001)
45–64	471 (29.6)	177 (32.8)	
65–74	385 (24.2)	142 (26.3)	
≥75	590 (37.0)	153 (28.3)	
BMI, kg/m²			
<18.5	184 (11.6)	77 (14.2)	.006 (.154)
18.5–22.9	743 (46.7)	206 (38.2)	
23–24.9	313 (19.6)	117 (21.7)	
>25	352 (22.1)	140 (25.9)	
Department			
Internal medicine	965 (60.6)	253 (46.8)	<.001
Surgery	233 (14.6)	83 (15.4)	
Neurology	394 (24.8)	204 (37.8)	

P < .05: difference by chi-square test. Values are number of patients (%). * Malnutrition: nutritional status <75%; Eutrophia: nutritional status ≥75%.

0.91) had a lower risk of malnutrition. Participants with >3 indications for NST therapy showed a lower risk of malnutrition than did those with only one indication (aOR=0.54, 95% CI=0.37–0.77).

Multiple logistic regression analysis was performed to identify the indications for NST therapy that most affect nutritional status, controlling for sex, age, BMI, clinical department, albumin ≤3.0g/dL, EN, PN, and ICU treatment (Table 4). The analysis revealed that the risk of malnutrition was highest for EN (aOR=2.06, 95% CI=1.43–2.98). The risk of malnutrition was lowest for PN (aOR=0.44, 95% CI=0.34–0.58), followed by albumin ≤3.0g/dL (aOR=0.77, 95% CI=0.60–0.99).

4. Discussion

With the introduction of NST therapy, the importance of nutritional support and management is emerging. If a hospitalized patient experiences a condition of malnutrition for an extended period, they might have a longer duration of hospitalization, more complications, and increased morbidity and mortality.^[6] This study aimed to evaluate the relationship between NST therapy indications and nutritional status, using 75% of required calorie intake as a threshold for malnutrition.

Adequate nutrition intake is important in hospitalized patients because it affects disease treatment and symptom recovery. In this study, PN was the most common cause for referral to NST therapy among the indications investigated, followed by decreased albumin levels. Furthermore, when a patient had multiple indications, PN and decreased albumin were the main factors.

PN is provided for a patient when they cannot receive EN or EN is insufficient to meet the patient-specific requirements. As PN formulations have relatively high osmotic pressure, it is necessary to determine the administration method (peripheral or central nutritional supply) in advance, depending on the expected supply period. Moreover, the amount of PN varies by disease.^[9] Albumin levels indicate the protein content and calorie deficiency of the body, and an appropriate supply of protein minimizes catabolism in the body. Therefore, patients with PN or decreased

Table 4**Association between indication for therapy by a nutrition support team and nutritional status.**

	Malnutrition* (n=1592)	Eutrophia* (n=540)	P-value (P-trend)	Multivariate analysis [†]	Multivariate analysis [‡]
Albumin					
No	802 (50.4)	313 (57.9)	.002	1.00	1.00
Yes	790 (49.6)	227 (42.1)		1.05 (0.85–1.31)	0.77 (0.60–0.99)
EN					
No	1244 (78.1)	478 (88.5)	<.001	1.00	1.00
Yes	348 (21.9)	62 (11.5)		3.77 (2.71–5.24)	2.06 (1.43–2.98)
PN					
No	767 (48.2)	145 (26.8)	<.001	1.00	1.00
Yes	825 (51.8)	395 (73.2)		0.38 (0.30–0.47)	0.44 (0.34–0.58)
ICU					
No	1370 (86.1)	431 (79.8)	.001	1.00	1.00
Yes	222 (13.9)	109 (20.2)		0.70 (0.54–0.91)	0.84 (0.63–1.12)
Nol					
1	1112 (69.8)	346 (64.1)	.011 (0.003)	–	–
2	377 (23.7)	141 (26.1)		0.82 (0.65–1.03)	–
≥3	103 (6.5)	53 (9.8)		0.54 (0.37–0.77)	–

P < .05: difference by chi-square test. Values are number of patients (%) or odds ratio (95% confidence interval).

Albumin, serum albumin ≤3.0 g/dL; EN=enteral nutrition, ICU=intensive care unit, Nol=number of indications for nutritional support team treatment, PN=parenteral nutrition.

* Malnutrition: nutritional status <75%; Eutrophia: nutritional status ≥75%.

[†] OR for nutritional status <75%: OR adjusted for sex, age, BMI, and department.

[‡] OR for nutritional status <75%: OR adjusted for sex, age, BMI, department, serum albumin ≤3.0 g/dL, enteral nutrition, parenteral nutrition, and intensive care unit.

albumin are required to be managed by a NST.^[10] It is believed that this is the reason why patients with PN and decreased albumin were frequently referred for NST therapy in our study.

In a comparison of the malnutrition group and eutrophia group, the latter had relatively more young patients than did the malnutrition group, which had a higher proportion of elderly patients. We speculate that the difference was caused by basic differences in immunity, digestive capability, and concomitant diseases, which are more common in older patients. Regarding BMI, the eutrophia group had a higher proportion of overweight and obese patients. This result agreed with previous studies showing that participants with poorer nutrient intake had lower body weight, and overweight participants mostly had good nutrition intake.^[11–13] The present results revealed that the internal medicine division had a higher proportion of patients with malnutrition and the neurology division had a higher proportion with eutrophia. This could be because many patients in the internal medicine division are hospitalized for gastrointestinal disorders and poor feeding whereas hospitalized patients in the neurology division infrequently have illnesses that directly affect nutrition intake. Neurology patients often receive EN because of illnesses that induce a swallowing disorder, such as trauma or acute cerebral infarction.

When we examined the relationship between NST therapy indications and nutritional status, patients receiving EN showed worse nutritional status than those receiving PN; however, patients receiving PN were the most frequently referred to a NST, indicating that they had the best nutritional status. When there is no limitation on the quantity of PN supply, nutrition can be supplied continuously after calculating the required kcal according to body weight and selecting the most suitable nutritional product according to the calculation. This could be a reason that the patients receiving PN showed good nutritional status. In contrast, it is often problematic to supply sustained EN in patients with difficulties of digestive function, such as vomiting, diarrhea, or abdominal discomfort. In such cases, it takes a long time to reach the caloric target; consequently, nutritional status could be poor in these patients. Therefore, it is

important to improve monitoring of the nutritional status of patients receiving EN so that these patients can also be referred for NST therapy. If it is difficult to supply the target amount of nutrition to a patient through EN, it will be necessary to provide the appropriate amount of nutrition by jointly using EN and PN in the early stages.

This study had several limitations. First, sample selection bias could affect the analyses because the study was conducted retrospectively. Second, this study only targeted patients who were hospitalized in a major general hospital; therefore, the severity of patients' illnesses could differ from those of patients in smaller hospitals. Consequently, the generalization of the results might be limited. Third, this study did not include other variables in the analyses, such as patient laboratory data and clinical data. Despite these limitations, the authors believe that this study provides meaningful findings because the primary study objectives were to analyze nutritional status according to the indication for NST therapy, which can serve as a basis to establish a strategy for intensive nutrition management support by identifying the indications that affect nutritional status.

In conclusion, PN was the most common indication for referral to NST therapy; however, EN was the indication with the poorest nutritional status. These results implied that when patients receiving EN are referred to an NST, they will need an intensive nutrition support strategy. In some cases, the patient may need an aggressive joint EN and PN supply. Future studies will be needed to evaluate how NST therapy influences clinical results and how each indication affects treatment, based on the results of this study.

Author contributions

Byung Chul Shin, In Ae Chun, and Hyun Goo Kang participated the design of this research. Byung Chul Shin, In Ae Chun, So Yeon Ryu, Ji Eun Oh, and Hyun Goo Kang collected and analyzed the raw clinical data. Byung Chul Shin, In Ae Chun, Pahn Kyu Choi, and Hyun Goo Kang carried out computational studies and wrote the manuscript. All authors have read and approved the final manuscript.

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