Original Article

Physician Compliance with Nutrition Support Team Recommendations: Effects on the Outcome of Treatment for Critically Ill Patients

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ABSTRACT

Purpose: Attending physicians in Korea are aware of the existence of the Nutrition Support Team (NST), but even when the NST are consulted, compliance with their recommendations may be low. This study was performed to identify physicians' compliance with the NST advice and how this affected the outcome of treatment for critically ill patients.

Methods: This study was a retrospective observational study. Critically ill patients who were older than 18 years, younger than 90 years, and had been admitted and managed in the intensive care unit were selected for this study. Patients were assigned to either the compliance group or the non-compliance group according to physician compliance with the NST advice. Each group were compared using variables such as calorie supply, protein supply, laboratory findings, hospital stay, 30-day mortality, and survival rate.

Results: The compliance group (81% of cases) was supplied with a significantly higher energy (1,146.36 ± 473.45 kcal vs. 832.45 ± 364.28 kcal, $p < 0.01$) and a significantly higher protein (55.00 ± 22.30 g/day vs. 42.98 ± 24.46 g/day, $p = 0.04$) compared with the non-compliance group. There was no significant difference in the basic demographics between groups, although the compliance group had a better outcome in the 30-day mortality rate (8% vs. 26%, $p = 0.02$), and in survival beyond 1 year (Crude model, hazard ratio: 2.42, CI: 1.11-5.29).

Conclusion: Critically ill patients whose attending physician complied with the NST advice, received an increased energy intake and supply of protein which was positively associated with survival.

Keywords: nutrition support team, compliance, critically ill patients

Introduction

In a multicenter survey of 6 hospitals in the Republic of Korea (ROK) on a given day, malnutrition was observed in 20.2% (*n* = 99 patients) of hospital admissions [1]. Undernourishment in admitted patients increases the mortality rate, length of hospital stay and economic burden [2,3]. Having a Nutrition Support Team (NST) has been shown to have a positive effect on the supply of nutrition to critically ill patients and reduce the length of hospital stay [4-6]. In ROK, the need for a NST emerged in the 1990s, and NST activities were carried out in earnest within hospitals from the 2000s. However, many attending physicians do not comply with NST advice [7,8]. Therefore, the objective of this study was to investigate the compliance of attending physicians with the NST advice and its effect on the outcome of treatment for critically ill patients. This study was performed in a single university medical institution.

Material and Methods

Data were collected retrospectively using electronic chart reviews from March, 2015 to August, 2016. Patients who were more than 18 years but less than 90 years, had been admitted and managed in the intensive care unit (ICU) were studied. Of these patients, readmission cases and mortality cases within 2 weeks were excluded. The clinical characteristic data such as age, gender, weight, body mass index, Acute Physiologic Assessment and Chronic Health Evaluation II (APACHE II) score, nutritional status, and laboratory findings (albumin, total protein, hemoglobin, lymphocyte count, and glucose levels) were retrieved.

Nutritional strategies including the total total calories and protein requirements calories and protein requirements were determined using the ASPEN guidelines. A simplistic weight-based equation was used to determine the calorie requirement (25-30 kcal/kg/d), and protein requirement (1.2-1.5 g/kg/d). Malnourished patients were assessed using the International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) with malnutrition described as mild, moderate, or severe [6]. In this study nutrition was categorized as good, mild malnutrition, moderate malnutrition, or severe malnutrition.

The NST was involved in clinical support for nutrition when the attending physician requested a consult regarding a patient in the ICU. Patients in this study were assigned to a group depending on the primary physician's compliance with the NST recommendations. For the group whose attending physician's compliance with the NST advice was good, it was named the "compliance group." The group whose attending physician did not follow the recommendations from the NST was called the "non-compliance group." Compliance was judged using several factors such as the time taken to initiate nutrient support (early vs. late initiation), supply methods (enteral nutrition vs. parenteral nutrition), the number of calories supplied (increased vs. decreased), the amount of protein supplied (increased vs. decreased), following recommendation for using a feeding pump, treatment for refeeding syndrome, and problems with defecation. After the consultation, if the attending physician followed the NST recommendations mentioned above, the patient was assigned to the "compliance-group." Compliance was judged by a multidisciplinary team during the ICU rounds once a week. Outcomes including 30-day mortality, overall mortality, duration of ICU stay, duration of hospital stay, and duration of ventilation days were compared between the 2 groups (compliance vs non-compliance) as well as several nutritional variables (total number of calories supplied, total protein supply, nutritional methods, and nutritional laboratory variables) and demographics.

Nutritional variables and laboratory findings 14 days later were also compared between the 2 groups at the time of consultation and according to compliance. Survival curves were also compared beyond 1 year according to the compliance. Patients who had died within 2 weeks after consultation were excluded from analysis because it was thought that factors other than nutritional issues were the cause of mortality.

Analysis was performed using SAS Version 9.4 (SAS inc., Cary, NC, USA). Chi-square tests and t tests were performed to determine characteristics of all patients studied. Statistical uncertainty was expressed as 95% confidence interval. Probability values which were < 0.05 were considered statistically significant.

The protocol of this study was approved by an independently constituted ethics committee within the institution (ethics approval no.: CR 318074).

Results

A total of 170 critically ill patients who stayed in the ICUs of a single hospital was retrospectively studied. The involved ICUs are surgical, trauma, neurosurgical, medical, and emergency ICUs. Of these patients, readmission cases ($n = 26$) and mortality cases ($n = 23$) within 2 weeks of admission were excluded from this study. Consequently, 121 patients were analyzed in this study (Figure 1; Table 1). The mean APACHE II score of these 121 patients was 15.91 (minimum 2, maximum 44). More than 80% of these patients had malnutrition (mild, 32.2%; moderate, 28.9%; and severe, 19%).

On the 14th day after the consultation with the NST, the average supply of calories and protein increased for the study group of patients in the ICU (calories: 230.11 ± 651.04 kcal, $p < 0.01$; protein: 9.45 ± 36.97 g/day, $p < 0.01$). After consultation, these calories and protein supplies were ranked as 75.9% and 75.6% of the calculated requirement, individually. Laboratory findings including total protein, albumin, glucose, and CRP levels became more stable on the 14th day after the NST consultation. The case of enteral nutrition increased more ($n = 19$ pre-consultation and $n = 30$ post consultation) than that of parenteral nutrition ($n = 54$ pre-consultation and $n = 29$ post consultation) (Generalized McNemar and Bhapkar's test, $p < 0.01$; Table 2).

For comparison between the compliance group and the non-compliance group, there was no significant difference in basic demographics. The compliance group showed a better outcome in the 30-day mortality rate (8% vs. 26%, $p = 0.02$). For the overall mortality rate, the compliance group showed a lower mortality rate, however this was not statistically significant (21% vs. 39%, $p = 0.08$; Table 3). When nutritional variables were compared prior to and following the consultation with the NST and in both the compliance and non-compliance groups, the total calories (1,146.36 ± 473.45 kcal vs. 832.45 ± 364.28 kcal,
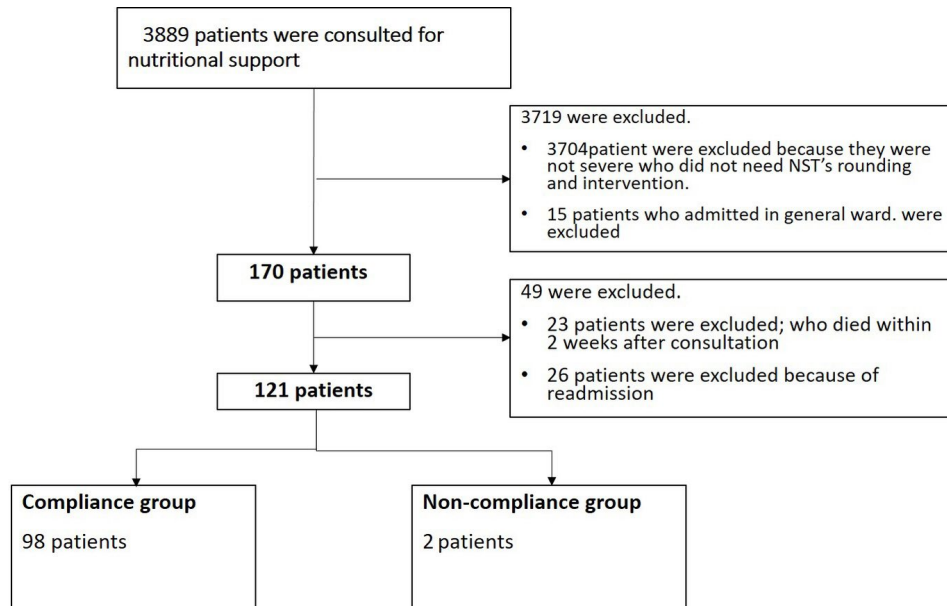
Figure 1. Patients studied.

A total of 3,889 patients had a consultation for nutritional support. Only critically ill patients (*n* = 170) who needed nutritional support and a multi-disciplinary approach were included in this study. Those (*n* = 23) who died within 2 weeks of the consultation, and those (*n* = 26) who were readmitted to the ICU were excluded from this study. According to attending physician's compliance with the NST advice, the patients were assigned to either the compliance or non-compliance group. ICU = intensive care unit; NST = nutrition support team.

Table 1. Descriptive statistics of the patients.

Variables		*N* (%)	Mean ± SD	Minimum; maximum
Age (y)		121	63.53 ± 15.09	20; 93
Gender	Male	41 (33.88)		
	Female	80 (66.12)		
Height (cm)		121	63.00 ± 12.48	136; 183
Weight (kg)		121	63.00 ± 12.48	35; 115
IBW		121	58.06 ± 7.11	38.84; 73.70
BMI		119	23.57 ± 3.73	13.46; 40.75
APACHE II			15.91 ± 7.82	2; 44
Nutritional status	Good	24 (19.83)		
	Mild malnutrition	39 (32.23)		
	Moderate malnutrition	35 (28.93)		
	Severe malnutrition	23 (19.01)		
Level of physician compliance*	Good (compliant)	98 (80.99)		
	Bad (non-compliant)	23 (19.01)		
Mechanical ventilation period (d)			26.88 ± 39.79	0; 226
ICU period (d)			34.58 ± 42.77	1; 242
Hospitalization period (d)			68.68 ± 63.33	6; 329
Total calorie requirement (kcal)			1,431.40 ± 189.75	1,100; 2,000
Total protein requirement (g)			69.76 ± 15.10	35; 139

APACHE II = Acute Physiology and Chronic Health Evaluation II; BMI = body mass index; IBW = ideal body weight; ICU = intensive care unit.
*Type of physician compliance = the time taken to initiate nutrition support (early vs. late); supply methods (enteral vs. parenteral nutrition); energy intake (increased vs. decreased); protein intake (increased vs. decreased); use of feeding pump (use vs. non-use); treatment of refeeding syndrome; defecation treatment.

Table 2. Comparison ICU patient data between pre- and post-NST consultation.

Variables	N	Pre-consultation	Post-consultation	Difference	p
Calorie supply (kcal/d)	107	857.57 ± 506.23	1087.69 ± 469.85	230.11 ± 651.04	0.001§
Protein supply (g/d)	107	43.30 ± 52.75	52.75 ± 23.08	9.45 ± 36.97	0.009§
Total protein (g/dL)	74	5.40 ± 0.65	5.97 ± 0.94	0.56 ± 1.02	< 0.001§
Albumin (g/dL)	107	2.79 ± 0.45	2.96 ± 0.51	0.17 ± 0.46	0.001§
Glucose (mg/dL)	107	152.09 ± 56.19	135.13 ± 52.62	-16.96 ± 50.71	0.001§
Cholesterol (mg/dL)	60	121.43 ± 44.94	125.73 ± 51.01	4.30 ± 36.94	0.371§
Triglyceride (mg/dL)	60	148.60 ± 80.49	157.60 ± 92.47	9.00 ± 87.34	0.428§
Hs-CRP (mg/dL)	95	11.59 ± 8.02	6.26 ± 5.71	-5.33 ± 8.30	< 0.001§
Hemoglobin (g/dL)	107	10.24 ± 1.46	10.30 ± 1.46	0.06 ± 1.67	0.704§
Hematocrit (%)	107	30.22 ± 4.17	30.77 ± 4.32	0.55 ± 5.09	0.264§
Total lymphocyte (10^3/μL)	103	889.81 ± 576.19	1,153.88 ± 604.99	264.08 ± 548.14	< 0.001§
Nutrition supply method	PN	54 (50.94)	29 (27.36)		< 0.01*†
	EN	19 (17.92)	30 (28.30)		
	PN + EN	14 (13.21)	12 (11.32)		
	Oral	2 (1.89)	27 (25.47)		
	Other‡	17 (16.04)	8 (7.55)		

CRP = C-reactive protein; ICU = intensive care unit; NST = nutrition support team.
* Bhapkar's test.
† Generalized McNemar.
‡ Other means no supply of nutrition without any acceptable reason.
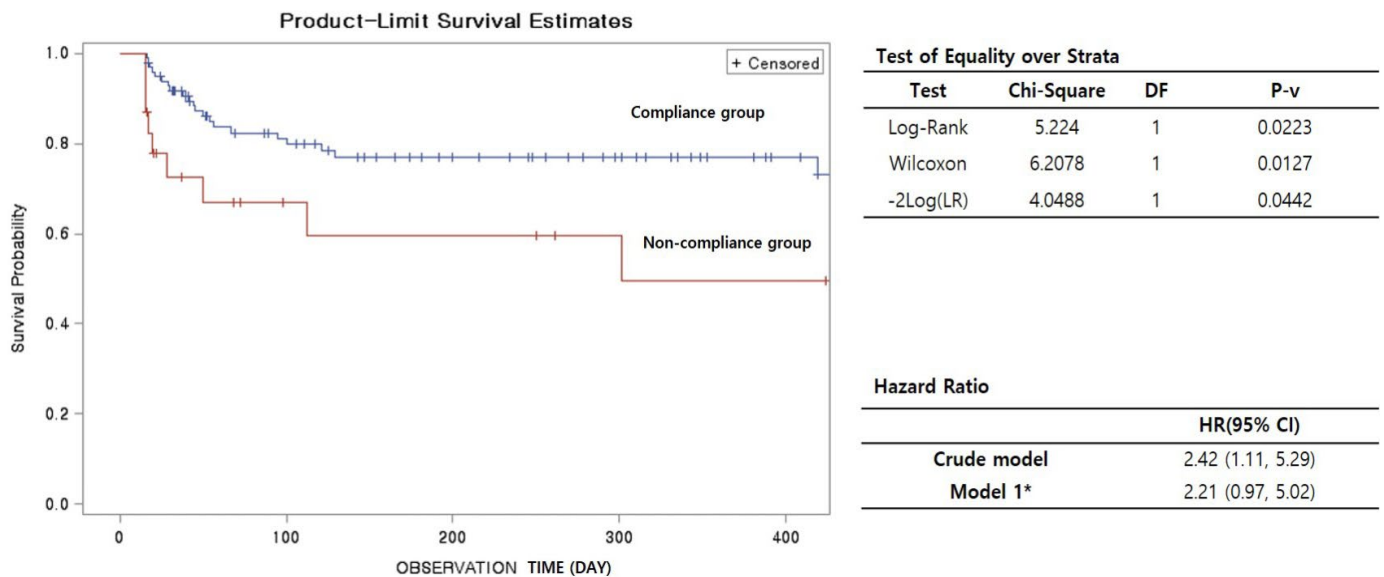§ p-value (paired t test).

Figure 2. Overall mortality. The overall mortality was investigated beyond 1 year after the consultation with the NST. The compliance group had a higher probability of survival compared with the non-compliance group (Crude model, hazard ratio: 2.42, CI: 1.11-5.29). After adjusting for age, gender, weight, and APACHE II score a similar result was observed (hazard ratio: 2.21, CI: 0.97-5.02).
* Adjusted by age, gender, weight, and APACHE II score.
APACHE II = Acute Physiology and Chronic Health Evaluation II; DF = degree of freedom; NST = nutrition support team.

Table 3. Comparison between physician compliance with the NST advice and non-compliance.

Variables		Compliance (N = 98)	Non-compliance (N = 23)	p
Age (y)	Mean ± SD	64.12 ± 14.55	61.00 ± 17.35	0.3742*
	Min, max	21, 93	20, 87	
Gender	Male	34 (34.69)	7 (30.43)	0.6977†
N (%)	Female	64 (65.31)	16 (69.57)	
IBW	Mean ± SD	57.93 ± 7.26	58.63 ± 6.54	0.6708*
	Min, max	38.84, 73.70	46.60, 67.40	
BMI	Mean ± SD	23.69 ± 3.86	23.07 ± 3.17	0.4816*
	Min, max	13.46, 40.75	18.92, 30.86	
APACHE II	Mean ± SD	15.47 ± 7.20	17.78 ± 10.04	0.3057*
	Min, max	2, 39	6, 44	
Height (cm)	Mean ± SD	163.18 ± 9.08	163.91 ± 7.93	0.7228*
	Min, max	136, 183	149, 175	
Weight (kg)	Mean ± SD	63.35 ± 12.96	61.54 ± 10.38	0.5347*
N = 96/23	Min, max	35, 115	42, 80	
Nutritional status	Good	21 (21.43)	3 (13.04)	0.6462‡
N (%)	Mild malnutrition	29 (29.59)	10 (43.48)	
	Moderate malnutrition	29 (29.59)	6 (26.09)	
	Severe malnutrition	19 (19.39)	4 (17.39)	
Mechanical ventilation period (d)	Mean ± SD	25.79 ± 38.98	31.52 ± 43.73	0.5361*
	Min, max	0, 226	0, 189	
ICU period (d)	Mean ± SD	33.29 ± 42.97	40.04 ± 42.45	0.4982*
	Min, max	1, 242	1, 189	
Hospitalization period (d)	Mean ± SD	68.75 ± 61.74	68.35 ± 71.16	0.9782*
	Min, max	6, 274	9, 329	
Overall mortality	Survival	77 (78.57)	14 (60.87)	0.0768†
	Death	21 (21.43)	9 (39.13)	
30-day mortality from consultation	Survival	90 (91.84)	17 (73.91)	0.0156†
	Death	8 (8.16)	6 (26.09)	
Nutrition methods	PN	58 (59.18)	11 (47.83)	0.2844‡
N (%)	EN	0 (0.00)	1 (4.35)	
N = 97/23	PN + EN	1 (1.02)	0 (0.00)	
	Oral diet	2 (2.04)	1 (4.35)	
	Other	36 (36.73)	10 (43.48)	
Total calorie requirement (kcal/d)	Mean ± SD	1,436.73 ± 195.51	1,408.70 ± 164.91	0.5259*
	Min, max	1,100, 2,000	1,100, 1,600	
Total protein requirement (g/d)	Mean ± SD	69.47 ± 195.51	71.00 ± 19.22	0.7216*
	Min, max	43, 139	35, 110	

ICU = intensive care unit; NST = nutrition support team.
* P-value (independent 2 sample t test).
† P-value (Chi-square test).
‡ P-value (Fisher's exact test).

Table 4. Comparison between variables pre- and post-NST consultation (14 days later) in the compliance group and the non-compliance group.

Variables		Compliance (N = 87)	Non-compliance (N = 20)	p^*
Calorie supply (kcal/d)	Pre-consultation	839.53 ± 511.08	936.05 ± 489.31	0.4446
	Post-consultation	1,146.36 ± 473.45	832.45 ± 364.28	0.0065
	Difference	306.83 ± 683.15	-103.60 ± 328.76	0.0002
	$p^\S$	< 0.0001	0.1749	
Protein supply (g/d)	Pre-consultation	43.27 ± 30.95	43.41 ± 26.60	0.9855
	Post-consultation	55.00 ± 22.30	42.98 ± 24.46	0.035
	Difference	11.73 ± 8.13	-0.43 ± 0.32	0.1859
	$p^\S$	0.0052	0.9495	
Total protein (g/dL)	Pre-consultation	5.37 ± 0.63	5.53 ± 0.71	0.4106
	Post-consultation	5.97 ± 0.90	5.95 ± 1.11	0.953
	Difference	0.60 ± 0.99	0.43 ± 1.16	0.5638
	$p^\S$	< 0.0001	0.1774	
Albumin (g/dL)	Pre-consultation	2.80 ± 0.48	2.76 ± 0.35	0.7549
	Post-consultation	2.96 ± 0.52	2.93 ± 0.46	0.807
	Difference	0.17 ± 0.47	0.17 ± 0.42	0.9687
	$p^\S$	0.0014	0.0831	
Glucose (mg/dL)	Pre-consultation	151.93 ± 53.49	152.80 ± 68.30	0.9506
	Post-consultation	133.14 ± 49.15	143.80 ± 66.47	0.4165
	Difference	-18.79 ± 53.69	-9.00 ± 34.91	0.3183
	$p^\S$	0.0016	0.2632	
Cholesterol (mg/dL)	Pre-consultation	122.30 ± 46.91	119.06 ± 40.34	0.8077
	Post-consultation	125.41 ± 54.09	126.63 ± 42.99	0.9358
	Difference	3.11 ± 34.56	7.56 ± 43.90	0.6836
	$p^\S$	0.5532	0.5013	
		N = 44	N = 16	
Triglyceride (mg/dL)	Pre-consultation	141.73 ± 76.76	167.50 ± 89.84	0.2764
	Post-consultation	142.91 ± 83.23	198.00 ± 106.76	0.0402
	Difference	1.18 ± 81.06	30.50 ± 102.46	0.2536
	$p^\S$	0.9234	0.2523	
		N = 78	N = 17	p^*
hs-CRP (mg/dL)	Pre-consultation	11.52 ± 7.90	11.90 ± 8.80	0.8614
	Post-consultation	5.82 ± 5.16	8.26 ± 7.62	0.223
	Difference	-5.70 ± 8.18	-3.64 ± 8.90	0.3559
	$p^\S$	< 0.0001	0.1115	

NST = nutrition support team.
* p-value (independent 2 sample t test).
† p-value (Chi-square test).
‡ p-value (Fisher's exact test).
§ p-value (paired t test).

Table 4. (Continued).

Variables		Compliance (N = 87)	Non-compliance (N = 20)	p^*
		N = 87	N = 20	
	Pre-consultation	10.27 ± 1.43	10.07 ± 1.62	0.5652
Hemoglobin (g/dL)	Post-consultation	10.46 ± 1.40	9.61 ± 1.56	0.0184
	Difference	0.18 ± 1.58	-0.46 ± 1.97	0.1225
	$p^{\S}$	0.2881	0.3101	
		N = 87	N = 20	
	Pre-consultation	30.31 ± 4.03	29.82 ± 4.84	0.6313
Hematocrit (%)	Post-consultation	31.26 ± 4.05	28.65 ± 4.92	0.0138
	Difference	0.95 ± 4.80	-1.17 ± 6.05	0.0934
	$p^{\S}$	0.0684	0.3979	
		N = 84	N = 19	
	Pre-consultation	885.95 ± 577.99	906.84 ± 583.52	0.8873
Total lymphocyte count (10^3/μL)	Post-consultation	1,143.57 ± 546.48	1,199.47 ± 829.52	0.7819
	Difference	257.62 ± 521.66	292.63 ± 668.40	0.8029
	$p^{\S}$	< 0.0001	0.0724	
		N = 86	N = 20	
	PN (before)	43 (50.00)	11 (55.00)	$0.3038^{\ddagger}$
	EN (before)	16 (18.60)	3 (15.00)	
	PN + EN (before)	10 (11.63)	4 (20.00)	
	Oral diet (before)	1 (1.16)	1 (5.00)	
	Other (before)	16 (18.60)	1 (50.0)	
Nutrition method	PN (after)	17 (19.77)	12 (60.00)	$0.0073^{\dagger}$
	EN (after)	26 (30.23)	4 (20.0)	
	PN + EN (after)	11 (12.79)	1 (5.00)	
	Oral diet (after)	24 (27.91)	3 (15.00)	
	Other (after)	8 (9.30)	0 (0.00)	

* *P*-value (independent 2 sample t test).
[†] *P*-value (Chi-square test).
[‡] *P*-value (Fisher's exact test).
[§] *P*-value (paired t test).

$p < 0.01$) and protein (55.00 ± 22.30 g/day vs. 42.98 ± 24.46 g/day, $p = 0.04$) supplied were significantly more in the compliance group compared with the non-compliance group. After the consultation, the compliance group was supplied 79.7% of required calories and 79.1% of the required amount of protein, which were individually higher than the non-compliance group (59% of the required calories and 60.5% of the required amount of protein). Parenteral nutrition was the main method of supply in both groups before the consultation ($n = 43$ in the compliance group and $n = 11$ in the non-compliance group). However, the prevalence was lower in the compliance group after the consultation ($n = 17$ in the compliance group and $n = 12$ in the non-compliance group; Chi-square test, $p < 0.01$; Table 4).

When survival rates of patients were estimated beyond 1 year after the consultation with the NST, the survival rate was higher in the compliance group than the non-compliance group (Crude Model; hazard ratio: 2.42, 95% CI: 1.11, 5.29). The survival rate remained higher in the compliance group after adjusting for age, gender, weight, and APACHE II score (hazard ratio: 2.21, 95% CI: 0.97, 5.02; Figure 2).

Discussion

Nutritional support has been recognized as an important strategy for the treatment of patients in the ICU. Many for parenteral and enteral nutritional developments have been accomplished in the world [2,3]. For approximately 4 decades, many physicians have known that the NST is important in achieving nutritional goals in terms of calories and protein for patients in the ICU [9-11]. In 1986, it was anticipated that NST polices would be expanded to encourage greater utilization of the NST [12]. However, the NST system in Korea is not in full operation yet. In the cases where the NST were consulted it depended on the attending physician's decision to follow the recommendations. Non-standardization of nutritional strategies may induce malnourishment or worsen it and this correlates with a bad treatment outcome [2,3,13,14]. The NST plays an important professional role in introducing information and suggesting alternative methods of nutritional support. The NST is a multidisciplinary team that has a positive effect on sufficient patient calorie supply, reducing the incidence of parenteral nutrition, and associated induced infections [2,3,10,15,16]. In the ROK, the government began support for the medical charge of the activity of the NST in August 2014. Its activity also became an appraisal standard for tertiary hospital evaluations. However, the potential effect of the NST advice could be immaterial without physicians' compliance with the recommendations for therapeutic intervention, particularly as it is not imperative that the physician follows the advice. In addition, regardless of the awareness of the NST, the rate of consultations have been reported as low, even in the ICU where patients are indicated for nutritional support [7,8]. To solve this problem, a message-window informing the physician that a patient is indicated for consultation with the NST was created in the electronic chart of patients in the hospital, after which consultation rates increased. However, nutritional support strategies were different for patients depending on a physician's preference. Therefore, physicians' compliance was the focus of this study which was compared with several outcomes such as nutritional variables and the results of treatment between the compliance group and the non-compliance group. In the compliance group, the supply and target performance rates of calories as well as the supply of protein after the NST consultation increased significantly. The compliant group, who had interventions recommended by the NST followed by the physician, showed a similar tendency to other studies [9,17]. Without the NST intervention, attending physicians may not be interested in nutritional therapy or the supply of calories and proteins possibly due to the lack of education, over-working, or manpower [18,19]. The rate of consultation was only 39% in a university hospital in Korea in 2015 and it was variable depending on the department [20]. According to a survey conducted in 2012, about 80% of attending physicians in Korea knew of the existence of the NST in their hospital, but this rate did not correlated with the rate of consultations with the NST [7]. It is important to increase individual awareness about the NST to increase physician compliance with NST recommendations.

In this current study, the compliance group received more calories and protein. An adequate supply of calories and protein for critically ill patients has been emphasized. Such patients are often under stressful conditions such as negative balance of nitrogen. Therefore, protein should be supplied to these patients successfully [3]. In addition, the closer to the goal of total calorie intake and protein intake, the lower the duration of hospital stay, and the greater the survival rate [21]. However, it is very difficult to take such a goal into practice in the ICU. In the 2000s, it was observed in Europe that the average supply rate of calories was 40% to 50% of the goal [15,22,23]. In 2010 in the ROK 52% of patients were supplied with the adequate amount of calories, reaching 80-100% of the goal [16]. In 2015-2016 in this current study, the total calories given to all patients reached 50-60% of the goal before consulting with the NST. After the consultation, the compliance group reached 80% of the goal, while the non-compliance group reached 59% of the calorie goal. It appears that many patients do not get adequate nutritional support without the NST recommendations. Interestingly, there has been reports regarding underfeeding (80% of total energy requirement) which have emphasized the positive effects of ICU treatment compared with full feeding which is similar to total energy intake of the compliance group in our study [24,25].

The method of delivery of nutritional support is also important. Furthermore, enteral nutrition has been regarded as a preferred method of nutritional support because the intestine is regarded as an immune organ as well as a digestive organ. If the gut is not used for a long time, the mucosal barrier may break down, making it easy for gut bacteria to penetrate the blood stream [3,26]. In addition, parenteral nutrition is expensive and is also correlated with infection [3]. However, parenteral nutrition is still a commonly used method in Korea [27]. Therefore, the NST plays an important role in reducing the prevalence of parenteral nutrition. This has been observed in this current study, and is similar to results of other studies [10,27].

The compliance group had a better survival rate than the non-compliance group in the beyond 1 year-follow up after the NST consultation. After survival curves were adjusted by age, gender, weight and APACHE II score, the result was similar (hazard ratio: 2.21, 95% CI: 0.97-5.02; Figure 2). Of course, outcomes of treatment cannot be considered only by nutritional resources. However, it is valuable to have observed that there are definite differences in terms of nutritional strategies between the compliance and non-compliance groups. The compliance group had an increase in the supply of calories and amount of

protein and so had a greater accomplishment rate of the goals after a consultation with the NST. This might be a reason for the observed survival benefit. The attempt to meet the calorie target has been associated with improved outcomes in critically ill patients in a previous study [25].

This study had several limitations. Firstly, the data were collected retrospectively in this study. There were a lot of different characteristics between the 2 groups. After representative risk factors were adjusted before analysis, outcomes including death rate were still influenced by many factors, especially in critically ill patients. In addition, many consultations were requested in the first week following admission. Nutritional factors have a lower priority than medical treatment or resuscitative procedure to influence patient outcome in the ICU [25]. Therefore, cases of death within 2 weeks after consultation with the NST were excluded from analysis in this study.

Critically ill patients whose attending physician complied with the NST advice received an increased intake of calories and protein supply, and achieved a better target supply level than patients in the non-compliant group. In addition, the survival rate of the compliance group was higher than the non-compliance group beyond 1 year after the NST consultation. For this reason, compliance with the recommendations proposed by the NST by the attending physician is needed to increase the survival rate of critically ill patients. Further investigations are needed to confirm these results in the future.

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Author contributions

HJS and JYJ contributed to the conception and design of the research; HJY and ESO contributed to the acquisition and analysis of the data; HJY and HJS drafted the manuscript. JYJ contributed to analysis and interpretation of the data. All authors critically revised the manuscript, approved the final version of manuscript.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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Ethical Statement

This research did not involve any human or animal experiment.

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