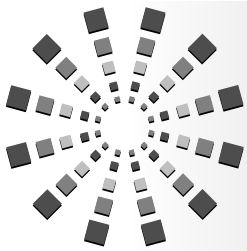

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The Effects of Nutrition Status of Patients With Digestive System Cancers on Prognosis of the Disease

KEY WORDS
Digestive system tumor
Follow-up study
Nutrition
Quality of life
Survival rate

To assess the association between nutrition status and prognosis of patients with digestive system cancer, epidemiological investigations were conducted in 2 periods to obtain information about the patients' nutrition status, survival time, and quality of life. Relative risks and 95% confidence intervals were estimated by logistic regression. Among the patients with esophagus, stomach, and colorectal cancers, nutritional indicators at time 1 did not affect relative risk for survival at time 2. At time 2, relations between quality of life and albumin, daily intake of calories, and daily intake of protein were statistically significant ($P < .05$). This study offers evidence that nutrition status shortly after operation does not affect 1-year survival rate and that nutritional status at 1 year is associated with quality of life.

The incidence of tumors of the digestive tract is high among Chinese residents. As the living standards of the people rose, dietary patterns were changed from high-carbohydrate, low-protein, and low-fat intake into high-fat and low–dietary fiber intake, which may contribute to the high incidence of colon cancer.[1] The prognosis for patients with stomach and esophagus cancers is poor, and the 5-year survival rates are about 30%. Of the many influencing factors on prognosis of the diseases, immune function is an important factor. It is generally thought that the nutrition status of the patients may have an impact on their immune functions and outcome of the cancer treatments.[2,3]

Many researchers have suggested that good nutrition in the patient with cancer may improve quality of life,[4–10] and the nutrition status of the patient after diagnosis is associated with cancer recurrence and survival rates.[2,11,12] However, the evidence linking nutrition status after cancer to survival is limited or unclear.[13] What have been confirmed are that adequate nutrition can minimize the adverse effects of the treatments, decrease treatment-related symptoms, and improve quality of life.[14–16] In 2004, we reported that the nutritional status of the patients with stomach cancer who underwent surgery can have an impact on their quality of life.[17] In 2005, we reported that chemotherapy-induced toxicity may be more severe in patients with preexisting malnutrition and that high-energy/protein diet can reduce the adverse effects of chemotherapy.[18] In this study, a follow-up survey was undertaken to assess the associations between 1-year survival rate for patients with stomach,

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Table 1 • Characteristics of the Patients With Esophagus, Stomach, and Colorectal Cancer at Time 1 and Time 2

	Age, Mean (SD), y		Education Level, %			Stage of Disease, %			
Time	Men	Women	Low	Middle	High	1	2	3	4
1	57.9 (11.5)	57.1 (11.7)	40.7	42.5	16.8	3.5	15.0	44.3	37.2
2	57.9 (10.9)	59.8 (12.5)	28.6	61.9	9.5	6.9	29.3	63.8	0.0

esophagus, and colon cancer and the nutrition status of the patients after operation and between quality of life and nutrition status of the patients 12 months after operation. Our results may provide information for estimating the effect of nutrition on prognosis of the disease.

■ Materials and Methods

Materials

The study participants were patients with esophagus, stomach, or colorectal cancers who were admitted and underwent operation in 4 provincial-level hospitals in Fuzhou, China, between January 2006 and June 2006. The eligible patients were those who resided in Fuzhou city and did not rely on parenteral nutrition support. There were 113 eligible participants for the study. A written consent was requested for each participant.

The interviewers were trained physicians and nurses in the hospitals. The study was approved by the relevant institutional review boards for human research in Fujian Province, China.

Methods

The first in-person interviews were performed for the patients on the 20th day postoperation (time 1). Their hemoglobin (HB; g/L), albumin (ALB; g/L), and body mass index (BMI; BMI = weight/height^2, kg/m^2) were measured. The patient's ALB is regarded as deficient when his/her ALB is less than 35 g/L. A low level of HB is defined as HB less than 120 g/L for men and less than 110 g/L for women. The food frequency survey method[19] was used to obtain information about the dietary intake for every patient during the last week. Daily intake of calories and protein for every patient in the last week was calculated according to the Food Composition Database.[20] On the basis of the reference values proposed by the Chinese Nutrition Society, the nutrition intake levels of the patients were evaluated. A low level of calorie intake is defined as daily calorie intake of less than 2,400 kcal for men and less than 2,100 kcal for women, and low level of protein intake is defined as daily protein intake of less than 70 g for men and less than 65 g for women. The patient's age, sex, and stage of disease were also recorded.

The second in-person interviews were performed in the patients' homes in the 12th month postoperation (time 2). For the patients who were alive in the second interview, their HB, ALB, and BMI were measured, and their dietary intake was obtained using the food frequency survey. A questionnaire proposed by the European Organization for Research and Treatment (EORTC QLQ-C30 V3.0) was used to measure the quality of life of the patient.[21] A high total score in this scale expresses good quality of life.

Unconditional logistic model was used to analyze the associations between 1-year survival rate and daily protein and calorie intake, HB, and BMI at time 1. The relative risks (RRs), adjusted for age, sex, and stage of disease, and 95% confidence intervals (95% CIs) for these nutritional factors were estimated from logistic model and were used to analyze the association between nutrition and survival rate. The effects of the nutritional factors on quality of life during the 12th month postoperation were estimated by means of multivariate regression model. The *t* test was used to compare differences of the means. Data were analyzed using SAS version 9.0 software (SAS Institute, Inc, Cary, NC). All *P* values presented were 2-tailed.

■ Results

In the first interview, the sample included 113 participants, with 79 (69.91%) men and 34 (30.09%) women. Of them, 23 were esophagus cancer patients, 51 were stomach cancer patients, and 39 were colorectal cancer patients. The mean ages; proportions of the patients with low, middle, and high level of education; and stage of disease (1, 2, 3, or 4) at time 1 are shown in Table 1.

At the time of the second interview, 55 patients were dead and 58 patients were still alive. Of them, 16 were esophagus cancer patients, 17 were stomach cancer patients, and 25 were

Table 2 • Means of Daily Intake of Calories and Protein During the Last Week for 113 Patients at Time 1

	Men (n = 79)		Women (n = 34)	
Nutrition	Reference Value	Mean (SD)	Reference Value	Mean (SD)
Calories, kcal	2,400	2,120.1 (1,192.57)[a]	2,100	1,910.9 (1,113.77)[a]
Protein, g	70	66.6 (40.23)	65	62.7 (38.92)

[a]The difference between mean daily intake of nutrition and reference value was statistically significant ($P < .05$).

Table 3 • Frequency Distribution of Body Mass Index (BMI) by Tumor Site at Time 1

Site	n	BMI <18 kg/m^2	BMI 18–25 kg/m^2	BMI >25 kg/m^2	*P*
Stomach and esophagus	74	14	60	0	<.001
Colorectal	39	0	27	12	

colorectal cancer patients. The mean ages; proportions of the patients with low, middle, and high level of education; and stage of disease (1, 2, 3, or 4) at time 2 are shown in Table 1.

Nutrition Status of the Patients

The means of daily intake of calories and protein during the last week at time 1 for 113 patients are shown in Table 2. For men and women, both calorie and protein intakes were lower than the reference values proposed by the Chinese Nutrition Society,[20] although the differences for protein intake were not statistically significant. Of 113 patients, 62 (43 men and 19 women) had daily calorie intake lower than reference value, 61 (45 men and 16 women) had daily protein intake lower than reference value, and 52 (37 men and 15 women) had both kinds of nutrition lower than reference values.

The mean (SD) levels of HB, ALB, and BMI of the sample at time 1 were 11.4 (18.12) g/L, 38.21 (5.30) g/L, and 21.04 (3.04) kg/m^2, respectively. Among the patients, 49.56% and 36.36% had low levels of HB and ALB, respectively. The frequency distribution of BMI in stomach and esophagus cancer patients and colorectal cancer patients is shown in Table 3. Among the patients, 12.39% had BMI less than 18 kg/m^2 (all of them were stomach and esophagus cancer patients), and 10.62% had BMI greater than 25 kg/m^2 (all of them were colorectal cancer patients).

The Relation Between Nutrition and 1-year Survival Rate

There were 55 patients who died within 1 year after operation and 58 patients who were alive at time 2. The 1-year survival rates of the diseases by 3 tumor sites and their 95% CIs are shown in Table 4. Compared with other sites, stomach cancer had the lowest 1-year survival rate ($P < .05$). The survival rate of esophagus cancer was higher than that of colorectal cancer, but the difference was not statistically significant ($P > .05$).

The association between nutrition and survival rate was analyzed by logistic model. Because a high level of BMI might be a risk factor for survival of the patients with colorectal cancer, whereas a low level of BMI might be a risk factor for survival of the patients with stomach or esophagus cancer, the 113 patients were grouped into 2 groups to fit the logistic model. Among the 74 patients with esophagus and stomach cancers, adjusted RR (95% CI) was 1.169 (0.408–3.348) for low level versus normal level of HB, 1.329 (0.528–3.344) for low level versus normal level of ALB, 1.357 (0.392–4.695) for low BMI (<18 kg/m^2) versus normal BMI, 1.039 (0.256–4.213) for low intake versus high intake of protein, and 1.774 (95% CI, 0.498–6.322) for low intake versus high intake of calories.

Among the 39 patients with colorectal cancer, adjusted RR (95% CI) was 1.143 (0.225–5.818) for low level versus normal level of HB, 0.889 (0.236–3.351) for low level versus normal level of ALB, 1.270 (0.083–19.384) for high BMI (>25 kg/m^2) versus normal BMI, 1.563 (0.191–12.820) for low intake versus high intake of protein, and 1.966 (0.213–18.129) for low intake versus high intake of calories.

Because all of the 95% CIs included 1 (Figure 1), we had the conclusion that HB, ALB, and BMI shortly after operation, as well as daily intake of calories and protein, do not have an impact on 1-year survival.

The Relation Between Nutrition and Quality of Life

Second visits were conducted for the 58 patients who were still alive 12 months after operation. Compared with those in time 1, mean levels of HB, ALB, daily calorie intake, and daily protein intake, but not BMI, at time 2 were significantly increased (Table 5).

The strengths of the relationships between the total score of EORTC QLQ-C30 scale and independent variables, including HB, ALB, BMI, daily calorie intake, and daily protein intake were determined by means of the multiple linear regression model. After age, sex, and stage of the disease were adjusted, ALB and daily intakes of calories and protein had an effect on quality of life, at a significant level of $\alpha = 0.05$ (Table 6). From the parameter estimates shown in Table 4, we could see that the patient with high daily intakes of calories and protein, as well as high level of ALB, had a good quality of life.

Discussion

The study reported in this article has sought to know whether the nutrition status of the patient with the digestive system

Table 4 • 1-Year Survival Rates of Tumors in 3 Sites and Their 95% Confidence Interval (95% CI)

Site	n	Deaths	1-Year Survival Rate	95% CI
Esophagus	23	7	0.6956	0.5076–0.8836
Stomach	51	34	0.3333	0.2039–0.4627
Colorectal	39	14	0.6410	0.4905–0.7915

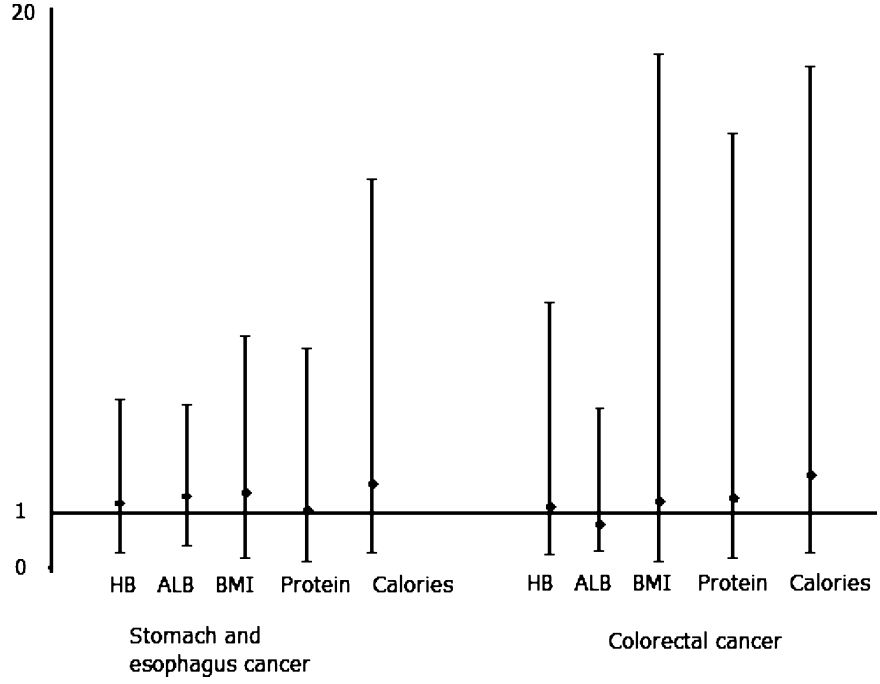

Figure 1 ■ Relative risks for hemoglobin (HB), albumin (ALB), body mass index (BMI), and protein and calorie intake.

tumor at the time of operation impacted survival and quality of life at 1 year postoperation. The HB, ALB, BMI, and daily intakes of calories and protein were selected to reflect the nutritional status of the patient. The results of our follow-up survey showed that there were no associations between the nutrition status of the patients after operation and 1-year survival rate. However, daily intakes of calories and protein at 1 year postoperation might have an impact on quality of life.

For many patients with tumors of the gastrointestinal tract, some adverse effects of cancer treatments and surgery make it difficult to eat well. Malnutrition can result, causing the patient to be weak and tired. Recent studies have suggested that a high-energy/protein diet could reduce the adverse effects of chemotherapy and enhance tolerance to chemotherapy. Thus, patients getting enough calories and protein in the diet might be able to handle higher doses of treatments and have a better prognosis.[22–26] Our previous work showed that poor nutrition status before chemotherapy was an independent risk factor of severe adverse effects of therapy and impacted the recovery of physical performance status after therapy.[19] However, results of the studies on the association between nutrition and survival rate are inconsistent.[13,27] Although some results showed that nutritional status of the patients affected survival rates,[28–32] few data were available to directly support this association.[13] Some research showed that nutritional status did not seem to influence immediate outcomes after operation for cancer patients, but it is a predictor of survival in the long-term.[33] In our study, HB, ALB, and BMI, the variables reflecting the patient's nutrition status, did not affect 1-year survival rate for the patients with esophagus, stomach, and colon cancers, although there was a weak (nonsignificant) association of BMI at time 1 with an increased risk of death among colon cancer patients 1 year later at time 2.

Many researchers have suggested that the nutrition status of a cancer patient has an impact on quality of life.[14,34,35] Some researchers suggested that although cancer stage was the major determinant of patients' quality of life, nutritional deterioration combined with deficiencies in nutritional intake might be more important factors for the quality of life of the cancer patients.[14] The EORTC QLQ-C30 V3.0 measures not only the physical status of the patients but also their

Table 5 • Mean (SD) Levels of HB, ALB, and Calorie and Protein Intake Measured in 2 Periods for 58 Patients

	Time 1	Time 2	P^a
Calorie intake, kcal	2,117.41 (1,162.68)	3,489.47 (990.91)	<.01
Protein intake, g	73.69 (38.50)	122.04 (47.50)	<.01
ALB, g/L	40.20 (4.10)	44.53 (3.05)	<.01
HB, g/L	118.09 (17.21)	135.90 (17.74)	<.01
BMI, kg/m^2	20.74 (3.37)	21.78 (3.60)	.12

Abbreviations: ALB, albumin; BMI, body mass index; HB, hemoglobin.
[a]Two-tailed *P* value obtained by *t* test for 2 samples.

Table 6 • Results of Regression Model Analyzing the Relations Between Nutrition Status and Quality of Life at Time 2

	Parameter Estimate	Standard Error of Estimate	*P*
Calorie	0.128	0.055	.037
Protein	0.481	0.172	.016
ALB	1.948	0.693	.016
HB	0.023	0.016	.194
BMI	0.229	0.116	.073

Abbreviations: ALB, albumin; BMI, body mass index; HB, hemoglobin.

psychological and social status. Nutrient depletion adversely affects the patient's enjoyableness and social interactions with family and friends, which can further depress appetite and increase the risk of having depression.[5] Low HB levels were associated with fatigue, poor overall quality of life, and decreased ability to work. Interventions that reverse fatigue and other anemia-related symptoms should have a positive effect on quality of life.[6] Our result was consistent with theirs. In our research conducted in 2005, results showed that the level of HB, daily calorie intake and protein intake were associated with the physical performance status of the cancer patients.[18] In general, a patient who has a good physical performance status will have a good quality of life, so the associations between nutrition status and quality of life may be explained, in some degree, by the physical performance status of the patient.

There were some limitations in our study. The small sample size makes the RRs for HB, BMI, calorie intake, and protein intake have wide 95% CIs. Other variables reflecting the nutritional status of the participants, such as serum pre-ALB and serum transferrin, were not measured. Moreover, we did not follow up the patients' nutritional variables in a period of 2 to 11 months after operation, so the association between nutrition and survival may be confounded by changes in nutrition status during that period. By comparing levels of HB and ALB, as well as the daily intakes of calories and protein, on the 20th day postoperation with those in the 12th month postoperation for the patients whose survival time were more than 1 year, we have seen that the levels of these variables have increased very much, which suggests that the patients' trying their best to improve their nutrition status after being discharged from hospital may be of benefit to prolonging their survival time. Further studies, including the field trial of nutrition intervention in the communities, should be conducted to assess the association between nutrition and prognosis of tumors objectively.

In summary, our data, obtained by epidemiological survey combined with follow-up on the patients, show that for the patients with esophagus, stomach, and colon cancers, nutrition status in the short-term after operations does not affect 1-year survival rate, but nutrition status 1 year after being discharged from hospitals may be associated with their quality of life.

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