Applied nutritional investigation

Prevalence and risk factors of malnutrition among cancer patients according to tumor location and stage in the National Cancer Center in Korea

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Abstract

Objective: Although malnutrition is common in cancer patients in Korea, little attention is paid to its risks and consequences. This study was carried out to investigate the prevalence and risk factors of malnutrition in hospitalized cancer patients according to tumor location and stage.

Methods: Of 14,972 cancer patients admitted to the National Cancer Center, screening examinations were carried out for 12,112 patients and nutritional status was assessed in 8,895 patients. Information on age, sex, length of hospital stay, and tumor location and stage were collected from the electronic medical records system. The nutritional status of each subject was assessed using body mass index, serum albumin, total lymphocyte count, and diet and classified into three groups: high risk, moderate risk, and low risk of malnutrition.

Results: About 61\% of hospitalized patients were malnourished and the prevalence of malnutrition was higher in male patients with longer hospital stays (60.2\%, \(P = 0.0101\)) and readmitted patients (66.6\%, \(P < 0.0001\)). Patients with liver and lung cancer (86.6\% and 60.5\%, respectively) and patients with advanced cancer stage (60.5\%, III or IV) had a higher prevalence of malnutrition than other patients (\(P < 0.0001\)). Logistic regression analysis showed that patients with advanced cancer stage and longer hospital stay and readmitted patients were at a higher risk for malnutrition.

Conclusion: The prevalence of malnutrition in hospitalized cancer patients was high and varied across tumor location and stage. Early identification of malnutrition status is required for proper nutritional intervention during hospitalization. © 2010 Elsevier Inc. All rights reserved.

Keywords: Cancer; Length of hospital stay; Tumor location; Malnutrition; Stage of cancer

Introduction

The prevalence of malnutrition in cancer patients ranges from 40\% to 80\%, which is higher than in the general patient population due not only to the illness but also to the treatment involved [1]. Malnutrition is associated with increased morbidity, mortality, length of hospital stay (LOS), and medical cost [2–5]. In addition, malnutrition makes treatment less effective and harder for patients to endure chemotherapy or radiation therapy, resulting in longer treatment periods and increased susceptibility to infection [6–9]. Therefore, early detection and appropriate nutritional support are necessary for better care.

Capra et al. [10] reported that weight loss and malnutrition status were different according to the tumor location: from 9\% for breast cancer to 80\% for esophageal cancer. The prevalence of malnutrition is highest in gastrointestinal cancer. In Korea, the leading cause of death was cancer for the past 10 y [11]. The most commonly diagnosed cancers in Koreans are gastric, lung, liver, colorectal, cervical, and breast [12]. The high prevalence of gastrointestinal cancer could mean a high prevalence of malnutrition in these patients. However,
malnutrition in the patients is seldom recognized by clinical professionals because no large-scale studies of malnutrition prevalence and its related risk factors have been performed in Korea. Most studies have focused only on the changes of nutritional status after hospital admission and dietary intake during chemotherapy or radiation therapy [13,14] or the nutritional status of patients with cancer of specific sites [15–17], but not overall prevalence and risk factors of malnutrition according to the cancer stage and its location. This study was undertaken to determine the prevalence of malnutrition in hospitalized cancer patients in Korea and to examine the risk factors of malnutrition in the following highly prevalent tumor sites: stomach, liver, lung, colorectum, uterus, and breast.

Materials and methods

Subjects

The subjects consisted of 14,972 cancer patients, admitted to the National Cancer Center of Korea from January 1 to December 31, 2004, in whom screening examinations were carried out for 12,112 patients and nutritional status was assessed in 8,895 patients, who comprise the study population.

Data collection

Data on patient profile, disease, and nutritional status were collected from the electronic medical records system and charts. The diet type provided during hospitalization was collected from the clinical nutrition department’s nutrition screening chart. Each patient’s height (centimeters) and weight (kilograms) were gathered from the nurse’s information sheet that was recorded at each admission interview to calculate for the body mass index (BMI; kilograms per meter squared). The data for gender, age, LOS, tumor location and stage, serum albumin (S-alb), and total lymphocyte count (TLC) were obtained from the electronic medical records system. The tumor location was classified by the Korean Standard Classification of Diseases [18], and severity of cancer was rated according to the sixth edition of the American Joint Committee on Cancer Cancer Staging Manual [19].

The nutritional status was assessed using data collected through the Ordering Communication System of the National Cancer Center within 48 h of admission. In this study, we defined nutritional status on the basis of BMI, S-alb, TLC, and type of diet [6–8,20–24]. Patients who had a BMI <18.5 kg/m², S-alb <2.8 g/dL, TLC <1,200 cells/mm³, or nothing per oral intake requiring enteral or parenteral nutrition were classified as having “high risk of malnutrition.” Patients who had a BMI from 18.5 to 20 kg/m², S-alb from 2.8 to 3.3

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>P</th>
</tr>
</thead>
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<td><strong>Age (y)</strong></td>
<td></td>
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<td>1093 (27.7)</td>
<td>1747 (19.6)</td>
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<td>&lt;65</td>
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<td>2085 (52.8)</td>
<td>5022 (56.5)</td>
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<tr>
<td>≥65</td>
<td>1356 (27.4)</td>
<td>770 (19.5)</td>
<td>2126 (23.9)</td>
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<tr>
<td><strong>Body mass index (kg/m²)</strong></td>
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<td></td>
<td>0.0103</td>
</tr>
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<td>&lt;18.5</td>
<td>1165 (23.5)</td>
<td>830 (21.0)</td>
<td>1995 (22.4)</td>
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<tr>
<td>&lt;20</td>
<td>419 (8.5)</td>
<td>321 (8.1)</td>
<td>740 (8.3)</td>
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<tr>
<td>≥20</td>
<td>3363 (68.0)</td>
<td>2797 (70.9)</td>
<td>6160 (69.3)</td>
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<td><strong>Length of hospital stay (d)</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>2398 (60.7)</td>
<td>5479 (61.6)</td>
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<td>1550 (39.3)</td>
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<td></td>
<td>&lt;0.0001</td>
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<tr>
<td>Once</td>
<td>1622 (32.8)</td>
<td>1472 (37.3)</td>
<td>3094 (34.8)</td>
<td></td>
</tr>
<tr>
<td>More than once</td>
<td>3325 (67.2)</td>
<td>2476 (62.7)</td>
<td>5801 (65.2)</td>
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<tr>
<td><strong>Tumor location</strong></td>
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<td>1392 (28.2)</td>
<td>677 (17.1)</td>
<td>2069 (23.3)</td>
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<td>Liver</td>
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<td>333 (8.4)</td>
<td>1497 (16.8)</td>
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<tr>
<td>Lung</td>
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<td>426 (10.8)</td>
<td>1747 (19.6)</td>
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<td>Colorectum</td>
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<td>713 (18.1)</td>
<td>1778 (20.0)</td>
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<td>Uterus</td>
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<td>927 (10.4)</td>
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<td>1096 (19.5)</td>
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<tr>
<td>II</td>
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<td>492 (19.5)</td>
<td>913 (16.2)</td>
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<tr>
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<td>882 (28.5)</td>
<td>648 (25.6)</td>
<td>1530 (27.2)</td>
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<td>IV</td>
<td>1315 (42.4)</td>
<td>772 (30.6)</td>
<td>2087 (37.1)</td>
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</tr>
</tbody>
</table>

* Values are presented as numbers of patients (percentages).

1 P value for chi-square tests of patients with gender.

1 P > 0.05.
g/dL, TLC from 1200 to 1500 cells/mm³ or diet tolerated were classified as having “moderate risk of malnutrition.” The other subjects were classified as “low risk of malnutrition.” A “malnourished patient” was defined as having high or moderate risk of malnutrition and a “well-nourished patient” was defined as having low risk of malnutrition.

Statistical analysis

All statistical analyses were conducted using SAS 9.1 (SAS Institute, Cary, NC, USA). General characteristics were summarized using descriptive statistics. Independence test for categorical variables was done by chi-square test, and logistic regression analysis was used to identify risk factors associated with malnutrition. The 95% confidence interval was calculated for each odds ratio. Statistical significance was set at \( P < 0.05 \).

Results

Table 1 presents the patient profile by gender. The mean age of the subjects was 55.3 y, and the average LOS was 9.7 d. The mean LOS was longer in women (10.1 d) than in men (9.5 d, \( P < 0.0001 \)). The mean BMI of women (23.2 kg/m²) was higher than that of men (22.5 kg/m², \( P < 0.0001 \)). The percentage of patients with gastric cancer was 23.3%, colorectal cancer 20%, lung cancer 19.6%, liver cancer 16.8%, cervical cancer 10.4%, and breast cancer 9.9%. About 64% of patients had an advanced cancer stage (III or IV) and 65.2% of patients had been hospitalized more than once.

Table 2 presents the prevalence of malnutrition. A total of 5456 patients (61.3%) were found to be malnourished, with 36.5% (\( n = 3248 \)) being at high risk of malnutrition and 24.8% (\( n = 2208 \)) being at moderate risk of malnutrition (data not shown). The prevalence of malnutrition in older female patients was higher than in younger patients (\( P < 0.0001 \)). The prevalence of malnutrition in readmitted patients was higher than that of patients on their first admission for men and women (\( P < 0.0001 \)). The percentage of patients with a high risk of malnutrition was higher in those with liver, lung, and breast cancer compared with patients with other cancer types (\( P < 0.0001 \)). A proportion of the high-risk population increased as the cancer stage got advanced (\( P < 0.0001 \)). The male population who had a high risk of malnutrition stayed longer in the hospital compared with their counterparts (\( P = 0.0101 \)), but there was no difference among women.

Table 3 presents the relation between nutritional status and tumor location. For patients with stomach cancer, longer LOS (\( P = 0.0017 \)), more than one hospitalization (\( P < 0.0001 \)), and advanced stage (\( P < 0.0001 \)) were positively associated with malnutrition. For those with liver, lung, and breast cancer, more than one hospitalization (\( P < 0.0001 \)) and advanced stage (\( P < 0.0001 \)) were significant indicators of malnutrition. Longer LOS (\( P = 0.0388 \))
and more than one hospitalization ($P = 0.0156$) were significant for colorectal cancer, and more than one hospitalization ($P < 0.0001$) was significant for uterine cancer. The results showed that cancer stage, LOS, and frequency of hospitalization could be significant risk factors for malnutrition in cancer patients. Therefore, patients with advanced cancer, longer LOS, and readmission have a higher risk of malnutrition.

**Discussion**

Malnutrition of cancer patients is an important but under-recognized problem in Korea’s health care system. About two-thirds (61.3%) of hospitalized cancer patients were classified as malnourished, which is higher compared with countries, such as the United States and the Netherlands, with 30% to 50% for general patient populations [25–27], but similar to countries with 30% to 80% [28–30]. Because malnutrition can lead to an unfavorable prognosis and outcome, cancer patients should be maintained on a good nutritional status to improve the effects of anticancer therapy, sustain the ability to confront stress, and minimize the side effects of treatment. In this respect, nutritional screening for cancer patients should be established as the most important step in preventing malnutrition to develop in admitted cancer patients.

Nutritional status is generally assessed with anthropometric measurements such as BMI and unintended weight loss, laboratory tests such as S-alb and TLC, and dietary information [25,31–33]. There is no gold standard for determining a patient’s nutritional status. Because various tools such as the Subjective Global Assessment, Malnutrition Universal Screening Tool, and Nutrition Risk Screening (NRS2002) have been used for screening [34,35], it is difficult to evaluate nutritional status and to compare results among studies. In this study, nutritional status was classified into high risk, moderate risk, and low risk of malnutrition according to S-alb, BMI, TLC, and dietary prescription, which were readily available from the medical charts. However, more accurate assessment of nutritional status with diet history and recent weight changes is required because S-alb, BMI, and TLC can be influenced by other disease-related factors and diet.

The prevalence of malnutrition depends on the tumor location [36–38]. In previous studies, it was found to be high for patients with cancer in the digestive organs [10], but low for those with lymphomas and breast cancer [39–41]. In this study, malnutrition was more prevalent for the patients with liver and stomach cancer than with other cancers. It was found that 86% of patients with liver cancer were malnourished (Table 2, data not shown) possibly because liver cirrhosis and advanced cancer stage (III or IV) can have a negative impact on the nutritional status of cancer patients. One puzzling feature in this study is that malnutrition was less prevalent for patients with stomach cancer than for patients with liver or lung cancer, even though stomach cancer is a digestive tract cancer. Possible explanations could be the smaller proportion of patients with stage III or IV stomach cancer (46.5%) compared with other cancers (liver cancer 53.3%, colorectal cancer 61.9%, and
lung cancer 81.3%). Even though prevalence of malnutrition was lower in patients with breast and colon cancer than in those with other cancers, malnutrition risks should still be addressed because half of the patients with breast or colon cancer were malnourished and the incidences of breast and colon cancers are rapidly increasing in Korea [18].

Previous reports have shown that malnutrition results in increased LOS and frequency of hospitalization [3,5,31,42], and that prevalence of malnutrition differs with cancer stage [36,38]. Our results confirm that LOS, frequency of hospitalization, and cancer stage were related to the risk of malnutrition in cancer patients (Tables 2 and 3). As shown in Table 3, the risk for malnutrition increased in patients with longer LOS, in readmitted patients, and those with a more severe cancer stage. The risk factors for malnutrition differed with the cancer site. For example, the risk of malnutrition in patients with gastric cancer was higher in female patients ($P < 0.0001$), in patients with a hospital stay $>10$ d ($P = 0.0017$), in readmitted patients ($P < 0.0001$), and according to cancer stage ($P < 0.0001$). Likewise, the risk of malnutrition in patients with colorectal cancer was higher in patients with a hospital stay $>10$ d ($P = 0.0388$) and in readmitted patients ($P = 0.0156$). These results imply that nutritional intervention programs should be individualized on the basis of patient’s characteristics such as gender, LOS, hospitalization frequency, and cancer stage to maintain adequate nutritional status.

This cross-sectional study observing nutritional status during hospitalization has several limitations. First, the metastasis of cancer, treatment method, duration of disease, and presence of other chronic diseases, which can influence the nutritional status and LOS [39], were not included in the risk analysis for malnutrition. Second, information on unwanted weight loss, a major component of early screening indices of nutritional status and an influencing factor on the effectiveness of clinical nutrition treatment [17,41,43] was not available. Third, nutritional biomarkers and the dietary intakes including nutrients and supplements that can provide immediate information for nutritional status were not gathered. In addition, validity of the criteria used in this study to determine malnutrition needed to be established.

At present, the medical care system in Korea does not include nutritional risk assessment and treatment, and nutritional care of patients is not considered a part of clinical treatment. However, a high prevalence of malnutrition would draw the attention of health professionals to the need for correcting this problem. The assessment of a patient’s nutritional status after admission should be recognized as the first step in the treatment of malnutrition [19,24,44–46]. Thus, early nutritional assessment followed by appropriate, timely, and cost-effective nutritional intervention must be accepted as an essential procedure in the care of hospitalized cancer patients [47].

This study provides a reasonable starting point for further research on the malnutrition of hospitalized cancer patients. The definitions of malnutrition and criteria for nutritional risk must be standardized and validated to establish evidence-based nutritional practice. Research on the benefits of nutritional intervention for the “malnourished” patients through prospective follow-up studies is also needed.

**Conclusion**

Although cancer is the leading cause of death in Korea, the nutritional problems of cancer patients are not systematically managed. More than half of the hospitalized cancer patients were malnourished and the prevalence of malnutrition depended on tumor location, cancer stage, and hospital LOS.

**Acknowledgments**

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**References**


