Prediction of Prognosis in Geriatric Palliative Care Patients with Diagnosed Malnutrition: A Comparison of Nutritional Assessment Parameters

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Objective: Malnutrition is very commonly encountered in palliative care centers (PCC), especially in geriatric patients. It is known that development of malnutrition increases morbidity and mortality. In this study, we aimed to investigate the effectiveness of commonly used nutritional assessment parameters in predicting prognosis in geriatric patients diagnosed in PCC with malnutrition.

Methods: Our study included 1451 patients aged ≥65 years, who were diagnosed with malnutrition in PCC between 2016–2020 and did not yet start receiving nutritional support. Demographic data, comorbidities, The Nutritional Risk Screening 2002 (NRS-2002), body mass index (BMI), albumin, prealbumin and C-reactive protein (CRP) values of the patients were recorded. Prognostic course was evaluated by dividing the patients into 3 groups, namely mortal patients during PCC follow-up, patients transferred from PCC to Intensive Care (ICU) and patients discharged to home from PCC.

Results: Logistic Regression analysis showed that low albumin levels affected transfer to ICU (P<0.05). Elevated NRS-2002 and low albumin and prealbumin levels were found to be factors affecting mortality (P<0.05). Areas under the ROC Curve were calculated to attain patients’ differential diagnosis. The area under the ROC Curve of low albumin in patients transferred to ICU was found to be significant (P<0.05). In the differential diagnosis of patients with mortal course, the area under the ROC Curve of low albumin and prealbumin and high CRP was found to be significant (P<0.05).

Conclusion: We found that BMI had no prognostic predictive effects in geriatric PCC patients with malnutrition. We concluded that NRS-2002 and high CRP and low albumin and prealbumin can be used to predict mortality. In addition, we found that low albumin indicates a poor prognosis and predicts patients to be transferred to ICU.

Keywords: NRS-2002, malnutrition, albumin, prealbumin, CRP, mortality

Introduction

With improving life conditions, developing technology and new treatment methods, human lifespan is getting longer. The increase in the geriatric population also leads to increased chronic diseases and related symptoms. Palliative care centers (PCC) are healthcare units which aim to increase patient quality of life by remedying these symptoms. Adequate and balanced nutrition is known to increase the quality of life. Malnutrition may develop in case of inadequate or unbalanced nutrition. Inadequate and unbalanced nutrition may lead to malnutrition. Malnutrition is more common in geriatric patients due to reasons such as cognitive retardation, comorbid diseases, polypharmacy, depression, and anorexia. The catabolic process caused by malnutrition can further increase morbidity and mortality. All these reasons indicate a necessity to conduct a nutritional risk assessment in hospitalized geriatric patients. These reasons demonstrate the importance of regular nutritional risk assessment, follow-up, and early treatment of malnutrition in geriatric patients treated in PCC.

The diagnosis of malnutrition is established using The Nutritional Risk Screening 2002 (NRS-2002), body mass index (BMI) measurements and biochemical blood tests such as serum albumin, prealbumin and C-reactive protein (CRP).
Many studies emphasized that NRS-2002 is more effective in determining nutrition. The use of parameters such as BMI, albumin, prealbumin and CRP alone is controversial. Studies on current nutritional assessment parameters to predict prognosis in geriatric patients are not sufficient.

For this reason, in our study, we aimed to investigate the effectiveness of NRS-2002, BMI, albumin, prealbumin and CRP, which are commonly used nutritional assessment tests, in predicting prognosis in geriatric patients diagnosed with malnutrition in PCC. We believe that the use of parameters that can predict prognosis in the follow-up and treatment of geriatric patients with malnutrition will contribute to the reduction of morbidity and mortality.

**Material and Methods**

**Study Design**

We performed a retrospective study to compare the abilities of the NRS-2002, BMI, albumin, prealbumin and CRP level to predict the prognosis of patients diagnosed with malnutrition admitted to the Palliative Care department of Haydarpaşa Numune Training and Research Hospital (HNTRH), Istanbul, Turkey, between January 2016 and December 2020. This study was approved by the Ethics Committee of HNTRH (no: 59, dated: 21.03.2022). With the authorization granted by the WMA (World Medical Association) Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects, in the local legislation of our country, there is no obligation to submit an informed consent sample in scientific studies based on retrospective data review applied to ethics committees. Since it is not practically possible in our country to reach the patients themselves and obtain informed consent to use the medical data of patients in scientific research in studies based on retrospective data scans, these data can be used in scientific research with the decision of the local ethics committee and as anonymous information in accordance with our national legislation. In the application forms, an original signed commitment is obtained from the researchers indicating that they will use the medical information of the patients only for scientific research purposes and will not share it with others, and that they will keep the privacy and confidentiality of these data for five years in accordance with the “Good Clinical Practices Guidelines” and the “Personal Data Protection Law”.

Geriatric patients aged ≥65 years, diagnosed with malnutrition in our hospital’s PCC, were included in our study on the condition that nutritional support was not initiated when malnutrition was diagnosed. Patients aged <65 years and with a clinical history of cancer-related cachexia were excluded from the study.

**Data Collection**

Demographic data of the patients, age, gender, diagnosis of PCC hospitalization, comorbidities, height, weight and NRS-2002 values of the day of malnutrition diagnosis were recorded. During follow-up, BMI was calculated for each patient diagnosed with malnutrition. Albumin, prealbumin and CRP parameters were checked. Consequently, appropriate nutritional support was started. Additional patient information and desired laboratory results were acquired from HNTRH’s hospital information system. Patients were divided into 3 groups as those who were mortal during PCC follow-up, those who were transferred from PCC to Intensive Care (ICU) and those who were discharged to home from PCC.

**Nutritional Assessment Parameters**

1. NRS-2002 is a widely used, reliable and current method developed by The European Society for Clinical Nutrition and Metabolism, which is non-invasive and easy to implement, and is based only on evidence in terms of evaluating nutrition. In our study, the diagnosis of malnutrition was established with an NRS-2002 value of ≥3. Patients with a score of <3 were considered as patients with normal nutrition.
2. BMI is a universal method used to assess nutritional status. BMI value groups are as follows: <18.5 kg/m² are underweight, 18.5–24.9 kg/m² are normal weight, 25–29.9 kg/m² are overweight, 30.0–34.9 kg/m² are in obesity class I, 35.0–39.9 kg are in obesity class II, and ≥40 kg/m² are in obesity class III.
3. Albumin is a protein which is abundant in plasma, can be easily measured, and is widely used to evaluate nutritional status. Patients with an albumin value of ≥3.5 g/dL are classified as normal, 3.0–3.49 g/dL as mild, 2.5–2.9 g/dL as moderate, and <2.5 g/dL as severe.

4. Prealbumin is an important protein which is synthesized in the liver and carries thyroid hormones. It is used as a nutritional marker, especially during refeeding in the older patients. Prealbumin values of >20 mg/dL are classified as normal, 20–12 mg/dL as low, and ≤11 mg/dL as very low.

5. CRP: It can be said that inflammatory markers are important in nutritional assessment and in predicting mortality. The value range of 0–10 mg/L is classified as normal, the value range of 11–50 mg/L is classified as high, and values >50 mg/L are classified as very high.

Statistical Analyses
In this study, statistical analyses were made using the NCSS (Number Cruncher Statistical System) 2007 Statistical Software (Utah, USA) package program. In the evaluation of the data, besides descriptive statistical methods (mean, standard deviation, median, interquartile range), the distribution of variables was examined using the Shapiro–Wilks Normality test. One-way analysis of variance was used for intergroup comparisons of normally distributed variables, and Tukey multiple comparison test was used for subgroup comparisons. The Kruskal Wallis test was used for the intergroup comparisons of the variables without normal distribution, Dunn’s multiple comparison test was used for subgroup comparisons, and the chi-square test was used for the comparisons of qualitative data. Logistic Regression analysis was performed to separate the factors affecting ICU transfer and mortality. For the differential diagnosis of transfer to ICU and mortality, the areas under the ROC Curve were calculated and sensitivity, specificity, positive predictive value, negative predictive value and LR (+) values and cut-off values of the variables were determined. The results were evaluated at the significance level of p<0.05.

Results
Patient Characteristics
A total of 2005 patients diagnosed with malnutrition were admitted to Palliative Care Unit in our hospital from 2016 to 2020. Of those patients, 1451 were enrolled in our study. A flowchart of the reasons for exclusion is presented in Figure 1. The characteristics of the included cohort are summarized in Tables 1 and 2.

Significant differences were observed between the mean NRS-2002 (p=0.0001), albumin (p=0.0001), prealbumin (p=0.0001) and CRP (p=0.0001) in the discharge, ICU, and Mortal groups (Table 1). In the multiple comparison test, the NRS-2002 averages of the Mortal group were found to be statistically significantly higher than those of the Discharged and ICU groups (p=0.0001, p=0.001). No statistically significant difference was observed between the NRS-2002 mean scores of the discharged and ICU groups (p=0.650) (Table 3).

The albumin averages of the discharged group were found to be statistically significantly higher than those of the ICU and Mortal groups (p=0.0001), and no statistically significant difference was observed between the albumin averages of the ICU and Mortal groups (p=0.213) (Table 3). The prealbumin averages of the discharged group were found to be statistically significantly higher than those of the ICU and Mortal groups (p=0.0001), and no statistically significant difference was observed between prealbumin averages of the ICU and Mortal groups (p=0.059) (Table 3).

The CRP values of the discharged group were found to be statistically significantly higher than those of the ICU and Mortal groups (p=0.0001), and no statistically significant difference was observed between the CRP values of the ICU and Mortal groups (p=0.650). Logistic Regression analysis was performed to separate the factors affecting ICU transfer and mortality. The areas under the ROC Curve were calculated and sensitivity, specificity, positive predictive value, negative predictive value and LR (+) values and cut-off values of the variables were determined. The results were evaluated at the significance level of p<0.05.
The averages of the discharged group were found to be statistically significantly lower than those of the ICU and Mortal groups (p=0.0001), and no statistically significant difference was observed between the CRP averages of the ICU and Mortal groups (p=0.116) (Table 3).
Logistic Regression Analysis

Logistic Regression analysis was performed with gender, hypertension, NRS-2002, albumin, prealbumin and CRP variables to determine the factors affecting mortality and transfer to ICU (Table 4). It was observed that low albumin (0.001) affected transfer to ICU. High NRS-2002 (p=0.003) and low albumin (p=0.001) and prealbumin (p=0.019) were found to be factors affecting mortality (Table 4).

ROC Analysis

The areas under the ROC Curve of NRS, albumin, prealbumin and CRP variables were calculated in the differential diagnoses of patients who were transferred to ICU. The area of albumin under the ROC Curve was found as 0.703 (0.664–0.740). The areas under the ROC curve for NRS (0.534), prealbumin (0.645) and CPR (0.653) were below 0.700. For the ≤2.44 Predictive value of the albumin variable, Sensitivity was found as 54.62, Specificity 74.28, Positive Predictive Value 31.5, Negative Prediction value 92.7, and LR (+) value 2.12.

The areas under the ROC Curve of NRS, albumin, prealbumin and CRP variables were calculated in the differential diagnosis of mortal patients. The area under the ROC Curve of the albumin variable was found as 0.744 (0.709–0.777), the area under the ROC Curve of the prealbumin variable 0.743 (0.708–0.776), and the area under the ROC Curve of the CRP variable, 0.706 (0.669–0.740) (Figure 2). The area under the ROC Curve of the NRS variable is below 0.700 (0.626).

For the ≤2.56 Predictive value of the albumin variable, Sensitivity was found as 68.50, Specificity 67.03, Positive Predictive Value 36.0, Negative Prediction value 88.7, and LR (+) value 2.08. For Prealbumin variable ≤8 Predictive value, Sensitivity was found as 59.39, Specificity 74.70, Positive Prediction 38.2, Negative Prediction 87.5, and LR (+) 2.35. For CRP variable >5.7 Predictive value, Sensitivity was found as 72.89, Specificity 59.01, Positive Prediction 32.8, Negative Prediction 88.8 and LR (+) 1.98.

Table 3 Multiple Comparison Test

<table>
<thead>
<tr>
<th>Multiple Comparison Test</th>
<th>Tukey</th>
<th>Dunn's</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>NRS-2002</td>
<td>Albumin</td>
</tr>
<tr>
<td>Discharge / ICU</td>
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<td>0.0001</td>
</tr>
<tr>
<td>Discharge / Mortal</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>ICU / Mortal</td>
<td>0.001</td>
<td>0.213</td>
</tr>
</tbody>
</table>


Table 4 Multivariate Logistic Regression Analyses of Patients Transferred to ICU, and Mortal Patients

<table>
<thead>
<tr>
<th></th>
<th>Discharge / ICU</th>
<th>Discharge / Mortal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>OR % 95 CI</td>
</tr>
<tr>
<td>Gender</td>
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<td>0.58–1.87</td>
</tr>
<tr>
<td>Hypertension</td>
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<td>0.31–1.09</td>
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<tr>
<td>NRS-2002</td>
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</tr>
<tr>
<td>Albumin</td>
<td>0.27</td>
<td>0.13–0.58</td>
</tr>
<tr>
<td>Prealbumin</td>
<td>0.99</td>
<td>0.92–1.08</td>
</tr>
<tr>
<td>CRP</td>
<td>1.03</td>
<td>0.98–1.08</td>
</tr>
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Abbreviations: ICU, Intensive Care; OR, Odds Ratio; CI, Confidence Interval; NRS-2002, The Nutritional Risk Screening 2002; CRP, C-Reactive Protein.
Discussion

Malnutrition is very commonly encountered in PCC, especially in geriatric patients. The development of malnutrition may lead to treatment failure, poor prognosis, and increased mortality.\textsuperscript{15} For this reason, patients should be screened for nutritional risk at regular intervals and appropriate nutritional support should be provided to requiring patients. Studies on current nutritional assessment parameters to predict prognosis in geriatric patients are not sufficient. Therefore, we aimed to investigate the efficiency of commonly used nutritional assessment parameters in predicting prognosis in this study. We believe that conducting our study in a single center, regular follow-up, and system logging of the patients by the same team will contribute positively to the purpose of our study.

In our study, we investigated the effectiveness of NRS-2002, BMI, albumin, prealbumin and CRP, which are commonly used nutritional assessment tests, in predicting prognosis in 1451 geriatric patients diagnosed with malnutrition in PCC. Our results showed that; BMI has no prognostic predictive effect, high NRS-2002 and CRP and low albumin and prealbumin levels can be used to predict mortality, and low albumin indicates poor prognosis and can predict patients who will be transferred to the ICU.

There are several studies reporting NRS-2002 as an independent predictor of malnutrition-related mortality and length of hospital stay.\textsuperscript{16} In a study conducted in ICU, it was stated that mortality increased by 2.1 times if NRS-2002 ≥3.\textsuperscript{17} Again, in a retrospective study conducted on 5698 patients, it was reported that if NRS-2002 is ≥3, then mortality is doubled, and that NRS-2002 is a good mortality indicator for 3–6 months and 1 year.\textsuperscript{15} It was shown that NRS-2002 is associated with high mortality in hospitalized patients,\textsuperscript{18} and even by itself it is still a mortality indicator (17 olacak). It was also shown that NRS-2002 is an independent predictor of mortality in patients aged ≥65 years,\textsuperscript{19} is a strong and independent factor in demonstrating early and late mortality,\textsuperscript{15,20} and is a good predictor to demonstrate 2-year mortality.\textsuperscript{16} In our study, we found that NRS-2002 averages were higher in the Mortal group than in the Discharge and ICU groups, which is in line with the literature (p=0.0001, p=0.001) (Table 3). In addition, we supported the fact that the height of NRS-2002 is a risk factor for mortality with our logistic regression analysis (Table 4).

In our study, BMI did not predict the prognosis in geriatric patients with malnutrition.\textsuperscript{21} A retrospective study, which investigates the effects of malnutrition markers in geriatric cancer patients, reports many studies that did not find a relationship between BMI and patient outcomes.\textsuperscript{22}

It was shown that a decrease in albumin levels is associated with increased morbidity and mortality in hospitalized patients. Therefore, it is commonly reported as a prognostic indicator.\textsuperscript{23} Various studies demonstrated that albumin is
associated with survival. A clear relationship was found between albumin concentration and all-cause mortality in older patients. In our study, we found that low albumin level is a risk factor for mortality (Table 4). In addition, it was shown in various studies that low albumin level is associated with poor prognosis. We also found that low albumin levels reveal poor prognosis in patients, and that a low albumin level is decisive regarding ICU transfer (Table 4). In a prospective observational study on 54,215 patients, it was found that when the albumin level decreased from 4.6 g/dL to 2.1 g/dL, the mortality rate increased from <1% to 29%, and the morbidity rate increased from 10% to 65%. We also found that a decrease in ALB level below ≤2.44 increased the rate of transfer to the ICU by 2.12 times, and a decrease below ≤2.56 increased mortality 2.08 times.

Prealbumin was also reported to be a prognostic indicator for mortality in patients at risk of malnutrition. In this study, we also found that low prealbumin is a risk factor for mortality (Table 3). The same study, reports that a prealbumin level of <11 mg/L increases the length of hospital stay and mortality. We can also say that prealbumin ≤8 mg/L increases mortality 2.35 times.

When the catabolic process caused by inflammatory diseases is coupled with old age, the risks of malnutrition, mortality and morbidity also increase. A relationship was demonstrated between CRP and survival. We can also say that the CRP level is lower in discharged patients (Tables 1 and 3), and high CRP may be an indicator of mortality. In addition, we can say that a CRP level above 5.7 increases mortality 1.98 times.

There are certain limitations to our study. Although we did not include patients with cachexia due to malignancy, in our study, we worked with a large group of comorbid patients diagnosed with malnutrition. We believe that new studies with a more specific patient group will bring more clarity to this issue.

**Conclusion**

Based on the results of our study, we found that BMI had no prognostic predictive effect. We concluded that high NRS-2002 and CRP, and low albumin and prealbumin levels can be used to predict mortality in patients diagnosed with malnutrition aged ≥65 years in PCC. We found that low albumin also indicates a poor prognosis and can predict patients who will be transferred to the ICU. There is a need for further studies on the prognostic predictive power of malnutrition parameters to support these results.

**Disclosure**

The authors declare no conflicts of interest in this work.

**References**


