

ORIGINAL RESEARCH

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Can nutritional status of patients in intensive care unit predict mortality and length of hospital stay? A single center retrospective case control study**Deniz Avci¹, Ali Cetinkaya¹, Yekta Gulunay², Sadik Oluk¹, Abdullah Eyvaz²**¹Health Sciences University, Kayseri Training and Research Hospital, Department of Internal Medicine, Kayseri, Turkey²Health Sciences University, Kayseri Education and Research Hospital, Department of Infectious Diseases, Kayseri, Turkey

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Abstract

To compare the hospitalization duration and mortality with the first day nutritional status of the patients who were hospitalized in intensive care unit of internal medicine department. The files of patients admitted to the ICU between 01-January-2017 and 30-June-2017 were retrospectively reviewed. Those who were not eligible for study in the selected files were later handed off. The remaining patients (169 patients) were evaluated for age, sex, stay in intensive care unit, APACHE2 and Glasgow scores, outcomes (exitus or discharge), NRS-2002 values in day of hospitalization, glucose, creatinine, albumin, White Blood Cell, hematocrit, thrombocyte, C-reactive protein and thyroid stimulating hormone (TSH) values were recorded. In addition, patients need for mechanical ventilation and underlying diseases (Chronic renal failure, cancer, sepsis, etc.) were recorded. The mean NRS-2002 score of the whole group was 4.28 ± 0.90 . The mean NRS-2002 score of discharged patients was 3.98 ± 0.80 while the mean NRS-2002 score was 4.71 ± 0.86 ($p < 0.001$). There were positive correlations between NRS-2002 scores and age ($r = 0.537$, $p < 0.001$), APACHE2 score ($r = 0.250$, $p = 0.001$), blood creatinine level ($r = 0.255$, $p = 0.001$). There were statistically significant correlations between NRS-2002 scores and serum albumin levels ($r = -0.250$, $p < 0.001$) and Glasgow coma scores ($r = -0.310$, $p < 0.001$) in the negative direction. There was a negative correlation between hospitalization and NRS-2002 scores in cancer patients ($r = -0.495$, $p = 0.019$). The mean NRS-2002 score was 5.0 ± 0.89 in patients with sepsis who were discharged, while it was 4.36 ± 0.91 in patients with sepsis who died ($p = 0.014$). The mean NRS-2002 score was 4.22 ± 0.74 in patients with chronic renal disease who were discharged, whereas this value was 4.90 ± 0.70 in exitus group ($p = 0.003$). In this study, we demonstrated nutritional status of serious patients in ICU related with certain outcomes including mortality and hospitalization length.

Keywords: NRS-2002, Mortality, intensive care unit, nutrition**Introduction**

Predicting mortality in intensive care unit patients has been a topic of study for many years. As a result of these studies commonly used scoring systems such as Acute Physiology and Chronic Health Evaluation 2 (APACHE2) and Glasgow coma scale have been developed and they provided to predict the possibility of mortality on the time of admission to hospital [1,2].

Various scoring systems have been developed to determine the nutritional risk. For example, Subjective Global Assessment [3] revealed in 1987, MNA (Mini-Nutritional Assessment) [4] in 1999, MUST (Malnutrition Universal Screening Tool) [5] recommended by European guidelines to determine nutritional risk in 2002 and NRS-2002 (Nutritional Risk Screening 2002) was published in 2003 [6].

The NRS-2002, which is still the most valid nutritional assessment test in especially hospitalized patients, was created by evaluating 128 randomized controlled trials. It is a scoring system that takes into account the deterioration of the nutritional condition of the patient, the severity of the illness and the age of the patient [6]. For today, NRS-2002 database is available in Turkey Clinical Enteral Parenteral Nutrition Society (KEPAN) website [6].

Malnutrition is a common problem in intensive care units. The degree of malnutrition is positively correlated with the hospitalization length of patient [7]. Malnutrition increases the risk of infection and multi organ dysfunction [8]; it is also an important factor that affects immunity [9]. It has been demonstrated that immune system is impaired [10] and infectious diseases are badly affected in the deficiency of micronutrients [11].

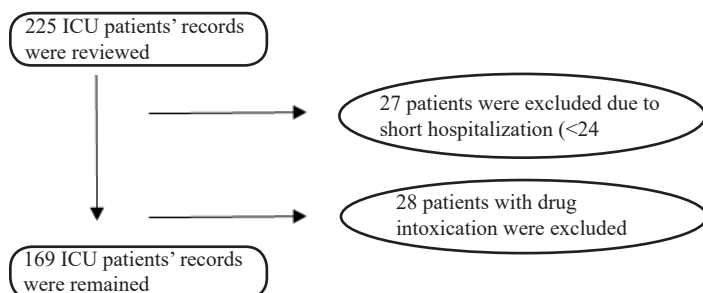
Relation between the prognoses of nutrition in intensive care patients was studied in many types of intensive care and various diseases [12,13]. In this study, we investigated the relationship of NRS-2002, APACHE2, Glasgow coma score calculated in the day

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of intensive care admission with mortality and hospitalization time in patients who were taken to Internal Medicine intensive care unit (IMICU) with the diagnosis of cancer, chronic kidney disease and sepsis.

Material and Methods

Files of patients that were hospitalized between 01-January-2017 and 30-June 2017 in Training and Education Hospital were reviewed retrospectively. The Kayseri Training and Research Hospital Ethics Committee approved this study. Drug intoxications, patients hospitalized in intensive care unit less than 24 hours and patients younger than 18 years were not included in the study.



The remaining 169 patient's ages, sex, duration of stay in intensive care unit, APACHE 2 and Glasgow coma scores, outcomes (discharge or exitus), NRS-2002 values at admission day; glucose, creatinine, albumin, white blood cell, hematocrit, platelet, C-reactive protein (CRP), Thyroid stimulating hormone (TSH) levels were recorded. Besides these, need of patients to mechanical ventilation and underlying diseases (chronic kidney disease, sepsis, cancer etc) were also recorded.

The NRS-2002 evaluation of patients was routinely performed by relevant dieticians in the day of intensive care unit admission. APACHE 2 scores and Glasgow scores of patients were recorded by the physicians in the intensive care unit. Patients' laboratory tests were the routinely taken values in intensive care unit admission.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software version 21.0 (SPSS Inc.,

Chicago, IL, USA). The suitability of the normal distribution of the data was performed with Shapiro–Wilk test and histograms. Continuous variables were presented as mean $\pm$ standard deviation or median (minimum-maximum), depending on whether their distribution is normal or not. Mean values between groups were compared using Student's T test, and median values were compared using Mann-Whitney-U test. Chi-square test was used to compare categorical data. Pearson correlation analysis was used for correlation calculations between continuous variables. The receiver operating characteristic (ROC) curves were used to evaluate the performance of NRS-2002 to indicate the presence of mortality in patients. A p-value <0.05 was considered significant.

Results

The mean age of whole group was 69.2 ± 17.1 years. The median age of discharged patient's was 67.3 ± 18.8 years and was 72.0 ± 14.0 years for patients with mortality and the difference was not statistically significant ($p=0.057$).

Both groups were similar in terms of gender. The male/female ratio (M/F) of the whole patient group was 58.6% ($n=99$)/41.4% ($n=70$). There was no statistically significant difference between the sex-distributions of discharged patient's M/F: %56. ($n=39$)/%43.5 ($n=30$) and mortal patients' M/F: %60 ($n=60$)/%40 ($n=40$) ($p=0.652$).

NRS-2002 scores were 4.28 ± 0.90 in the whole group evaluation. The mean NRS-2002 score was 3.98 ± 0.80 in the discharged patients. In mortal cases, the mean NRS-2002 score was 4.71 ± 0.86 . The difference between these two mean values were a statistically significant difference ($p<0.001$).

While 68.8% ($n=47$) of the cancer cases ended with death in intensive care unit, this rate was 34.4% ($n=22$) in the non-cancer patients ($p<0.001$).

51.8% ($n=26$) of patients with sepsis resulted in death in intensive care unit while the mortality rate in patients without sepsis was 36.4% ($n=43$) ($p=0.078$). This difference was tending to be statistically significant.

Group comparisons are summarized in Table 1.

Table.1 Comparison of variables according to outcomes of patients in intensive care unit

Continuous variables	Total	Outcome		p
		Exitus	Discharge	
Age(year)	69.2 ± 17.1	72.0 ± 14.0	67.3 ± 18.8	0.057
APACHE 2 score	23 (3-48)	25 (10-48)	19 (3-44)	0.002
Glasgow coma score	11 (3-15)	10 (3-14)	12 (3-15)	0.001
Hospitalization duration (day)	5 (2-32)	7 (2-37)	5 (2-21)	0.018
NRS-2002	4.28 ± 0.90	4.71 ± 0.86	3.98 ± 0.80	<0.001
Glucose (mg/dL)	126.5 (54-818)	129 (54-412)	124 (69-818)	0.772
Creatinine (mg/dL)	1.4 (0.2-14.6)	1.9 (0.3-14.6)	1.3 (0.2-13.2)	0.035
Albumin (g/L)	2.73 ± 0.71	2.6 ± 0.6	2.8 ± 0.8	0.111
WBC(1/uL)	10500 (600-40000)	11150 (3300-38000)	10200 (600-40000)	0.388
Hematocrit	34.4 ± 9.0	35.1 ± 9.8	34.0 ± 8.5	0.448
Platelet (1/uL)	182000 (4000-488000)	173000 (27000-478000)	195000 (4000-488000)	0.638
TSH (mU/L)	0.9 (0.01-99)	0.9 (0.01-99)	0.9 (0.2-10)	0.479
Categoric variables				
Gender M/F (%)	58.6($n=99$)/41.4 ($n=70$)	56.5($n=39$)/43.5 ($n=30$)	60 ($n=60$)/40 ($n=40$)	0.652
CRP (mg/dL)	99 (3-212)	121 (9-212)	64 (3-199)	0.010

There were statistically significant correlations in the positive way between NRS-2002 scores and age ($r=0.537$, $p<0.001$), APACHE2 score ($r=0.250$, $p=0.001$), blood creatinine levels ($r=0.255$, $p=0.001$) and CRP levels ($r=0.356$, $p<0.001$).

When the whole group is considered: there was no correlation between NRS-2002 scores and hospitalization duration ($r=0.117$, $p=0.129$).

In order to estimate the power of NRS-2002, APACHE2, Glasgow coma scoring and CRP as predictors of intensive care unit mortality area under curve (AUC) was used for ROC analyses. (Figure 1) (Table 2).

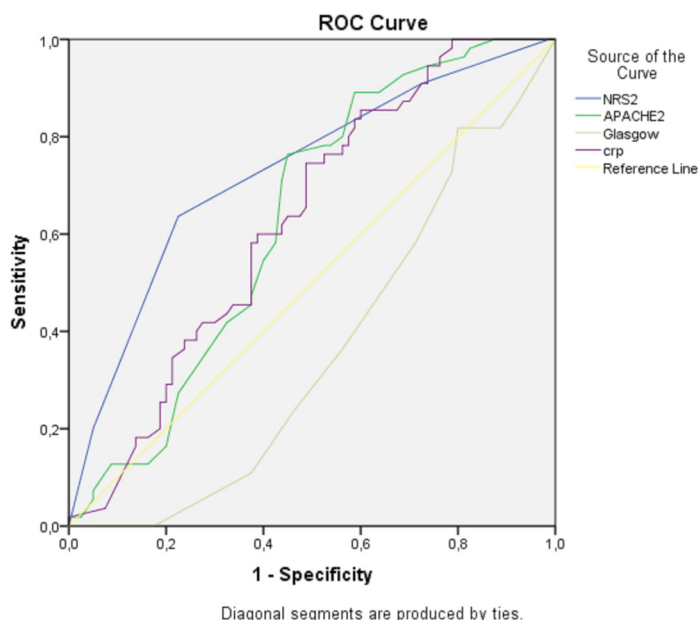


Figure 1. In order to estimate the power of NRS-2002, APACHE2, GCS and serum CRP as predictors of intensive care unit mortality area under curves (AUC) were used for ROC analyses

Table 2. Area under curves for NRS-2002, APACHE2 scores, Glasgow Coma Scores and Serum CRP for predicting mortality in patients admitted to internal medicine intensive care unit

Variables	AUC	p	95% Confidence Interval	
			Lover	Upper
NRS-2002	0.728	<0.001	0.640	0.815
APACHE2 score	0.630	0.011	0.537	0.723
Glasgow Coma score	0.359	0.006	0.267	0.451
CRP	0.628	0.012	0.535	0.720

Patients with cancer

There were 32 patients with cancer. Twenty-two of these patients were died in intensive care unit, while 10 of them could be discharged. The mean NRS-2002 score in survivors was 4.8 ± 0.78 while it was 4.5 ± 0.80 in non-survivors. The difference between these two means was not statistically significant ($p=0.332$). In cancer patients there was a moderate, statistically significant correlation on the negative direction between the length of hospital stay and the NRS-2002 scores ($r=-0.495$, $p=0.019$). In cancer patients there was a moderate, statistically significant correlation on positive direction between the age of the patients and the NRS-2002 scores ($r=0.426$, $p=0.048$).

Patients with sepsis

26 of 51 septic patients were died while 25 of them discharged from intensive care unit. The mean NRS-2002 score in survivors was 5.0 ± 0.89 , while it was 4.36 ± 0.91 in non-survival septic patients. The difference between these two values was statistically significant ($p=0.014$). In patients with sepsis there was a moderate, statistically significant correlation on positive way between the age of the patients and the NRS-2002 scores ($r=0.504$, $p<0.001$). In patients with sepsis there was not statistically significant correlation between the length of hospital stay and the NRS-2002 scores ($r=-0.037$, $p=0.798$). In patients with sepsis there was a mild, statistically significant correlation on positive direction between blood glucose level and NRS-2002 scores ($r=0.288$, $p=0.049$).

Patients with chronic kidney disease

Forty-four patients were diagnosed as chronic kidney disease (CKD). Twenty-one of them were died and 23 of patients discharged. The mean NRS-2002 score was 4.22 ± 0.74 in discharged patients while the value was 4.90 ± 0.70 in non-survivals with CKD. The difference between these two means was statistically significant ($p=0.003$). In patients with CKD there was a strong, statistically significant correlation on positive direction between the ages of the patients and the NRS-2002 scores ($r=0.701$, $p<0.001$). In patients with CKD there was a moderate, statistically significant correlation on positive way between serum CRP levels and the NRS-2002 scores ($r=0.484$, $p<0.049$).

Patients with mechanical ventilation necessity

There were 54 patients who needed mechanical ventilation. 35 of these patients had mortality while 19 of them discharged from intensive care unit. The mean NRS-2002 score was 4.58 ± 0.77 in discharged patients while the value was 4.74 ± 0.89 in non-survival patients. The difference between these two values was not statistically significant ($p=0.500$). In patients with mechanically ventilated there was a moderate, statistically significant correlation on positive way between the ages of the patients and the NRS-2002 scores ($r=0.672$, $p<0.001$). In patients with mechanically ventilated there was a mild, statistically significant correlation on negative direction between serum albumin levels and the NRS-2002 scores ($r=-0.336$, $p=0.033$).

Discussion

Malnutrition affects a significant proportion of hospitalized patients and is associated with increased hospital mortality and morbidity [14]. The efforts of the discovery of new laboratory/clinical parameters that may predict mortality in the intensive care unit are still maintain their importance. A series of scoring systems have been proposed for predicting mortality. Glasgow coma scale and APACHE2 models are the best known of these systems. In addition, many parameters have been studied in some special patient groups in intensive care units [15-17].

The aim of the present study was to compare the certain outcomes such as mortality and hospital stay of intensive care patients with NRS-2002. The mean NRS-2002 score of whole group was 4.28 ± 0.90 . The mean NRS-2002 score was 3.98 ± 0.80 in discharged patients, while it was 4.71 ± 0.86 in patients with mortality. When all patients were taken into account, the NRS-2002 scores on the day of admission were significantly higher in patients resulted with mortality compared to those discharged. The NRS-2002 scores

were generally associated with hospital mortality and morbidity when the literature was reviewed [14,18].

Patients were also examined in terms of specific disease groups. In this context, the mortality status of cancer patients did not seem to be related to the NRS-2002 scores. The mean NRS-2002 score in surviving patients was 4.80 ± 0.79 , whereas in cancer patients resulted with death it was 4.50 ± 0.80 . However, there was a significant correlation between the NRS-2002 scores of cancer patients and the age (positive direction) and hospitalization duration (negative direction). In the accumulated literature, the NRS-2002 score was reported to be associated with increased mortality and morbidity in hospitalized cancer patients (in ICU or not) [19,20].

Similarly, patients with chronic kidney disease were examined. The difference between groups was statistically significant in terms of mortality. Forty-four patients had chronic kidney disease. 21 of these patients had mortality while 23 of them discharged. The mean NRS-2002 score was 4.22 ± 0.74 in discharged patients while the mean NRS-2002 score was 4.90 ± 0.70 in mortal chronic kidney disease patients. Also in chronic kidney disease patients there were statistically significant correlations between NRS-2002 scores and age of patients and serum CRP levels. Rather than randomized controlled trials working the mortality relation of NRS-2002 scores of patients with chronic kidney disease in intensive care unit, studies in nephrology services were more intense and in these studies NRS-2002 scores were associated with mortality and morbidity [21,22].

The number of sepsis patients in the group was 51. 26 of these patients were mortal while 25 of patients discharged from intensive care unit. The mean NRS-2002 score in discharged patients was 5.0 ± 0.89 , whereas in septic patients with mortality this value was 4.36 ± 0.91 . The difference between this two values was statistically significant. There was no correlation between NRS-2002 scores and hospitalization length. However, NRS-2002 scores showed a statistically significant correlation with both the blood glucose level and the mean age of the patients. In previous studies, there were associations between NRS-2002 and sepsis mortality or hospitalization [13].

It is known that the nutritional support of the patient after admission is related to the outcome of the patients in the intensive care unit and hospitalization time [23]. In our study this was confirmed by another method. Patient entry values were taken and disease states were examined separately. There should be no escape from the fact that the diseases are not distributed homogeneously among the groups. For example, a 10 day hospitalized stomach perforation and a septic patient who died within 2 days affected the homogeneity of hospitalization time. Patients with a gastric perforation and a low NRS-2002 score may stay longer for the treatment of the primary pathology, but in severe cases this may be different and the duration of hospitalization may be shorter. Another factor was the length of hospitalizations was relatively short. Patients' progress in non-ICU clinics may be more predictable. Associating malnutrition scores with length of stay in these patients may be associated with more predictable outcomes [21]. It would not be wrong to think that patients in intensive care units are more likely to be close to death. In other words, it is not uncommon for patients to die from other causes without experiencing the consequences

of malnutrition. For this reason, the statistical significance to be obtained can be interpreted as valuable.

Limitations

1-The fact that the diseases are not homogeneously distributed among the groups and additionally disease stages are not standardized could affect the results.

2-Retrospective design may have affected the standard feature of NRS-2002 evaluations.

Conclusion

Malnutrition is a factor that negatively affects the mortality, morbidity and hospitalization length of patients in intensive care units. It was once again shown that the NRS-2002 scores calculated for patients in Internal medicine-ICU admission is an important predictor of mortality and hospitalization time, in terms of total and disease groups. There was a significant correlation between the NRS-2002 scores of cancer patients and the age (positive direction) and hospitalization duration (negative direction). The mean NRS-2002 score in septic patients with mortality was significantly higher than discharged septic patients'. Also in chronic kidney disease patients there were statistically significant correlations between NRS-2002 scores and age of patients and serum CRP levels.

Competing interests

The authors declare that they have no competing interest

Financial Disclosure

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Ethical approval

Before the study, permissions were obtained from local ethical committee

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