

# The effect of malnutrition on prognosis in surgical inpatients in the intensive care unit

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## Abstract

**Introduction:** Malnutrition, which is a clinical process starting with systemic inflammation and extending to immune deficiency is a common problem in intensive care units. In this study, we aimed to investigate the effect of malnutrition on prognosis in surgical patients followed in intensive care unit.

**Material and methods:** The study is retrospective, and the files of the surgical patients hospitalized in the intensive care units of Aydın State Hospital between January 2018 and January 2020 were reviewed. The demographic data of the patients, the duration of hospitalization in the intensive care unit and the hospital, the type of surgery being urgent-elective, and the ex-discharge status of the patients were recorded. For malnutrition screening, in addition to NRS-2002 and MNA-SF scores at the time of hospitalization, statistical analysis was performed by recording C-reactive protein, albumin, total protein and C-reactive protein/albumin values as markers.

**Results:** A total of 160 patients were included in this study. The mean NRS-2002 score was  $2.20 \pm 1.85$ , while the MNA-SF score was  $11.39 \pm 2.99$ . The mean C-reactive protein/albumin value was 39.10, the hospital stay in intensive care was 3.4 days, and hospital stay was 13.58 days. It was observed that as the NRS-2002 scores at the time of hospitalization increased and MNA-SF scores decreased, the duration of hospitalization in the intensive care and the hospital increased ( $p < 0.001$ ). However, as the NRS-2002 scores increased and MNA-SF scores decreased, the need for mechanical ventilator and mortality rate increased ( $p < 0.001$ ).

**Conclusion:** Malnutrition is a condition that triggers the inflammatory cascade in surgical patients and has a negative effect on prognosis. Its effect is more pronounced in patients who need intensive care for surgical reasons. We think that the early identification of the risk of malnutrition and providing the necessary nutritional support in the perioperative period, especially in surgical patients who need intensive care, would affect the prognosis positively.

**Key words:** malnutrition, surgery, MNA-SF, NRS-2002, mortality

## ЖЕТКІЛІКСІЗ ТАМАҚТАНУДЫҢ ҚАРҚЫНДЫ ТЕРАПИЯ БӨЛІМШЕСІНДЕ ХИРУРГИЯЛЫҚ НАУҚАСТАРДЫҢ БОЛЖАМЫНА ӘСЕРІ

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### ТҰЖЫРЫМДАМА

**Мақсаты:** Жүйелі қабынудан басталып, иммундық тапшылыққа әкелетін клиникалық процесс болып табылатын жеткіліксіз тамақтану қарқынды терапия бөлімшелерінде жиі кездеседі. Бұл зерттеудің мақсаты жеткіліксіз тамақтану қарқынды терапия бөлімшесінде бақыланатын хирургиялық пациенттердің болжамына әсерін зерттеу болды.

**Материалдары және әдістері:** Зерттеу - бұл 2018 жылдың қаңтары мен 2020 жылдың қаңтары аралығында Айдын мемлекеттік ауруханасының реанимация бөліміне түскен хирургиялық науқастардың медициналық есебін қарайтын ретроспективті зерттеу. Науқастың демографиялық деректері, қарқынды терапия бөлімшесінде және стационарда болу ұзақтығы, жедел емдеуді қажет ететін хирургия түрі, пациенттердің шығарылу жағдайы тіркелді. Жеткіліксіз тамақтану скринингіне келсек, қабылдау кезінде NRS-2002 және MNA-SF-тен басқа, статистикалық талдау C-реактивті ақуызды, альбуминді, жалпы протеинді және C-реактивті ақуыз/альбумин қатынасын маркер ретінде тіркеу арқылы жүргізілді.

**Нәтижелері:** Осы зерттеуге барлығы 160 пациент енгізілді. NRS-2002 бойынша орташа балл  $2,20 \pm 1,85$  құрады, ал MNA-SF көрсеткіші  $11,39 \pm 2,99$  болды. C-реактивті ақуыз/альбуминнің орташа коэффициенті 39,10 құрады, қарқынды терапия бөлімінде болу 3,4 күн, ауруханада -13,58 күн. NRS-2002 көрсеткіштері ауруханаға жатқызу кезінде жоғарылаған және MNA-SF көрсеткіштері төмендеген сайын, қарқынды терапия бөлімшелерінде және стационарларда болу ұзақтығы артқан ( $p < 0.001$ ). Алайда, NRS-2002 ұпайлары жоғарылап, MNA-SF көрсеткіштері төмендеген сайын респираторға механикалық қажеттілік пен өлім деңгейі жоғарылады ( $p < 0.001$ ).

**Қорытынды:** Жеткіліксіз тамақтану - хирургиялық науқастарда қабыну реакцияларының каскадын тудыратын және болжамға кері әсер ететін жағдай. Оның әсері хирургиялық себептерге байланысты қарқынды терапияны қажет ететін пациенттерде айқын көрінеді. Жеткіліксіз тамақтану қаупін ертерек анықтау және периоперативті кезеңде жеткіліксіз парентеральды тамақтану, әсіресе қарқынды терапияны қажет ететін хирургиялық науқастарда болжамға оң әсер етеді деп санаймыз.

**Негізгі сөздер:** жеткіліксіз тамақтану, хирургия, MNA-SF, NRS-2002, өлім-жітім

# ВЛИЯНИЕ НЕДОСТАТОЧНОСТИ ПИТАНИЯ НА ПРОГНОЗ У ХИРУРГИЧЕСКИХ БОЛЬНЫХ В ОТДЕЛЕНИИ ИНТЕНСИВНОЙ ТЕРАПИИ

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## РЕЗЮМЕ

**Цель:** Недостаточность питания, которая является клиническим процессом, начинающимся с системного воспаления и приводящим к иммунодефициту, является распространенной проблемой в отделениях интенсивной терапии. Целью настоящего исследования стало изучить влияние недостаточности питания на прогноз у хирургических пациентов под наблюдением в отделении интенсивной терапии.

**Материалы и методы:** Исследование является ретроспективным, в котором были рассмотрены истории болезни хирургических пациентов, госпитализированных в отделения интенсивной терапии государственной больницы г. Айдын в период с января 2018 года по январь 2020 года. Зарегистрированы демографические данные пациентов, продолжительность госпитализации в отделении интенсивной терапии и больнице, тип операции, требующей неотложного лечения, и статус выписки пациентов. Что касается скрининга на недостаточность питания, в дополнение к показателям NRS-2002 и MNA-SF на момент госпитализации, был проведен статистический анализ путем регистрации значений С-реактивного белка, альбумина, общего белка и соотношение С-реактивного белка/альбумина в качестве маркеров.

**Результаты:** Всего 160 пациентов были включены в настоящее исследование. Средний балл по NRS-2002 составлял  $2,20 \pm 1,85$ , в то время как показатель MNA-SF составлял  $11,39 \pm 2,99$ . Среднее значение соотношения С-реактивного белка/альбумина составило 39,10, пребывание в отделении интенсивной терапии составило 3,4 дня, а в стационаре - 13,58 дня. Было отмечено, что по мере увеличения показателей NRS-2002 во время госпитализации и снижения показателей MNA-SF, продолжительность госпитализации в отделениях интенсивной терапии и в стационаре увеличивалась ( $p < 0,001$ ). Однако по мере того, как баллы по NRS-2002 увеличивались, а баллы по MNA-SF уменьшались, потребность в механическом респираторе и процент смертности увеличивались ( $p < 0,001$ ).

**Заключение:** Недостаточность питания - это состояние, которое запускает каскад воспалительных реакций у хирургических пациентов и отрицательно влияет на прогноз. Его эффект более выражен у пациентов, которые нуждаются в интенсивной терапии по хирургическим причинам. Мы считаем, что раннее выявление риска недостаточности питания и обеспечение необходимого парентерального питания в периоперационном периоде, особенно у хирургических пациентов, нуждающихся в интенсивной терапии, окажет положительное влияние на прогноз.

**Ключевые слова:** недостаточность питания, хирургия, MNA-SF, NRS-2002, смертность

## Introduction

Malnutrition in intensive care units is a serious problem seen in developing countries with high rates of 50-78% [1]. In surgical patients, malnutrition is a clinical process that starts with systemic inflammation and extends to immune deficiency and has an important effect on hospital stay and mortality in the postoperative period [2,3]. In addition to malnutrition in intensive care, conditions such as infection, undernutrition, and prolonged inflammatory events also play a role in prolonging the duration of hospitalization in intensive care [4].

Practical and validated tests are used today to evaluate malnutrition and the nutritional conditions of the patient. Surveys such as Nutritional Risk Screening (NRS), Nutrition Risk Index (NRI), Malnutrition Universal Screening Tool (MUST), Mini Nutrition Evaluation (MNA), Mini Nutrition Evaluation - Short Form (MNA-SF) are some of them [5,6]. In our study, we investigated the effect of malnutrition on prognosis in surgical patients monitored in intensive care unit using NRS-2002 and MNA-SF scoring.

## Material and methods

The study is retrospective, and the files of surgical patients hospitalized in the intensive care units of Aydin State Hospital between January 2018 and January 2020 were reviewed. Ethics committee approval was not obtained since the study was planned retrospectively. Patients over 18 years of age, hospitalized more than 24 hours in intensive care, having a life expectancy over 48 hours, and needing intensive care urgently or after elective surgery were included in the study. The demographic data of the patients, length of stay in ICU (LOS ICU) and length of stay in the hospital (LOS H), the type of surgery being urgent-elective, and the ex-discharge status of the patients were recorded. For malnutrition screening, in addition to the NRS-2002 and MNA-SF scores at the time of hospitalization, CRP, albumin, total protein and CRP/albumin values were recorded as markers, statistical analyses were performed and compared.

The Mini Nutritional Assessment – Short Form (MNA®-SF) is a short, valid nutritional screening tool for free-living and

clinically relevant elderly populations. The MNA-SF contains geriatric-specific assessment questions related to nutritional and health conditions, independence, quality of life, cognition, mobility and subjective health. The MNA-SF is recommended for routine geriatric assessments by the European Society for Clinical Nutrition and Metabolism (ESPEN) [7]. It was validated in 2009 [8]. This information belongs to introduction or discussion.

The use of NRS - 2002 is recommended especially by the ESPEN - European Society of Parenteral and Enteral Nutrition for nutritional assessment and it was developed in 2002 with the intended use for hospitalized adult patients. NRS includes assessment of the patient's nutritional status (based on weight loss, Body Mass Index (BMI) and general condition or food intake) and disease severity (stress metabolism due to the degree of disease) and is associated with higher risk for adverse outcomes. It focuses on patients in acute care and in need of nutritional support [9]. This information belongs to introduction or discussion.

## Statistical analysis

Data analyses were performed by using SPSS for Windows, version 22.0 (SPSS Inc., Chicago, IL, United States). Whether the distribution of continuous variables were normal or not was determined by Kolmogorov Smirnov test. Levene test was used for the evaluation of homogeneity of variances. Unless specified, continuous data were described as mean  $\pm$  SD for normal distributions and mean  $\pm$  SD (median) for skewed distributions. Categorical data were described as number of cases (%). Statistical analysis differences in normally distributed variables between two independent groups were compared by Student's t test, Mann Whitney U test were applied for comparisons of the not normally distributed data test and categorical variables were compared using Pearson's chi-square test or fisher's exact test. It was evaluated degrees of relation between variables with spearman correlation analysis. It was accepted p-value  $< 0.05$  as significant level on all statistical analysis.

## Results

A total of 160 patients were included in the study and 101 (63.5%) were elective while 59 (36.5%) were emergency surgery cases. The mean NRS-2002 score was  $2.20 \pm 1.85$ , while the MNA-SF score was  $11.39 \pm 2.99$ . The mean CRP/albumin value was 39.10, length of stay in intensive care was 4.1 days, and length of stay in hospital stay was 13.58 days (Table 1).

It was observed that as the NRS-2002 scores at the time of hospitalization increased and MNA-SF scores decreased, the duration of hospitalization in the intensive care and the hospital increased ( $p < 0.001$ ). As the CRP/Albumin ratio increased, the duration of hospitalization increased in the same way ( $p < 0.001$ ) (Table 2). However, as the NRS-2002 scores increased and the MNA-SF scores decreased, the need for mechanical ventilator and mortality rate increased ( $p < 0.001$ ) (Table 3-4).

**Table 1** Demographic Data

	± SD	Median (Range)
Age	63,55 ± 17,74	66 (78)
Gender (male/female)	91 (57,2%)	68 (42,8%)
BMI	28,54	24,9
Reason for hospitalization	Urgent	58 (36,5%)
	Electively	101 (63,5%)
NRS2002	2,20 ± 1,85	2 (7)
MNA-SF	11,39 ± 2,99	12 (13)
CRP (mg/L)	102,16 ± 81,99	85 (365)
Albumin (g/dL)	3,10 ± 0,74	3(3,2)
CRP/Albumin	39,10 ± 35,77	27,18 (155,3)
Total protein (g/dL)	5,63 ± 0,79	5,7 (3,5)
Length of stay in ICU (LOS ICU) (day)	4,10 ± 3,40	2 (19)
Length of stay in hospital (LOS H) (day)	13,58 ± 10,29	10 (58)

**Table 2** Factors affecting the LOS ICU and LOS H

		Length of stay in ICU (LOS ICU)	Length of stay in hospital (LOS H)
Age	r	0,357	0,170
	p	<0,001	0,033
BMI	r	-0,301	-0,311
	p	<0,001	<0,001
NRS2002	r	0,391	0,330
	p	<0,001	<0,001
MNA-SF	r	-0,367	-0,269
	p	<0,001	0,001
CRP	r	0,388	0,332
	p	<0,001	<0,001
Albumin	r	-0,444	-0,447
	p	<0,001	<0,001
CRP/Albumin	r	0,411	0,380
	p	<0,001	<0,001
Total protein	r	-0,276	-0,268
	p	<0,001	0,001

Spearman correlation analyzer; correlation coefficient

**Table 3** Relationship with mechanical ventilation

	Need for mechanical ventilation		p
	No (n:134)	Yes (n:25)	
	$\bar{X} \pm SD$ (Med)	$\bar{X} \pm SD$ (Med)	
Age	61,26 ± 17,49	75,80 ± 13,84	0,001
Gender (male/female)	76 (56,7%) / 58 (43,3%)	15 (60%) / 10 (40%)	0,761
BMI	29,26 ± 9,83 (25)	24,64 ± 5,57 (24)	0,041
Reason for hospitalization	Urgent	39 (29,1%)	19 (76,0%)
	Electively	95 (70,9%)	6 (24,0%)
NRS2002	1,90 ± 1,72 (2)	3,84 ± 1,68 (4)	<0,001
MNA-SF	11,87 ± 2,63 (13)	8,84 ± 3,53 (9)	<0,001
CRP (mg/L)	88,96 ± 75,79 (65)	172,88 ± 79,02 (185)	<0,001
Albumin (g/dL)	3,23 ± 0,70 (3,15)	2,39 ± 0,44 (2,3)	<0,001
CRP/Albumin	32,22 ± 31,23 (19,67)	75,98 ± 36,57 (87,61)	<0,001
Total protein (g/dL)	5,73 ± 0,77 (5,8)	5,09 ± 0,68 (5,2)	<0,001

**Table 4** Relationship with mortality

			p
	Exitus (n:23)	Discharged (n:136)	
	$\bar{X} \pm SD$ (Med)	$\bar{X} \pm SD$ (Med)	
Age	77,87 ± 10,44	61,13 ± 17,60	0,001
Gender (male/female)	13 (56,5%)/10 (43,5%)	78 (57,4%)/58 (42,6%)	0,941
BMI	24,06 ± 5,03 (23,8)	29,29 ± 9,80 (25)	0,018
Reason for hospitalization	Urgent	18 (78,3%)	40 (29,4%)
	Electively	5 (21,7%)	96 (70,6%)
NRS2002	4,04 ± 1,52 (4)	1,89 ± 1,72 (2)	<0,001
MNA-SF	8,52 ± 3,48 (9)	11,88 ± 2,61 (13)	<0,001
CRP (mg/L)	184,22 ± 71,31 (2,2)	88,28 ± 75,48 (65)	<0,001
Albumin (g/dL)	2,34 ± 0,38 (2,2)	3,23 ± 0,70 (3,15)	<0,001
CRP/Albumin	81,17 ± 33,13 (88,63)	31,98 ± 31,09 (19,67)	<0,001
Total protein (g/dL)	5,07 ± 0,67 (5,2)	5,73 ± 0,77 (5,8)	<0,001

## Discussion

Due to conditions such as trauma, sepsis and major surgery in patients in intensive care, proper nutritional treatment is very important in patients with hypermetabolic status [10]. If nutritional balance cannot be achieved in these critical conditions, the catabolic state that changes energy and protein metabolism and causes an increase in cytokine and stress hormones becomes inevitable [11]. Infection with malnutrition, hospital stay, re-admission to the intensive care unit, follow-up time on the mechanical ventilator, and mortality are related parameters [10,12,13]. In our study, we examined mechanical ventilation time, mortality and the CRP/Albumin values as an inflammatory marker.

In the study of Lew et al. [1] on 285 intensive care patients, no significant difference was found between patients with malnutrition and patients that do not have malnutrition in terms of dependence on mechanical ventilator. In another study conducted on 245 patients, it was shown that the duration of detachment from the mechanical ventilator was earlier and the mortality was lower in patients who started enteral nutrition early [14]. In our study, we see that both the duration of adherence to the mechanical ventilator and the stay in intensive care unit increased with low MNA-SF, high NRS 2002 and high CRP/Albumin values.

In an observational study of Zaki et al. [15] in which 68 intensive care patients were followed for 3 months, the albumin levels and malnutrition rates of the patients were examined, and the patients were divided into 3 groups as mild, moderate and severe malnutrition. They reported that as the albumin levels of the patients decreased, they became more susceptible to complications and the morbidity and mortality rates increased. In another study [13], it was stated that low albumin level was associated with malnutrition and it significantly increased the rate of re-admission to intensive care unit and mortality. In our study, we see that patients with mortality in intensive care unit have lower albumin levels and higher malnutrition rates than healthy discharged patients. In this way, our study shows the importance of early nutritional screening and nutrition of

intensive care patients by giving information parallel to the literature.

There are many objective and subjective tests and surveys available to evaluate malnutrition. In their study, Osooli et al. [11] stated that parameters such as albumin, prealbumin, IL-6 cannot be shown to the full nutritional status since they are affected by events such as malnutrition and inflammation, so they used the scoring system called NUTRIC score in their studies. In our study, we used both albumin, CRP/Albumin and MNA-SF, NRS 2002 tests. Another important effect of malnutrition is that it increases the susceptibility to both intensive care and hospitalization and it increases the susceptibility to infection and complications and puts the patient into a vicious circle [1]. In their study, Shpata et al. [17] showed that the duration of hospitalization in intensive care in patients with malnutrition in intensive care unit was  $10.55 \pm 9.35$  days while it was  $7.31 \pm 5.23$  days in cases without malnutrition. Again, in a study by Mogensen et al. [18], it was reported that in the absence of early nutrition of intensive care patients, the length of hospital stay was longer, organ failure was more common, and mortality was observed more. In our study, while the mean length of hospitalization was found to be  $4.10 \pm 3.40$  days, it is noteworthy that this period was extended in cases with malnutrition.

The limitation of our study is the absence of a control group. The control group was not taken as the majority of patients who were followed up for different reasons (pneumonia, sepsis, acute kidney injury, respiratory failure, acute myocardial infarction, etc.) in intensive care were advanced age and malnutrients.

As a result, malnutrition is a very frequent picture in surgical patients in intensive care units, and if early nutritional treatment is not applied, it may be necessary to expend extraordinary efforts on patient groups with high mortality, morbidity and complication rates. Therefore, malnutrition should be recognized early, objective and subjective tests should be performed, and malnutrition should be prevented by early nutritional treatment.

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