# Nutritional status of trauma patients hospitalized at surgical intensive care unit

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*Abstract*

Malnutrition results from a decrease or increase or imbalance of energy, protein and other nutrients, leading to measurable negative effects on body tissue, body shape, organ function and clinical status. Research shows that nutritional support is one of the necessary processes for survival of traumatic patient hospitalized at surgical intensive care unit. The purpose of this study is to evaluate the nutritional status of trauma patients hospitalized at surgical intensive care unit of Kowsar Hospital in Semnan, Iran. This cross-sectional descriptive study was performed on patients older than 18 years with head, neck and femur injuries. Initial data were collected using a checklist containing demographic information questions, designed from the Ministry of Health and Medical Education's Nutrition Screening Form, which was available in the Nutrition Assessment Forms and Guidelines for Hospitalized Patients Approved in 2013. The data were analyzed using Chi-square or Fisher's exact tests, paired t-test and Pearson coefficient. The confidence level was 95% and significance level was less than 0.05 in all tests. The amount of energy determined by the intensive care unit for the patients, with a significantly lower relationship than the amount of energy required by the patients for 24 hours, based on the Harris Benedict formula was ($918.20 \pm 474.80$ calories vs. $1535.76 \pm 243.73$ calories, respectively and P-value<0.001). The amount of protein determined by the intensive care unit for the patients for 24 hours, with a significantly relationship lower than the protein required for the patients for 24 hours, was ($51.68 \pm 34.39$ vs. $106.57 \pm 13.67$, respectively, and P-value< 0.001). There was a statistically significant relationship between the age of the patients and energy (P<0.001) and protein (P<0.001) determined by the intensive care unit for the patients for 24 hours and energy (P<0.001) and protein (P<0.001) required for the patients for 24 hours. The results of this study showed that both the amount of energy and the amount of protein determined by the intensive care unit for trauma patients for less than 24 hours were lower than the required level; therefore, dietary modification for these patients is recommended.

**Key Words**: Nutritional assessment, trauma patient, Intensive Care Unit
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**M**alnutrition is a state of nutrition that results from a decrease or increase or imbalance of energy, protein and other nutrients, leading to measurable negative effects on body tissue or body shape (shape, size, body composition), organ function and clinical status.[1] Malnutrition is one of the most serious problems in the world, especially in hospitalized patients. Malnutrition has detrimental effects on the treatment process of patients.[2] The importance of nutrition at hospital units cannot be ignored. This importance is particularly emphasized at intensive care units, as malnutrition is a major problem in many hospitals, especially at intensive care units.[3,4] Studies have shown that the prevalence of malnutrition among adults in all age groups ranges from 20 to 69%,[5] and has a high prevalence of 40% among patients hospitalized at intensive care units. Over 35% of patients hospitalized at intensive care units were malnourished at the time of admission,[6] and about two thirds of the patients experience poor nutritional status during hospital stay. Malnutrition can increase risks of infection, spread stress ulcers, reduce wound healing, prolong hospital stay, increase health care costs, and increase morbidity and mortality.[7] Therefore, supportive nutrition is an essential component of treatment for such patients.[8] Research shows that nutritional support is one of the supportive processes necessary for the survival of

trauma patients hospitalized at surgical intensive care units and is estimated based on the requirements met for each patient, taking into account clinical findings.[9,10] During the stay in the surgical intensive care unit, malnutrition can progress with progression of disease that may be associated with reduced appetite or inability to swallow, and in some cases lack of proper function of the gastrointestinal tract and ultimately incomplete absorption of food as well as increased patient need for food due to the body's metabolic response to stress, malnutrition can progress.[11] The aim of this study was to evaluate the nutritional status of trauma patients hospitalized at the intensive care units.

## Materials and Methods

### Trial

This descriptive cross-sectional study was performed on patients over 18 years of age with head, neck and femur injuries in the second to fourth quarters of 2016 at the surgical intensive care unit of Kowsar Hospital in Semnan, Iran. Inclusion and exclusion criteria are listed in Table 1. In this study, 40 trauma patients aged 18 years or older with head, neck and femur injuries were selected by simple or available sampling method. Initial data were collected using a checklist containing questions about demographic information, clinical examination, and paraclinical information collected and were followed up. In other words, the data collection was based on a

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**Table 1.** Inclusion and exclusion criteria

**Inclusion criteria**

1. Being 18 years old and over
2. Consent of the patients or the caregivers for participation in the study
3. No need for emergency or sequential surgeries
4. Trauma patients with head, neck and femur injuries
5. Patients without any underlying disease
6. Patients who only had enteral and parenteral nutrition and who did not have oral nutrition

**Exclusion criteria**

1. Infection or other disease during the study
2. Certain underlying disease such as diabetes requiring special diets
3. Unexpected reactions and discharge or death of the patients before completing the data collection process
4. Failure to measure one of the anthropometric or biochemical or nutritional evaluation markers
5. Pregnancy and lactation
6. Liver and renal patients
7. Lack of consent to participate in the study

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researcher-made questionnaire developed from a portion of the Ministry of Health and Medical Education's Nutrition Screening Form that was available in the Nutrition Assessment Forms and Guidelines for Hospitalized Patients Approved in 2013, including patients' demographic information, disease records, biographies, clinical examinations, anthropometric evaluations, nutrition type, and nutritional pathways. The first part of the checklist contained demographic information (sex, age, and body temperature), medical history and clinical examination of physicians, which was completed based on the patient records in the ward. A mercury thermometer was used to determine patients' body temperature. The thermometer was placed in the axillary region of the patient and precisely on the skin, and the patient arm was attached to the trunk. Just one thermometer was used for all patients to prevent measurement error. A non-elastic tape measure with a 5 mm accuracy, based on which the height of the subjects was measured, was used to measure the length of the ulna (distance of the ulnar elbow bulge to the prominent point of the wrist) in cm. It should be noted that in order to reduce the error, measurements of height and body temperature and other anthropometric markers of the patients were performed by one person. In the second part, the data from the results obtained during the study were collected and recorded. Assessment of dietary intake of each patient, including type of nutrition and amount of energy received, was determined by calculating the amount of calories received from enteral and parenteral or oral nutrition and the amount of administration. Patients' protein and energy intake status was calculated based on their nutritional times and the amount of protein and energy in each type of material used. In the case of foods prepared by the caregivers or outside the hospital and the patients consumed them, the patients were under complete control in terms of their calorie intake. If the food was consumed out of the researcher's control, the research unit would be excluded from the study. The energy required by the patients were calculated and obtained using the Harris-Benedict formula. 55 to 65% of this was for carbohydrates, 25 to 30% for fat and 15 to 20% for protein. Therefore, the protein needed by the patients at the intensive care unit was considered to be 1 to 1.5 kg / kg for ideal weight. Since micronutrients are important to consider and increasing or decreasing laboratory markers such as serum albumin, phosphorus, magnesium and total lymphocyte count may be indicative of poor nutritional status of patients; therefore, laboratory values of albumin, potassium, total lymphocyte count, sodium, phosphorus and magnesium were recorded as biochemical markers. These biomarkers were measured in the hospital's medical diagnostic laboratory. This study examined only energy and protein and did not address the critical micronutrients needed for these patients, such as selenium and zinc, because the cost of examining these micronutrients was beyond the budget of the project.

*Sample size*

The sample size of this study was 388 people based on the formula below, based on the Krishnan et al. (2002) study, which reported an average intake of 52%, and 40 were collected during the study period:[12]

$$N = \frac{Z^2_{1-\frac{a}{2}}P(1-P)}{d^2}$$

*Data collection method*

Data were recorded in pre-developed forms by research colleagues and entered into SPSS version 23 for statistical analysis. Numerical variables, mean and standard deviation (Mean ± Std.Deviation) were reported for statistical description, and for categorical variables, count and percentage were reported. Data were analyzed using chi-square or Fisher's exact tests, paired sample t-test and Pearson's coefficient. In all tests, confidence level was 95% and significance level was less than 0.05.

*Ethical considerations*

In this study, the checklists were anonymous and included only raw data and figures. Research units were also assured that we were committed to protecting their information and that this information would remain confidential. On the other hand, written consent was received from all research units and they were assured that if they did not consent to continue their participation, they would have the right to withdraw at any stage of the project.

## Results

According to the results of the age criterion evaluation, the mean age was 49.35±23.5 years. The minimum age was 19 years and the maximum age was 94 years. According to the count distribution and frequency percentage of the age groups, 17 (42.5%) were in the young group (19-39 years), 10 (25%) were in the middle-aged group (40-59 years) and 13 (32.5%) were in the elderly group (60 years and older), respectively. Also 25 (62.5%) subjects were male and 15 (37.5%) were female. The mean and standard deviation of body temperature in the axillary region were 36.71 and 0.27 ° C, respectively. The minimum body temperature in the axillary region of the subjects was 36 ° C and the maximum was 37.2 ° C, respectively, based on which none of the subjects had fever during the study. The mean ulnar length of the subjects was 26.59±1.68 cm. The minimum ulnar length of the subjects was 23.5 cm and the maximum was 29.5 cm. The mean and standard deviation of the subjects' height were 172.17 and 7.84 cm, respectively. The minimum height of the subjects was 153 cm and the maximum was 185 cm. The mean weight of the subjects was 71.05±9.11 kg. The minimum weight of the subjects was 53 kg and the maximum was 85 kg. The mean serum lymphocyte count was 13.87±8.31 units. The minimum serum lymphocyte count was 1.56 units and the maximum was 35.00 units. The mean and standard deviation of white blood cell count were 10.84 and 3.91 per 1000 units, respectively. The minimum white blood cell count was 3.16 per 1000 units and the maximum was 20.26 per 1000 units. The mean serum albumin concentration was 3.62±0.75 units, respectively. The minimum serum albumin concentration was 2.50 units and the maximum was 4.50 units. The mean and standard deviation of blood sodium concentration were 139.45 and 3.76 units, respectively. The minimum serum sodium concentration was 131.0 units and the maximum was 145.0 units. The mean blood potassium concentration was 4.04±0.46 units. The minimum serum potassium concentration was 3.10 units and the maximum was 5.20 units. The mean blood magnesium concentration was 1.57±0.2 units. The minimum serum magnesium concentration was 1.30 units and the maximum was 1.90 units. The mean blood phosphorus concentration was 4.12±0.53 units. The minimum serum phosphorus concentration was 3.20 units and the maximum was 4.80 units.

Also, all research units had very low levels of activity, and all research units had a history of using both intravenous feeding and nasogastric tube feeding during their recent stay at intensive care units. It should be noted that during the study no food was given to them by their caregivers. The mean and standard deviation of the number of oral or enteral feeding prescribed in the hospital at 24 hours were 7.00 and 2.68 times, respectively. The minimum number of oral or enteral feeding prescribed in the hospital at 24 hours was zero and the maximum was 8 times. Given that the caloric value of each cc of oral or enteral nutrition determined was 0.62; therefore, the mean and standard deviation of the caloric or enteral calorie feeding determined in the hospital within 24 hours were 843.20 and 561.05 calories, respectively. The minimum calorie of oral or enteral feeding determined in the hospital at 24 hours was zero and the maximum was 2480 calories. Also, given that the amount of protein in each cc of the oral or enteral feeding determined was 0.038; therefore, the mean and standard deviation of the oral or enteral protein determined in the hospital at 24 hours were 51.68 and 34.39 units, respectively. The minimum amount of oral or enteral protein, determined in hospital at 24 hours, was zero and the maximum was 152 units. The mean and standard deviation of intravenous feeding volume determined in the hospital at 24 hours were 1.36 and 0.69 liters, respectively. The minimum number of intravenous feeding prescribed in the hospital at 24 hours was one liter and the maximum was 3 liters. Normal saline serum was used in 18 (45%), semi-normal serum was used in 17 (42.5%), and 1/3 and 2/3 serum was used in 5 (12.5%). The mean and standard deviation of intravenous calorie intake determined in the hospital at 24 hours were 75.00 and 200.96 calories, respectively. The minimum intravenous calorie intake determined in the hospital at 24 hours was zero and the maximum was 600 calories.

*Analytical statistics*

Calculation of patient energy requirement for 24 hours based on the Harris-Benedict formula showed that the mean and standard deviation of patient energy requirement for 24 hours were 1535.76 and 243.73 calories, respectively. The minimum amount of energy needed for the patients for 24 hours was 1015.14 calories and the maximum was 1958.73 calories. The results of the data analysis showed that the amount of energy determined by the intensive care unit for the patients for 24 hours with a significantly less relationship than the amount of energy required for the patients for 24 hours based on the Harris-Benedict formula was (918.20±474.80 calories vs. 1535.76±243.73 calories, respectively, and P-value<0.001). The mean and standard deviation of the amount of energy determined and required for the patients for 24 hours by different age groups are given in Table 2. The results of data analysis showed that there was a significant relationship between the age of the patients and the amount of energy determined by the intensive care unit for 24 hours (P<0.001). As such, at the intensive care unit, the most

amount of calories were determined for the elderly (60 years and older) (992.00±607.47 calories), while the most need for calories was in the young ones (19-39 years) (1634.73±228.82 calories). The mean and standard deviation of the amount of energy determined and required for the patients for 24 hours by gender are given in Table 3. The results of data analysis showed that there was no statistically significant relationship between the patients' genders and the amount of energy determined by the intensive care unit for 24 hours (P=0.588) and the amount of energy required for the patients for 24 hours based on the Harris-Benedict formula (P=0.173).

*Relationship between the amount of calorie determined and required and the indices examined*

There was no significant relationship between the amount of energy determined by the intensive care unit for 24 hours and body temperature in axillary region (P = 0.730 and R = 0.056), ulna length (P = 0.743 and R = 0.054), height (P = 0.899 and R = 0.021) and weight (P = 0.843 and R = 0.032). There was a significant and direct relationship between the amount of energy required for

**Table 2.** *Mean and standard deviation of determined and required calories for the patients by age group*

| Age group | Determined calories | | Required calories | |
|---|---|---|---|---|
| | Mean | Std. deviation | Mean | Std. deviation |
| Young (19 to 39 years) | 943.53 | 422.07 | 1634.73 | 228.82 |
| Middle-aged (40 to 59 years) | 779.20 | 370.95 | 1587.03 | 219.70 |
| Elderly (60 years and older) | 992.00 | 607.47 | 1366.90 | 200.25 |

**Table 3.** *Mean and standard deviation of the calorie determined and required for the patients by gender*

| Gender | Determined calories | | Required calories | |
|---|---|---|---|---|
| | Mean | Std. deviation | Mean | Std. deviation |
| Male | 950.72 | 514.52 | 1656.02 | 205.93 |
| Female | 864.00 | 411.26 | 1335.33 | 154.69 |

**Table 4.** *Mean and standard deviation of the protein determined and required for the patients by age group*

| Age group | Determined protein | | Required protein | |
|---|---|---|---|---|
| | Mean | Std. deviation | | Mean |
| Young (19 to 39 years) | 49.18 | 36.26 | 105.26 | 14.22 |
| Middle-aged (40 to 59 years) | 44.08 | 27.24 | 110.55 | 15.12 |
| Elderly (60 years and older) | 60.80 | 37.23 | 105.23 | 12.18 |

**Table 5.** *Mean and standard deviation of the protein determined and required for the patients by gender*

| Gender | Determined protein | | Required protein | |
|---|---|---|---|---|
| | Mean | Std. deviation | | Mean |
| Male | 55.33 | 35.07 | 115.80 | 6.93 |
| Female | 27.05 | 33.50 | 91.20 | 5.73 |

the patients for 24 hours according to the Harris-Benedict formula and ulna length (P<0.001 and R = 0.785), height (P<0.001 and R = 0.877) and weight (P<0.001 and R = 0.859). But this relationship was not significant with body temperature in axillary region (P = 0.864 and R = 0.028).

*Relationship between the amount of calorie determined and required and biochemical markers*

There was no significant relationship between the amount of energy determined by the intensive care unit for 24 hours and white blood cell count (P = 0.118 and R = 0.251), lymphocyte count (P = 0.615 and R = -0.082), albumin (P = 0.790 and R = -0.043), sodium (P = 0.374 and R = 0.144), potassium (P = 0.744 and R = -0.116), magnesium (P = 0.853 and R = 0.030), and phosphorus (P = 0.965 and R = 0.007). There was no significant relationship between the amount of energy required for the patients for 24 hours based on the Harris Benedict formula and white blood cell count (P = 0.705 and R = 0.062), lymphocyte count (P = 0.782 and R = -0.045), albumin (P = 0.804 and R = -0.040), sodium (P = 0.176 and R = -0.218), potassium (P = 0.248 and R = -0.178), magnesium (P = 0.773 and R = 0.047) and phosphorus (P = 0.515 and R = 0.106). Calculation of patient energy requirement for 24 hours showed that the mean and standard deviation of protein required for the patients for 24 hours were 106.57 and 13.67 units, respectively. The minimum amount of protein needed for the patients for 24 hours was 79.50 and the maximum was 127.50 units. The mean and standard deviation of the protein determined for the patients for 24 hours were 51.68 and 34.39 units, respectively. The results of data analysis showed that the amount of protein determined by the intensive care unit for 24 hours with a significantly less relationship than the amount of protein required for the patients for 24 hours was (51.68±34.39 vs. 106.57±13.67, respectively, and P-value<0.001).

*Relationship between the amount of protein determined and required and age*

The mean and standard deviation of the amount of protein determined and required for the patients for 24 hours by different age groups are given in Table 4. The results of data analysis showed that there was a significant relationship between the age of the patients and the amount of protein determined by the intensive care unit for 24 hours (P<0.001) and the amount of protein required for the patients for 24 hours. As such, at the intensive care unit, the most amount of protein were determined for the elderly (60 years and older) (60.80±37.23 units), while the most need for protein was in the middle-aged ones (40-59 years) (110.55±15.12 units).

*Relationship between the amount of protein determined and required and gender*

The mean and standard deviation of the amount of protein determined and required for the patients for 24

hours by gender are given in Table 5. The results of data analysis showed that there was no statistically significant relationship between the patients' genders and the amount of protein determined by the intensive care unit for 24 hours (P=0.949) but there was a significant relationship between gender and the amount of protein required for the patients for 24 hours (P=0.004), so that the men needed more protein than the women did.

*Relationship between the amount of protein determined and the indices examined*

There was no significant relationship between the amount of protein determined by the intensive care unit for 24 hours and body temperature in axillary region (P = 0.538 and R = 0.100), ulna length (P = 0.382 and R = 0.142), height (P = 0.550 and R = 0.097) and weight (P = 0.550 and R = 0.097). There was a significant and direct relationship between the amount of protein required for the patients for 24 hours and ulna length (P<0.001 and R = 0.996), height (P<0.001 and R = 0.996) and weight (P<0.001 and R = 0.999). But this relationship was not significant with body temperature in axillary region (P = 0.579 and R = 0.090).

*Relationship between the amount of protein determined and required and biochemical markers*

There was no significant relationship between the amount of protein determined by the intensive care unit for 24 hours and white blood cell count (P = 0.173 and R = 0.220), lymphocyte count (P = 0.536 and R = -0.101), albumin (P = 0.683 and R = -0.067), sodium (P = 0.687 and R = 0.066), potassium (P = 0.52 and R = -0.104), magnesium (P = 0.843 and R = 0.032), and phosphorus (P = 0.952 and R = 0.010). There was no significant relationship between the amount of protein required for the patients for 24 and white blood cell count (P = 0.470 and R = 0.118), lymphocyte count (P = 0.600 and R = -0.086), albumin (P = 0.623 and R = -0.080), sodium (P = 0.256 and R = -0.184), potassium (P = 0.214 and R = -0.201), magnesium (P = 0.704 and R = 0.062) and phosphorus (P = 0.407 and R = 0.135).

## Discussion

Appropriate nutritional care for patients with acute and critical conditions hospitalized at Intensive Care Unit (ICU) plays an important and decisive role in the process of patient treatment and prevention of disease progression.[9,13] Various studies have shown that nutrition counseling and the implementation of a variety of nutritional support strategies by treatment teams in hospital, and in particular intensive care units, lead to a decrease in the prevalence of malnutrition.[14,15] Therefore, the aim of this study was to evaluate the nutritional status of trauma patients hospitalized at surgical ICU. The amount of energy determined by the intensive care unit for the patients for 24 hours, with a significantly lower relationship than the amount of energy required by the patients for 24 hours, based on the Harris-Benedict formula was (918.20±474.80 calories vs.

1535.76±243.73 calories, respectively and P-value<0.001). The amount of protein determined by the intensive care unit for the patients for 24 hours, with a significantly relationship lower than the protein required for the patients for 24 hours, was (51.68±34.39 vs. 106.57±13.67, respectively, and P-value< 0.001). There was a statistically significant relationship between the age of the patients and energy (P<0.001) and protein (P<0.001) determined by the intensive care unit for the patients for 24 hours and energy (P<0.001) and protein (P<0.001) required for the patients for 24 hours. In studies conducted in this field, such as the study by Wei et al.[16] in 2014, all adult patients hospitalized at the intensive care unit who had undergone mechanical ventilation for at least 8 days were studied. The average daily calorie intake by patients for eight days was obtained and then the life expectancy and quality of life of the patients three and six months later were assessed. The results of their studies showed that high nutrition levels in hospitalized patients in the first weeks increase life expectancy and function recovery to three months, but do not have much effect after six months.[16] In a study by Cathy Alberda et al. in 2009 in Canada, 2772 patients older than 18 years who were hospitalized for more than 72 hours at the intensive care unit and were under mechanical ventilation and were intubated within the first 48 hours of hospitalization were studied.[17] The results of their study showed that increasing 1000 calories per day reduces mortality over 60 days, especially in patients whose BMI is below 25 or above 35, and increases days without mechanical ventilation.[17] In another study by Krishnan et al. in 2002 in the US, 1539 patients who were admitted to two separate teaching hospitals and were hospitalized for at least 96 hours in intensive care units were studied.[12] Disease severity indices were collected by SAPS and nutritional assessment including serum albumin level and BMI. The results indicated that the caloric intake was 50.6% of the expected ACCP goals. Also, the amount of caloric intake depends on the intestinal intolerance but does not depend on the severity of the disease and the basic nutritional status and type of nutrition. Their study also found that patients with moderate caloric intake had better outcomes than those who received low or high calorie intake.[12] In a study conducted by the Department of Nutrition and Diet Therapy at Hammersmith Hospital, London, the results showed that precise nutritional assessment and strategies to improve the quantity and quality of diet therapy in patients hospitalized at intensive care units reduce the prevalence of malnutrition, improve weight gain and thus facilitating the healing process becomes successful.[18] Some studies report like statemnets above[19,20]. Our study is in agreement with all previous cited studies that, by improving the quality and quantity of patients' diets, healing process is facilitated and malnutrition is reduced. The results of the present study show that the gavage solution provided to trauma patients hospitalized at the surgical intensive care unit is insufficient to meet the energy and protein requirements of the patients.

In conclusion, it seems necessary for sensitive patients at high risk, to use precise assessment systems and nutritional support in the hospital by coordinating the medical staff, including doctors, nurses, clinical pharmacists and dietitians.

## List of acronyms

ACCP - American College of Chest Physicians
BMI – Body Mass Index

## Author's contributions

All authors played a substantial role in data acquisition and analysis, and also in conception and revision of the manuscript.

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## Conflict of Interest

The authors have no conflicts to disclose.

## Ethical Publication Statement

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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