

## Prevalence of malnutrition in traffic-injured orthopedic trauma patients

### Abstract

**Introduction:** Malnutrition is an underestimated problem among patients admitted to general hospitals. Although most physicians are aware of the risk of malnutrition, half of the malnourished patients are not identified during their hospital stay. This study aimed to investigate the prevalence of malnutrition in orthopedic trauma patients resulting from traffic accidents.

**Methods:** A total of 60 patients were randomly selected from among orthopedic trauma patients resulting from traffic accidents. Required variables, including age, gender, height, weight, albumin levels, lymphocyte count, and white blood cell count, were collected through patient interviews or extracted from patient records. Additionally, malnutrition in patients was assessed using the translated SGA (Subjective Global Assessment - Diagnosing Malnutrition) questionnaire.

**Results:** Out of the 60 patients, 17 (28.3%) were assessed as having an appropriate nutritional status. In contrast, 43 (71.6%) of the patients were classified as having mild to severe malnutrition. Furthermore, there was no statistically significant difference in nutritional status between male and female patients (P-value=0.838).

**Conclusion:** To improve treatment outcomes and reduce hospitalization costs, nutritional screening and identification of individuals in need of nutritional therapy, especially among severely traumatized patients, are emphasized.

**Keywords:** Malnutrition, Trauma, Orthopedics, Traffic Accidents

*Accepted: 40 days before printing*

Shirvan Rastegar, MD<sup>1</sup>, Mehdi Teimouri, MD<sup>2</sup>, Sahar sadat Lalehzar, MD<sup>1</sup>, Afsane Babamir, MD<sup>1</sup>, Aria Hatami, MD<sup>1</sup>

1. Department of Orthopedic Surgery, Kashani University Hospital, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.

2. Department of Orthopedic Surgery, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran.

### Introduction

Malnutrition is a global problem manifesting as either over-nourishment or undernourishment<sup>(1)</sup>. It is defined by a body mass index (BMI) of less than 18.5 kg/m<sup>2</sup>, or unintentional weight loss accompanied by a reduced BMI or low fat-free mass index. Weight loss can be characterized as more than 10% of usual body weight over an indefinite period or more than 5% over three months<sup>(2)</sup>. Additionally, albumin levels below 3.5 g/dl are considered to be an indication of malnutrition<sup>(3)</sup>.

Malnutrition is an underestimated issue among patients admitted to general hospitals. Estimates suggest that up to 50% of hospitalized patients are malnourished, with even higher rates among critically ill patients<sup>(4)</sup>. In hospitalized patients, malnutrition is significant because it is associated with adverse outcomes such as prolonged hospital stays, more side effects, in-hospital mortality, and higher healthcare costs. Despite most physicians being aware of the risk of malnutrition, half of the malnourished patients remain unidentified during their hospital stay<sup>(5)</sup>. In traffic accidents, where patients are severely injured, the relationship between nutritional status and clinical outcomes becomes more complex due to the systemic pathophysiological responses to trauma. This not only affects the patient's nutritional status but also means that malnutrition can impact the treatment outcomes and recovery of injured individuals. However, the complexity of the impact of nutrition on metabolic changes and clinical outcomes in trauma patients is still not well understood<sup>(6)</sup>. Timely intervention against malnutrition is crucial due to its high health and financial costs. Malnutrition in patients increases the risk of infectious and non-infectious complications, slows wound healing, causes muscle wasting, and increases mortality. These adverse health outcomes are unsurprisingly linked to

Corresponding Author:  
Mehdi Teimouri  
Email Address:  
mteimouri@med.mui.ac.ir

longer hospital stays, higher rates of hospital readmission, greater use of hospital resources, and higher costs for healthcare systems. In contrast, nutritional interventions before, during, and after hospitalization for malnourished individuals can reduce complications, improve treatment outcomes, and lower care costs<sup>(7)</sup>. This study was conducted in light of the lack of comprehensive studies on malnutrition in trauma patients in Iran and the economic burden imposed on society in recent years.

This study aimed to investigate the prevalence of malnutrition in orthopedic trauma patients admitted to Kashani Hospital affiliated with Isfahan University of Medical Sciences. It has ethical code number 1401/039 and project code number 340127 from Isfahan University of Medical Sciences.

## Methodology

This study was conducted in the emergency department of Kashani Hospital, Isfahan University of Medical Sciences, which serves as a referral and admission center for patients with orthopedic trauma resulting from traffic accidents. To estimate the prevalence of malnutrition in this specific patient population, the sample size was determined using the formula for estimating a proportion ( $n = (z^2 \cdot 1 - \alpha / 2) \cdot p(1 - p) / d^2$ ), with  $d = 0.05$ , a confidence interval of 80%, and a sample size of 60. Patients were selected using random simple sampling from the list of orthopedic trauma patients due to traffic accidents. Immediately after admission, a complete history was taken, necessary tests were conducted, and a questionnaire was provided. Variables such as age, gender, height, and weight were collected through patient interviews or from their records. Malnutrition was assessed using the translated Subjective Global Assessment (SGA) questionnaire, which had been localized and validated in 2018 by Jalil Shah Abbasi and colleagues at Tabriz University of Medical Sciences, with its content validity, face validity, construct validity, and reliability confirmed<sup>(7)</sup>. The Persian version of the SGA, used as the gold standard for comprehensive nutritional assessment, includes evaluations of weight, gastrointestinal symptoms, and clinical status, and has been validated in various populations. According to the SGA, a score of A indicates appropriate nutritional status, B indicates mild to moderate malnutrition, and C indicates severe malnutrition.

Demographic information and questionnaire data were entered into SPSS version 18 for analysis, with a statistical significance level of 0.05 considered for all analyses.

## Results

The study population comprised 60 adult patients injured in traffic accidents and admitted to Kashani Hospital. Among them, 19 patients (31.7%) were injured in car accidents, and 41 patients (68.3%) were injured in motorcycle accidents. There were no statistically significant differences between the two groups regarding age, BMI, and blood markers such as white blood cells, lymphocytes, and serum albumin ( $P$ -value  $> 0.05$ ). The gender distribution included 50 men (80%) and 10 women (20%), with an average age of  $46.72 \pm 25.39$  years and an average BMI of  $25.02 \text{ kg/m}^2$  (Table 1).

In this study, the nutritional status of trauma patients was assessed using the SGA questionnaire. It was found that 28.3% of the trauma patients admitted to Kashani Hospital had an appropriate nutritional status, while 71.6% were classified as having mild to severe malnutrition. According to the 95% confidence interval, the prevalence of severe malnutrition among these patients ranged from 31.7% to 56.7% (Table 2). Additionally, there was no statistically significant difference in nutritional status between male and female patients ( $P$ -value = 0.838). Logistic regression analysis revealed that among the variables of age, gender, albumin, white blood cell count, lymphocyte count, and BMI, only serum albumin significantly predicted malnutrition in patients, showing a statistically significant association ( $P$ -value = 0.004). In this study, 40% of trauma patients had serum albumin levels below 3.5 g/dl (Table 3). The study's limitations included a small sample size, as it was conducted in only one hospital, a focus solely on trauma patients, and the restriction of entry criteria to only orthopedic trauma patients.

## Discussion

This study utilized the SGA questionnaire to assess malnutrition, although various other standard methods exist, such as the Subjective Global Assessment (SGS), Mini-Nutritional Assessment (MNA), and Nutrition Risk in the Critically Ill (NUTRIC)<sup>(3-6)</sup>.

**Table 1. Demographic and clinical characteristics of patients (n=60)**

Variable	Number of patients (%) or [interquartile range] ± median	95% Confidence Interval	
		Low	High
Gender, Male	50 (83.3%)	73.3%	93.3%
Age, years	46.72 ± 25.39	39.98 -	53.35
Body Mass Index (BMI), kg/m <sup>2</sup>	25.02 ± 5.26	4.10 -	6.24
White Blood Cell Count (WBC/mm <sup>3</sup> )	9101 ± 3053.33	8348.63	9911.62
Lymphocyte Count (lymphocyte/mm <sup>3</sup> )	1536 ± 800.46	1353.94	1745.56
Albumin, g/dL	3.72 ± 0.74	3.50	4.00

**Table 2. Nutritional status of trauma patients using the SGA questionnaire**

Nutritional Status by SGA	Number (Percentage)	95% Confidence Interval
Adequate nutrition (A)	17 (28.3%)	16.7% - 38.3%
Mild to moderate malnutrition (B)	16 (26.7%)	15.0% - 38.3%
Severe malnutrition (C)	27 (45.0%)	31.7% - 56.7%

**Table 3. Analysis of some predictors of malnutrition in traffic accident victims using logistic regression**

Variable	Odds Ratio	Z	P-value	95% Conf. Interval
Age	1.00	0.06	0.948	0.970 - 1.032
Gender	1.66	0.58	0.0562	0.298 - 9.258
White Blood Cells (WBC)	1.00	0.59	0.554	0.999 - 1.000
Lymphocyte	0.98	-0.39	0.693	0.906 - 1.067
Body Mass Index (BMI)	1.06	0.96	0.338	0.933- 1.693
Albumin	0.121	-2.89	0.004	0.029 - 0.508

The prevalence of malnutrition was investigated in 60 orthopedic trauma patients admitted to Kashani Hospital, affiliated with Isfahan University of Medical Sciences. Results showed that 71.6% of these patients had mild to severe malnutrition, with only 28.3% having an appropriate nutritional status. Specifically, 26.7% (95% CI: 15.0-38.3%) had mild to moderate malnutrition, and 45% (95% CI: 31.7-56.7%) had severe malnutrition. A significant association was found between serum albumin levels and malnutrition, with 40% of trauma patients having serum albumin levels below 3.5 g/dL. However, Celine et al. argued that nutritional status is independent of albumin concentration, advising against using albumin as a nutritional marker<sup>(8)</sup>.

Loftus et al. indicated that serum albumin levels can be misleading as biomarkers for malnutrition, as visceral proteins are valid only during homeostasis.

Inflammation alters liver protein synthesis, making albumin an unreliable marker<sup>(9)</sup>.

Another study criticized albumin's lack of specificity and long half-life (about 20 days) for nutritional assessment<sup>(10)</sup>. These findings contrast with ours, where albumin was linked to malnutrition in trauma patients. Conversely, Eckart et al. (2019) found albumin could predict disease outcomes based on a study of 2,600 participants<sup>(11)</sup>. Malafarina et al. examined over 26,000 individuals and concluded that malnutrition impacts disease outcomes, considering multiple variables, including albumin<sup>(12)</sup>. Khalidish et al. demonstrated that albumin administration in trauma patients improved treatment outcomes, suggesting albumin as a predictor of progress<sup>(13)</sup>. Egbert's study on orthopedic trauma patients found a 39.4% prevalence of hypoalbuminemia using serum markers (albumin below 3.5).

Subjective Global Assessment			
Name: .....			
Date: .....			
<b>Medical History</b>			
<b>WEIGHT</b>	Usual weight.....	Current weight.....	<b>A B C</b>
<b>Wt change past 6 months</b>	Amount weight loss.....	% weight loss.....	
0-<5% loss			*
5-10% loss			*
>10% loss			*
<b>Weight change past 2 weeks</b>	Amount.....		
No change; normal weight			*
Increase to within 5%			*
Increase (1 level above)			*
No change, but below usual wt			*
Increase to within 5-10%			*
Decrease			*
<b>DIETARY INTAKE</b>			
No change; adequate			*
No change; inadequate			*
<b>Change</b>	<b>Duration of change.....</b>		
Suboptimal diet			*
Full liquid			*
Hypocaloric liquid			*
Starvation			*
Intake borderline; increasing			*
Intake borderline; decreasing			*
Intake poor; no change			*
Intake poor; increasing			*
Intake poor; decreasing			*
<b>GASTROINTESTINAL SYMPTOMS</b>			
	Frequency (never, daily, no. of times/week)	Duration (<2wk, >2wk)	
Nausea	.....	.....	
Vomiting	.....	.....	
Diarrhoea	.....	.....	
Anorexia	.....	.....	
None; intermittent			*
Some (daily >2 week)			*
All (daily >2 week)			*
<b>FUNCTIONAL CAPACITY</b>			
No dysfunction	Duration of change .....		*
Difficulty with ambulation/normal activities			*
Bed/chair-ridden			*
<b>Change past 2 week</b>			
Improved			*
No change			*
Regressed			*
This is a consensus document from Dietitian/ Nutritionists from the Nutrition Education Materials Online, "NEMO", team.			

**Figure 1 SGA questioner (Subjective global assessment)**

Kim et al. studied malnutrition in severely injured trauma patients at Busan Hospital's trauma center, using serum albumin parameters, total lymphocyte count, appetite, and gastrointestinal issues. They found malnutrition common in these patients,

serving as an independent prognostic indicator of mortality<sup>(14)</sup>.

These studies align with ours, confirming albumin's impact on malnutrition. No significant differences were found in other variables, such as age, gender,

Physical examination	A	B	C
<b>SUBCUTANEOUS FAT</b>			
Under the eyes	Slightly bulging area		Hollowed look, depression, dark circles
Triceps	Large space between fingers		Very little space between fingers, or fingers touch
Biceps	Large space between fingers		Very little space between fingers, or fingers touch
<b>MUSCLE WASTING</b>			
Temple	Well-defined muscle/flat	Slight depression	Hollowing, depression
Clavicle	Not visible in Males; may be visible but not prominent in females	Some protrusion; may not be all the way along	Protruding/prominent bone
Shoulder	Rounded	No square look; acromion process may protrude slightly	Square look; bones prominent
Scapula/ribs	Bones not prominent; no significant depressions	Mild depressions or bone may show slightly; not all areas	Bones prominent; significant depressions
Quadriceps	Well rounded; no depressions	Mild depression	Depression; thin
Calf	Well developed		Thin; no muscle definition
Knee	Bones not prominent		Bones prominent
Interosseous muscle between thumb and forefinger	Muscle protrudes; could be flat in females		Flat or depressed area
<b>OEDEMA</b> (related to malnutrition)	No sign	Mild to moderate	Severe
<b>ASCITES</b> (related to malnutrition)	No sign	Mild to moderate	Severe
<b>OVERALL SGA RATING</b>	<b>A</b>	<b>B</b>	<b>C</b>

Adapted from: Detsky et al., 1994<sup>8</sup>; Baxter Healthcare Corporation, 1993; McCann, 1996 (Ferguson, Bauer, Banks, Capra, 1996)

**Figure 2: SGA questioner (Subjective global assessment)**

lymphocyte count, white blood cell count, and BMI. Deitch et al. showed the prevalence of malnutrition in severely injured patients varied between 7% and 76%, depending on the context, population, and assessment tools used, identifying malnutrition as a risk factor for complications, mortality, prolonged hospital stays, and reduced quality of life<sup>(15)</sup>.

The study found a 45% prevalence of severe malnutrition. An Iranian study by Kimiyai et al. (2020) reported an 18.6% prevalence of severe malnutrition (C) in trauma patients at Shiraz's Chamran Hospital, with a larger sample size<sup>(16)</sup>. Differences in findings can be attributed to varied measurement tools, sample sizes, populations, and settings. Overall, evidence on malnutrition's impact on trauma recovery is limited, with most studies being small and single-centered. The diversity in definitions, diagnostic criteria, and populations makes comparisons challenging. Nonetheless, addressing malnutrition and early nutritional intervention can potentially reduce complications, improve recovery, and lower healthcare costs in trauma patients.

## Conclusion

Considering that approximately 71.6% of trauma patients experience malnutrition, early detection and intervention are crucial for improving treatment outcomes, reducing complications, and lowering healthcare costs. However, since this study was limited to a single center with a small sample size, more extensive research involving multiple hospitals is recommended to achieve more definitive conclusions.

## References:

1. Bernstein LH, editor the global problem of malnutrition2017. DOI: 10.29011/2575-7091.100059.
2. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition - An ESPEN Consensus Statement. *Clinical nutrition* (Edinburgh, Scotland). 20. 40 -335:(3)3;15  
DOI: 10.1016/j.clnu.2015.03.001. PubMed PMID: 25799486.

3. Lee B, Han HS, Yoon YS, Cho JY, Lee JS. Impact of preoperative malnutrition, based on albumin level and body mass index, on operative outcomes in patients with pancreatic head cancer. *Journal of hepato-biliary-pancreatic sciences*. 2021 ;75-1069:(12)28. DOI: 10.1002/jhbp.858. PubMed PMID: 33128839.
4. Dijkink S, Meier K, Krijnen P, Yeh DD, Velmahos GC, Schipper IB. Malnutrition and its effects in severely injured trauma patients. *European journal of trauma and emergency surgery: official publication of the European Trauma Society*. 1004-993:(5)46;2020. DOI: 10.1007/s00068-020-01304-5. PubMed PMID: 31974669; PubMed Central PMCID: PMC7593306.
5. Clendenen N, Nunns GR, Moore EE, Reisz JA, Gonzalez E, Peltz E, et al. Hemorrhagic shock and tissue injury drive distinct plasma metabolome derangements in swine. *The journal of trauma and acute care surgery*. 2017;83(4):635-42. DOI: 10.1097/TA.0000000000001504. PubMed PMID: 28463938; PubMed Central PMCID: PMC5608631.
6. Rogobete AF, Sandesc D, Papurica M, Stoicescu ER, Popovici SE, Bratu LM, et al. The influence of metabolic imbalances and oxidative stress on the outcome of critically ill polytrauma patients: a review. *Burns & trauma*. 2017;5:8. DOI: 10.1186/s41038-017-0073-0. PubMed PMID: 28286784; PubMed Central PMCID: PMC5341432.
7. Correia M, Sulo S, Brunton C, Sulz I, Rodriguez D, Gomez G, et al. Prevalence of malnutrition risk and its association with mortality: nutritionDay Latin America survey results. *Clinical nutrition (Edinburgh, Scotland)*. 2021;40(9):5114-21. DOI: 10.1016/j.clnu.2021.07.023. PubMed PMID: 34461585.
8. Bretscher C, Boesiger F, Kaegi-Braun N, Hersberger L, Lobo DN, Evans DC, et al. Admission serum albumin concentrations and response to nutritional therapy in hospitalised patients at malnutrition risk: secondary analysis of a randomised clinical trial. *EClinicalMedicine*. 2022;45. DOI: 10.1016/j.eclinm.2022.101301. PubMed PMID: 35198927; PubMed Central PMCID: PMC8844847.
9. Loftus TJ, Brown MP, Slish JH, Rosenthal MD. Serum levels of prealbumin and albumin for preoperative risk stratification. *Nutrition in Clinical Practice*. 2019;34(3):340-8. DOI: 10.1002/ncp.10271. PubMed PMID: 30908744.
10. Keller U. Nutritional laboratory markers in malnutrition. *Journal of clinical medicine*. 2019;8(6):775. DOI: 10.3390/jcm8060775. PubMed PMID: 31159248; PubMed Central PMCID: PMC6616535.
11. Egbert RC, Bouck TT, Gupte NN, Pena MM, Dang KH, Ornell SS, et al. Hypoalbuminemia and obesity in orthopaedic trauma patients: body mass index a significant predictor of surgical site complications. *Scientific reports*. 2020;10(1):1953. DOI: 10.1038/s41598-020-58987-4. PubMed PMID: 32029855; PubMed Central PMCID: PMC7004978.
12. Chalidis B, Kanakaris N, Giannoudis PV. Safety and efficacy of albumin administration in trauma. *Expert Opinion on Drug Safety*. 2007;6(4):407-15. DOI: 10.1517/14740338.6.4.407. PubMed PMID: 17688384.
13. Malafarina V, Reginster JY, Cabrerizo S, Bruyère O, Kanis JA, Martinez JA, et al. Nutritional Status and Nutritional Treatment Are Related to Outcomes and Mortality in Older Adults with Hip Fracture. *Nutrients*. 2018;10. (5) DOI: 10.3390/nu10050555. PubMed PMID: 29710860; PubMed Central PMCID: PMC5986435.
14. Kim H, Hong K-H, Choi I, Lee K-A, Am Song G. Clinical Significance of Malnutrition Risk in Severe Trauma Patients: A Single-Center Study. *Annals of Clinical Nutrition and Metabolism*. 2021;13(2):68-74. doi.org/10.15747/ACNM.2021.13.2.68.
15. Dijkink S, Meier K, Krijnen P, Yeh DD, Velmahos GC, Schipper IB. Malnutrition and its effects in severely injured trauma patients. *European Journal of Trauma and Emergency Surgery*. 2020;46:993-1004. DOI: 10.1007/s00068-020-01304-5. PubMed PMID: 31974669.
16. Kimiaei-Asadi H, Tavakolitalab A. The assessment of the malnutrition in traumatic ICU patients in Iran. *Electronic Physician*. 2017;9(6):4689. DOI: 10.19082/4689. PubMed PMID: 28848649; PubMed Central PMCID: PMC5557154.
17. Ihle C, Bahrs C, Freude T, Bickel M, Spielhauer I, Wintermeyer E, et al. Malnutrition in elderly trauma patients-comparison of two assessment tools. *Zeitschrift fur Orthopadie und Unfallchirurgie*. 2016;155(2):184-93. DOI: 10.1055/s-0042-116822. PubMed PMID: 27685613.
18. Wilson JM, Boissonneault AR, Schwartz AM, Staley CA, Schenker ML. Frailty and malnutrition are associated with inpatient postoperative complications and mortality in hip fracture patients. *Journal of orthopaedic trauma*. 2019;33(3):143-8. DOI: 10.1097/BOT.0000000000001386.
19. Müller F, Meyer OW, Chocano-Bedoya P, Schietzel S, Gagesch M, Freystaetter G, et al. Impaired nutritional status in geriatric trauma patients. *European journal of clinical nutrition*. 2017;71(5):602-6. DOI: 10.1038/ejcn.2017.25. PubMed PMID: 28327565.
20. Chakravarty C, Hazarika B, Goswami L, Ramasubban S. Prevalence of malnutrition in a tertiary care hospital in India. *Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine*. 2013;17(3):170. DOI: 10.4103/0972-5229.117058. PubMed PMID: 24082614; PubMed Central PMCID: PMC3777371.
21. Ebrahimi Fakhari HR, Salemi Z. MALNUTRITION OF PATIENTS IN INTENSIVE CARE UNITS OF ARAK HOSPITALS, IN 1389. *Nursing and Midwifery Journal*. 2012;10(4):0-0. URL: <http://unmf.umsu.ac.ir/article-1-1005-en.html>.
22. Hosseinpour-Niazi S, Naderi Z, Delshad M, Mirmiran P. Prevalence of malnutrition in hospitalized patients in Taleghani hospital in Tehran. *Journal of Gorgan University of medical sciences*. 2011;13(4):97-106. URL: <http://goums.ac.ir/journal/article-1-1201-en.html>.