Educational Administration: Theory and Practice
2024, 30(1), 4246 -4255
ISSN: 2148-2403
https://kuey.net/

Research Article

An Overview OfMalnutrition As An Underestimated Factor In Orthopaedic Surgery

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Citation:Naila Irshad, et.al (2024)An Overview Of Malnutrition As An Underestimated Factor In Orthopaedic Surgery, *Educational Administration: Theory and Practice*, 30(1) 4246 -4255
DOI: 10.53555/kuey.v30i1.7882

ARTICLE INFO

ABSTRACT

A balanced lifestyle and a healthy diet are crucial components of optimal health maintenance.All human metabolic functions depend on proper nutrition hence it is imperative that people receive enough nourishment.Adequate nutrition not only keeps the body functioning but also safeguards against infections and disease and aids in the healing process.For patients undergoing either major or minor surgeries, getting adequate calories and maintaining a healthy nutritional status becomes even more necessary.Substantial effects on outcomes are possible from malnutrition in orthopaedic patients, a condition that is understudied and sometimes neglected.Numerous investigations have demonstrated that malnutrition is highly prevalent in orthopaedic patients. Delays in healing, extended hospital stays, morbidity, a high rate of post-operative complications, and even death are all associated with inadequate nutrition.To prevent complications after surgery, it is crucial to consume a healthy diet while in the hospital. Malnutrition can strike even a well-nourished orthopaedic patient experiencing severe trauma or a post-operative wound infection.Major surgery tends to be tolerated better by well-nourished patients than by severely malnourished patients. The American Society of Parenteral and Enteral Nutrition (ASPEN) has recommended methods for assessing hospital patients' nutritional status. These methods include criteria and data for nutritional needs, food intake, clinical picture of the patients, anthropometric and laboratory parameters. The findings revealed that preoperative and postoperative nutrition is an important yet often overlooked aspect of surgical care. For decades, the link between poor nutritional status and surgical outcomes has been clearly and consistently demonstrated.

Keywords: Malnutrition, Orthopaedic surgeries, post-operative complications, Wound infection, Preoperative nutrition, Postoperative nutrition

Introduction

India is one of the nations with the highest percentage of undernourished people on record in the world[1].A number of contributing factors, such as inadequate intake, increased requirements, impaired absorption, and altered nutrient transport or utilization, have been linked to malnutrition[2]. According to the American Society for Parenteral and Enteral Nutrition (ASPEN), malnutrition results from a combination of varying degrees of overnutrition or undernutrition with or without inflammatory activity, which leads to a change in body composition and diminished function[3]. Malnutrition is common among hospitalized patients and is a serious problem. It occurs all over the world and affects patients of all ages[4]. Malnutrition is also linked to higher rates of morbidity and mortality, a decline in functioning, longer hospital stays, and higher medical expenses[5].Malnourished patients are also at higher risk of re-admission after discharge[6]. It is common in the field of orthopaedic surgery that hospitalized patients have suboptimal clinical outcomes[7]. Malnutrition has been defined in the orthopaedic literature in various ways, including low serum albumin, total lymphocyte count, serum prealbumin, transferrin levels, and haemoglobin. Serum albumin is the most commonly used

serologic measure of pre-operative malnutrition in orthopaedic surgery, with or without total lymphocyte count (TLC) as a supplemental measure[8]. According to studies, 50% of patients in surgical practices are malnourished, and there is a link between nutrition and surgical outcomes. It leads to prolonged treatment, increased morbidity and mortality, and increased hospital costs. Malnutrition is sometimes undiagnosed, untreated, and worsened in hospital[8,9].Good food and exercise were not previously considered effective interventions to promote recovery in orthopaedic surgery, and prolonged bed rest with few calories was deemed sufficient for proper health restoration until the nineteenth century. The advancement of scientific knowledge proved the opposite, requiring professionals to maintain surgical patients' nutritional status and physical fitness[10].The importance of nutrition in surgery was first recognized in the 1930s, when malnutrition was discovered to have a negative impact on surgical outcomes[11]. Malnutrition is so important that in a recent consensus, 95% of orthopaedic surgeons recommended that patients be optimized by correcting malnutrition, anticoagulation, anaemia, and diabetes prior to surgery, as this can significantly alter the patients' postoperative outcome[12]. Preoperative risk factors that can be modified to improve patient outcomes have been investigated and continue to be a source of great interest[13]. During the pre-operative period, the traditional and strict rule applies. Nothing by mouth is used from midnight to the day of surgery to ensure an empty stomach. The pre-operative diet is intended to reduce the risk of regurgitation, nausea, and vomiting in patients under anaesthesia, thereby preventing stomach contents aspiration[14]. Traditional overnight fasting before surgery is thought to be beneficial. However, over the last decade, many national and international anaesthesia societies have changed preoperative fasting guidelines, now recommending free intake of clear fluids up to 2-3 hours before surgery. This has been proven safe and was developed to alleviate the discomfort of thirst. The goal of preoperative nutrition is to ensure that there is enough energy to deal with the stress[15]. The therapeutic goal for the postoperative patient is rapid recovery to normal function and wellbeing; early oral intake and mobilization are the most effective weapons. There is no scientific justification for withholding food from patients following surgery. Most patients undergoing surgery can resume oral feeding within hours of surgery[16]. This review will discuss the role of nutrition in orthopaedic surgical patients, including the importance of adequate nutrition and how preoperative nutrition can help reduce nutrition-related and other complications. The goal of this review is to better understand how malnutrition affects post-surgical outcomes. This review will provide a new perspective on the importance of nutritional status and how the outcomes of surgery are directly related to nutritional status before and after the procedure.

Nutrients and Bone Health

Protein

Protein and calcium are essential components of peak bone mass. Adequate protein intake combined with adequate calcium intake is required for optimal bone health[17]. A meta-analysis of studies on protein intake and bone health indicators found that while it had a slight positive effect on bone mass density, it had no long-term effect on fracture risk[18]. A satisfactory state of protein nutrition promotes rapid wound healing, increases resistance to infection, protects the liver from the toxic effects of anaesthesia, and reduces the possibility of oedema at the wound site. The amount of protein used in preoperative and postoperative diets is determined by the patient's previous nutritional status, the nature of the operation, and the postoperative losses. As a general guideline, 1.0 to 1.5g per kilogram or 100g of protein should be consumed. When protein is depleted in the postoperative period, complications increase. Protein catabolism is increased in the days immediately following surgery[4].

Calcium

Calcium is an essential element that serves a variety of biological functions in the human body, the most important of which is skeleton mineralization. Bone is a mineralized connective tissue made up primarily of calcium, which provides bone strength and structure. Proper calcium intake is essential for bone development and metabolism, and it varies throughout life[19]. A healthy calcium homeostasis is essential not only for bone remodelling, the physiological process of bone resorption and formation that constantly renews bone throughout life, but also for normal fracture healing[20].

Vitamin D

Vitamin D levels are primarily determined by sunlight exposure, followed by dietary intake. Vitamin D is synthesized when the skin is exposed to sunlight. Only a few foods naturally contain vitamin D, including egg yolks, fatty fish, cod liver oil, and mushrooms[21]. Vitamin D is essential for bone mineralization. Deficiency causes rickets in children and osteomalacia in adults, both of which are characterized by bone pain, proximal muscle weakness, and increased risk of fractures[22]. Vitamin D is produced in the skin through ultraviolet light exposure; however, prolonged exposure to sunlight is not recommended due to skin aging and an increased risk of skin cancer[23]. The upper limit for safe vitamin D intake is 2000 IU per day. Many experts, including the National Osteoporosis Foundation, recommend aggressive supplementation with at least 800-1000 IU per day in patients over the age of 50 who have insufficient vitamin D levels[24]. Vitamin D clearly plays an important role in bone metabolism. Vitamin D deficiency can impede bone metabolism, affecting fracture healing. Vitamin D deficiency has been observed in hip fracture patients and paediatric patients undergoing orthopaedic

surgery. Low vitamin D levels have been linked to fracture nonunion, stress fractures, Blount's disease, and slipped femoral epiphysis[24].

Nutritional Assessment Components

The nutritional status of the hospitalized patient is evaluated in four steps. First and foremost, patients must undergo a nutritional screening to determine whether they are at risk of poor nutritional status. The second step involved providing patients who are nutritionally at risk with a more thorough nutritional assessment to determine the severity and causes of their nutritional impairment. Third, if the patient is nutritionally deficient, the dietitian should devise a nutritional plan to improve the patient's nutritional status. Finally, the patient should be closely monitored to ensure an appropriate response to nutritional support[25]. Within 24 hours of a patient's admission to a hospital, a nutritional screening is performed to identify those who are malnourished or at risk of malnutrition. A nutrition screening is the process of gathering a limited amount of health-related information in order to identify malnutrition. In recent years, a number of screening tools based on different combinations of variables have gained popularity, including the Mini Nutritional Assessment and the Subjective Global Assessment[26]. Once nutritional screening has determined that a patient is at nutritional risk, a nutritional assessment should be performed to determine the severity and causes of the patient's nutritional impairment[27]. Nutritional assessment components consist of:

1. Historical information
2. Dietary data
3. Anthropometric data
4. Laboratory indicators
5. Clinical signs and physical examination[27].

Historical data reveals clues about the patient's nutritional status, nutrient requirements, and personal preferences that must be considered when developing a nutrition care plan. This information can be obtained from medical records or by interviewing the patient or caregiver[26]. Accurate food intake data collection is difficult, and the results may differ depending on the individual's memory and the assessor's skill and training. Once food intake data has been collected, nutrient intake can be estimated using dietary analysis software or a food composition table. The food list reveals a person's food preferences, which can be useful when developing a nutrition care plan, planning menus, or providing dietary counselling. Some techniques for gathering dietary data include 24-hour recall, food frequency questionnaires, food records, and direct observation[28]. Anthropometric data can reveal issues related to overnutrition and protein-energy malnutrition. Height and weight are the most commonly used anthropometric measurements for assessing growth in children and nutrition status in adults[29]. Anthropometric measurements, such as calf muscle circumference, provide an indirect measure of malnutrition by revealing body composition. Arm circumference between 60-90% of the standard for a specific sex indicates modern malnutrition, while circumference <60% indicates severe malnutrition[30]. Calculating a patient's BMI is a very useful method for determining weight and nutritional risk status. BMI should be interpreted with caution and in light of the individual patient's condition. Some conditions that can affect the accuracy of BMI values include edema, high muscularity, short stature, and muscle wasting[31]. Another critical aspect of the nutritional assessment is a review of nutrition-related laboratory values. Prealbumin, albumin, transferrin, haemoglobin, and total lymphocyte count are the most commonly measured laboratory parameters. Despite the fact that these laboratory measures are influenced by fluid shift and the physiologic response to injury, they have been shown to predict postoperative complications and outcomes. These markers, particularly albumin and total lymphocyte count, have been shown to be reliable indicators of malnutrition[32]. Patients may be classified as malnourished or at high nutritional risk in a preoperative nutrient assessment if these laboratory markers are below normal. Although lower-than-normal levels of albumin, prealbumin, total protein, and transferrin can help diagnose malnutrition in preoperative patients, they may not accurately reflect postoperative nutritional status. These values may change as a result of postoperative physiological stress, an inflammatory response, medication changes, or fluid balance changes[33]. When assessing postoperative nutritional status, changes in these laboratory values should be evaluated and reported in relation to the patient's preoperative baseline values, rather than following standard laboratory guidelines[34]. Signs of malnutrition are most common in areas of the body where cell replacement occurs quickly, such as the hair, skin, eyes, lips, nails, and digestive tract, including the month and tongue. Some clinical symptoms and signs appear on these body parts, indicating a deficiency of various nutrients in the body. For example, dull, brittle, corkscrew hairs may indicate malnutrition, as may pale membranes, spots, dryness, night blindness, and redness of the eyes, but these signs may also indicate other causes[26].

Preoperative and Postoperative Nutritional Care

Many settings have discontinued the routine practice of ordering a patient to take nothing by month (NPO) at midnight prior to surgery. Historically, the American Society of Anaesthesiologists recommended avoiding solids for 6 hours before surgery and clear liquids for 2 hours before anaesthesia was administered[35]. It has been demonstrated that drinking carbohydrate-rich beverages before surgery improves glycaemic control and reduces nitrogen, lean body mass, and muscle strength losses[36]. Preoperative fasting is not possible in emergency patients, so surgery should be scheduled based on urgency[37]. The timing of solid food introduction after surgery is determined by the patient's level of alertness and the condition of the gastrointestinal tract. A

common practice has been to progress from clear liquids to full liquids and then solid foods over the course of several meals. There is no physiological reason why solid foods should not be introduced as soon as the GI tract is functional and a few liquids can be tolerated[38].

Methodology

The following review study is the result of compiled information gathered from relevant research articles and clinical reviews; Google Scholar, Pub Med, and Medline were used to explore and target such content using keywords such as *Malnutrition, Orthopaedic surgeries, post-operative complications, Wound infection, Preoperative nutrition, Postoperative nutrition*. The content was critically analysed for the purpose of reviewing. The search reviewed all the available articles and reviews, published in the English Language from the time period of 2015-2023. More than 30 studies were reviewed but only 15 studies were selected for this review paper.

Table 1 Studies examining the effects of malnutrition on postoperative outcomes in orthopaedic surgeries

Year	Author	Summary of methods	Main Findings
2015	Walls JD *et al*[39]	The study's methodology involved identifying a large sample of total hip arthroplasty patients and comparing morbidly obese, non-morbidly obese, patients with hypoalbuminemia, and those with normal albumin.	Clinical research could benefit from the identification of high-risk patients and modifiable risk factors prior to surgery. Hypoalbuminemia increases the risk of mortality and major morbidity in total hip arthroplasty patients, whereas morbid obesity only increases the risk of superficial surgical site infection. Patients with hypoalbuminemia had a 5.94-fold higher risk of 30-day mortality.
2016	Kamath AF *et al*[40]	1098 patients were followed as part of a prospective risk stratification program at a tertiary, high-volume arthroplasty centre. Chronic malnutrition was defined as preoperative albumin <3.5 g/dL.	Malnutrition was present in 16.9% of patients undergoing primary and revision arthroplasty overall. Nutritional status has an impact on postoperative ICU admission; preoperative albumin levels below 3.0 and 3.5 g/dL were linked to 15.4% and 3.8% rates of unplanned ICU admission, respectively. Individuals with inadequate nutritional status ought to receive counselling regarding the potential for unfavourable medical outcomes.
2017	Ihle C *et al*[41]	The study's methodology included a prospective field study in a level I trauma center in Germany, utilizing the Nutritional Risk Screening (NRS) to screen for malnutrition, the SF-36 to measure quality of life, and clinical outcomes like adverse events, length of hospital stay, and post-treatment mobilization. Patients were included regardless of age or type of surgery.	Hospitalized orthopaedic and trauma patients frequently suffer from malnutrition, particularly the elderly who have common fractures. Malnourished patients are more likely to require prolonged hospital stays, be delayed in being mobilized following treatment, and have a higher rate of adverse events. A delayed recovery and less than ideal clinical outcomes are directly caused by malnutrition.
2018	Rudasill SE *et al*[42]	The methodology used in the study involved a retrospective study design, stratification of patients by preoperative serum albumin level and type of procedure, and the utilization of multivariable regressions to adjust for demographics and comorbidities.	The costs of treatment increased by 16.2% for hypoalbuminemia, decreased by 6.6% for every 1.0 g/dL increase in serum albumin, and decreased by 53% for readmissions and 0.6 days for length of stay for every 1-point increase in serum albumin.

2018	Phan Kevin *et al*[43]	The ACS NSQIP database was used for retrospective cohort analysis, patients were divided into cohorts according to serum albumin levels, chi-square and multivariate logistic regression models were employed, and SAS Studio Version 3.4 was used for statistical analysis.	Nutritional deficiency, as demonstrated by preoperative hypoalbuminemia, is substantially linked to a higher risk of death, hospital stays longer than five days, complications, pulmonary complications, renal complications, and intra- and postoperative red blood cell transfusion in patients having adult spinal deformity surgery. The frequency of adult spinal deformities is rising among the aging population, and elderly patients undergoing deformity surgery are more likely to have preoperative morbidities that could compromise the success of the procedure. When patients are having adult spinal deformity surgery, preoperative hypoalbuminemia is a significant and independent risk factor for postoperative complications, 30-day mortality, and longer hospital stays.
2019	Black CS et *al*[44]	A single institution's TJA patients' preoperative albumin levels were reviewed for a total of 4047 cases between 2013 and 2018. To determine the association between albumin levels and outcomes like length of stay, readmissions, and ED visits, statistical techniques were employed, including univariable and multivariable logistic regression.	According to the paper, preoperative albumin may be a factor in predicting 90-day outcomes and length of stay in patients undergoing total joint arthroplasty (TJA). Malnutrition is also associated with an increased risk of complications in TJA patients. A preoperative evaluation that includes screening for malnutrition may be crucial, and an albumin cutoff value of 3.5 g/dL may fail to identify certain at-risk patients.
2019	Bala et *al*[45]	Using a combination of Medicare and private payer databases, the methodology entailed matching patients according to serum albumin levels and other characteristics, computing odds ratios and confidence intervals for complications, and contrasting reimbursements between matched groups.	Patients who underwent total joint arthroplasty (TJA) and were malnourished were more likely to experience periprosthetic joint infection, multiple organ failure, and reoperation 90 days after surgery. When a patient with protein malnutrition had a TJA, the average reimbursement increase over a 90-day period was $3875.
2020	Yagi T *et al*[46]	The study employed a retrospective review approach to examine patients who underwent hip fracture surgery. Additionally, preoperative laboratory tests were used to calculate the CONUT score, and data on potential confounders were collected. Postoperative complications were defined and simple and multivariable logistic regression analyses were conducted.	In patients with hip fractures, the CONUT score was discovered to be an independent risk factor for surgical complications. The incidence of postoperative complications is independently correlated with preoperative CONUT scores. Once ASA-PS and CCI were taken into account, the CONUT score was found to be an independent predictor of postoperative complications.
2020	Kishawi D *et al*[47]	To find the relationship between hypoalbuminemia and postoperative outcomes, the methodology included using data from the NSQIP database, performing a multivariate regression analysis, and doing univariate analyses using the student t test and chi-square test.	Postoperative complications, such as cardiac arrest, myocardial infarction, cerebrovascular accident, surgical site infection, sepsis, pneumonia, renal insufficiency, unplanned intubation, return to the operating room within 30 days, urinary tract infection, and wound infection, were more common in patients with lower albumin levels. Following all primary total joint arthroplasties or revisions, patients with normal preoperative albumin levels and those with low albumin levels showed significantly different 30-day postoperative complications, according to the study. To mitigate unfavourable outcomes, more research is required to develop interventions to raise serum albumin concentrations prior to surgery.

2020	Wilson JM *et al*[48]	A retrospective cohort design, patient identification from a particular database, exclusion of patients with hip fractures, preoperative serum albumin levels and frailty index scores, formation of four cohorts based on malnourishment and frailty, and gathering and analysis of demographic and complication data were all part of the study's methodology.	For patients undergoing total hip arthroplasty (THA), the co-existence of frailty and malnutrition has deleterious effects, such as increased risk of complications, a 30-day mortality rate of 1.9%, and higher resource utilization. Although they only have a weak correlation, frailty and malnutrition are physiologically compromised states that require further investigation to determine how modifiable these risk factors are.
2021	Eminovic S *et al*[49]	The methodology comprised retrieving clinical and demographic data from medical records, evaluating nutritional status retrospectively using serum albumin and TLC, performing statistical analysis, including group comparisons and hazard ratio and Kaplan-Meier curve analysis of complications.	The purpose of the study was to determine the prevalence of protein energy malnutrition (PEM) and whether it was associated with a worse prognosis following primary total hip replacement (THA) in older patients. PEM patients were more likely than non-PEM patients to experience complications six months after surgery (hazard ratio: 6.3). There was a difference between the study's observed (12.3%) PEM prevalence and that of a related study.
2021	Sugumar D *et al*[50]	The approach comprised gathering nutritional parameter data on patients undergoing major spine surgery both before and after the procedure, then performing statistical analyses with a variety of tests to find trends over time and correlations between variables. Every analysis was conducted using the IBM SPSS program.	There was a significant correlation found between low postoperative prealbumin levels and higher rates of complications. The degree to which surgery reduces nutritional status in terms of albumin and prealbumin levels is a strong indicator of complications related to wound healing. Individuals undergoing major spinal surgery run the risk of becoming malnourished.
2021	Meyer M *et al*[51]	The study employed a retrospective methodology to analyse 599 elderly patients who had elective orthopaedic surgery. The patients' hypoproteinaemia and folate, vitamin D, and vitamin B12 deficiencies were assessed. After adjusting for confounding variables, multivariable logistic regression models were utilized to evaluate the association between postoperative adverse events and malnutrition. Information from the hospital information system was taken out.	A higher incidence of reoperation, more wound-healing disorders, and complications from Clavien-Dindo IV° were linked to malnutrition. An increased risk of falls has been connected to vitamin D deficiency. A multivariable regression analysis revealed malnutrition as a separate risk factor for wound healing disorders and reoperation.
2022	Briguglio et *al*[52]	In order to properly restore health following orthopaedic surgery, the paper addresses the historical perspective on the role of exercise and a healthy diet, the significance of maintaining a good nutritional status and physical ability, and the application of HACCP-derived methodology for managing preoperative nutritional and physical hazards.	The study suggests using the Hazard Analysis and Critical Control Points (HACCP) system to define an efficient optimization protocol in advance of surgery and highlights the significance of maintaining a healthy nutritional status and physical ability for appropriate health restoration following orthopaedic surgery. It highlights the necessity of a methodical approach to preoperative risk management, which includes hazard identification, risk calculation, action monitoring, and intervention planning to address unmanaged risk.
2023	Pes M *et al*[53]	All categories of peer-reviewed literature published in English between 2015 and 2022 were included in the search. From a starting point of 745 studies, we finally included 16 articles in the review.	The most frequent complication in ten studies was surgical site infection; malnutrition was associated with an increase in average length of stay (LOS) in eight studies; and an increase in costs was the primary finding in five studies. Two studies showed an increase in the number of transfusions, while three studies showed an increase in morbidity. Lastly, a high rate of unscheduled ICU admissions was discovered in one study.

Discussion

Malnutrition is widespread among hospitalized patients in the field of orthopaedic surgery results in suboptimal clinical outcomes, it should be considered as an important factor contributing to delayed recovery[41]. The findings indicate that optimizing a patient's nutritional status prior to surgery may help reduce postoperative complications and improve surgical outcomes. The studies found that malnutrition impairs normal immune function and frequently leads to poor wound healing, putting the patient at risk for surgical site infections and poor postoperative outcomes. Studies have shown that optimizing patients' pre-operative nutritional status is associated with improved surgical outcomes and number of functions. Bone health is an ongoing concern because bones are living tissues. The better our nutritional status prior to surgery, the better our body's ability to heal after surgery and reduce recovery time. Malnutrition affects nearly half of all hospitalized patients, increasing the risk of post-operative complications. Preoperative nutrition is an important yet underappreciated aspect of surgical care. In recent years, there has been a growing interest in the impact of nutritional status on clinical outcomes in hospitalized patients. Nonetheless, available literature is extremely limited. From this review it was realized that a very few studies have been published from Indian hitherto. Hence, this review brings about information that will be indispensable in aid of this research gap.

Conclusion

For decades, there has been a clear and consistent link between poor nutritional status and surgical outcomes. Post-operative nutrition is critical to a patient's rapid return to normal function and health. Post-operative nutrition reduces complications and allows for an early hospital discharge. It is estimated that malnutrition affects one in every three hospital patients. Increased awareness and knowledge about the problem could help patients recover faster, shorten their convalescence period, and reduce the associated complications. It is critical to raise awareness and improve understanding of the importance of pre- and post-operative nutrition in order to effectively manage the condition and recover quickly. Intervention strategies would be provided to promote their nutritional and health status.

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