GOIANA JOURNAL OF MEDICINE

DOI 10.63162/V67N70E26717
ISSN 0034-9585
e26717
SCIENTIFIC ARTICLE - SYSTEMATIC REVIEW

IMPORTANCE OF NUTRITIONAL SUPPORT IN THE PRE- AND POSTOPERATIVE PERIODS OF ORTHOPEDIC SURGERY

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ABSTRACT

Total hip and knee arthroplasty are among the most frequently performed orthopedic procedures worldwide, with projections indicating exponential growth over the coming decades. Although long-term functional outcomes are favorable, the perioperative period is marked by a systemic inflammatory response, protein catabolism, and muscle atrophy—particularly of the quadriceps—that may impair recovery. Perioperative nutritional optimization has emerged as a promising strategy to mitigate surgical stress and enhance rehabilitation. Specific interventions, including essential amino acid supplementation, preoperative carbohydrate loading, and immunonutrition, have shown potential to preserve muscle mass, modulate metabolic response, and reduce postoperative complications. However, the literature remains fragmented, with significant methodological heterogeneity regarding populations, supplementation protocols, and outcome measures, underscoring the need for standardized clinical trials. Current evidence indicates that perioperative nutritional interventions are safe and effective in improving functional and metabolic outcomes after hip and knee arthroplasty. Personalized nutritional strategies tailored to patient characteristics represent a valuable opportunity to establish nutritional support as a standard component of perioperative orthopedic care.

Keywords: Arthroplasty, Perioperative nutrition, Essential amino acids, Immunonutrition, Functional recovery.

INTRODUCTION

Total hip and knee arthroplasty represent some of the most commonly performed orthopedic surgical interventions worldwide, with projections indicating exponential growth in the number of procedures over the coming decades. In the United States, Medicare data demonstrate that the annual volume of primary hip arthroplasty increased from 305,082 in 2013 to 594,981 in 2022, with projections reaching 2,174,382 procedures by 2040. For knee arthroplasty, projections are equally remarkable, with estimated increases of 139% by 2040 and 469% by 2060 compared with 2019 figures.[1,2]

This exponential growth is driven by global population aging and the increasing prevalence of osteoarthritis, which affects approximately 365 million people worldwide, with 73% of cases occurring in individuals over 55 years of age.[3]

Although these procedures demonstrate excellent long-term functional outcomes, the perioperative period is characterized by a significant systemic inflammatory response, protein catabolism, and muscle atrophy that may compromise functional recovery. Quadriceps muscle strength loss may reach up to 62% in the immediate postoperative period, with a 10% reduction in muscle cross-sectional area, and this atrophy is particularly problematic in vulnerable populations such as older adults, individuals with diabetes, and patients with preexisting sarcopenia.[4]

Perioperative nutritional optimization has emerged as a promising strategy to mitigate the deleterious effects of surgical trauma and accelerate functional recovery. Specific nutritional interventions, including essential amino acid supplementation, preoperative carbohydrate loading, immunonutrition, and multimodal protocols, have demonstrated potential to preserve muscle mass, modulate the metabolic response, and reduce postoperative complications.[5]

Despite the growing interest in these interventions and evidence supporting their benefits, the literature remains fragmented, with studies showing significant methodological heterogeneity regarding populations, supplementation protocols, and assessed outcomes, thereby justifying the need for a systematic synthesis of the literature to guide evidence-based clinical practice.

Therefore, the aim of this study is to evaluate, through a literature review, the impacts of nutritional support in the preoperative and postoperative periods of orthopedic surgery.

METHODS

A literature review was conducted focusing on the identification of clinical trials and systematic reviews addressing the impact of nutritional support in patients undergoing orthopedic surgery, both in the preoperative and postoperative periods. The objective of the search was to gather and analyze recent scientific evidence investigating the influence of nutritional interventions on functional recovery, reduction of complications, and improvement of clinical outcomes in these patients.

The search was performed in the following electronic databases: PubMed/MEDLINE (via the National Library of Medicine), Scopus (Elsevier), Web of Science (Clarivate Analytics), SciELO (Scientific Electronic Library Online), and the Cochrane Library. These platforms were selected because of their broad coverage and relevance in indexing clinical studies and systematic reviews in the health sciences.

The search period included publications from January 2016 to October 2025. The selection of this timeframe aimed to ensure the inclusion of recent studies. The following inclusion criteria were established: randomized and non-randomized clinical trials; studies involving adult patients undergoing orthopedic surgery; investigations evaluating nutritional interventions, such as oral supplementation, specialized diets, enteral nutrition, or parenteral nutrition; and studies reporting outcomes related to functional recovery, length of hospital stay, wound healing, infection, or postoperative complications.

Exclusion criteria comprised observational studies without nutritional intervention, narrative reviews, case reports, editorials, experimental animal studies, and studies involving pediatric populations. Studies whose full text was not available in English, Spanish, or Portuguese were also excluded.

The article selection process was carried out in four main stages. Initially, titles and abstracts were screened to eliminate duplicates and studies unrelated to the topic. Subsequently, the full texts of potentially eligible articles were reviewed. A systematic extraction of data from the included studies was then performed, encompassing information regarding authors, year of publication, type of nutritional intervention, sample size, evaluated outcomes, and principal findings. Finally, a qualitative synthesis of the findings was conducted, allowing the identification of patterns and gaps in the available evidence.

The classification of levels of evidence and methodological strength proposed by the Oxford Centre for Evidence-Based Medicine (CEBM, 2011) was adopted. According to this classification, level 1A–1B studies correspond to high-quality randomized clinical trials or meta-analyses; levels 2A–2B include lower-quality controlled studies or cohort studies; level 3 encompasses case-control studies; and levels 4–5 refer to case series and expert opinions. Combinations of controlled descriptors and free-text keywords, in English and Portuguese, were used according to the Medical Subject Headings (MeSH) and Health Sciences Descriptors (DeCS) systems.

The primary search strategy, adapted for each database, was as follows:
("Nutritional Support" OR "Nutrition Therapy" OR "Perioperative Nutrition" OR "Dietary Supplementation")
AND ("Surgery" OR "Orthopedic Surgery")
AND ("Preoperative Period" OR "Postoperative Period")
AND ("Clinical Trial" OR "Randomized Controlled Trial")

Portuguese version (of SciELO and LILACS):
("Suporte Nutricional" OR "Terapia Nutricional" OR "Suplementação Dietética")
AND ("Cirurgia" OR "Cirurgia Ortopédica")
AND ("Período Pré-operatório" OR "Período Pós-operatório")

After applying the inclusion and exclusion criteria to each study, the relevant data were extracted and compiled in Table 1.

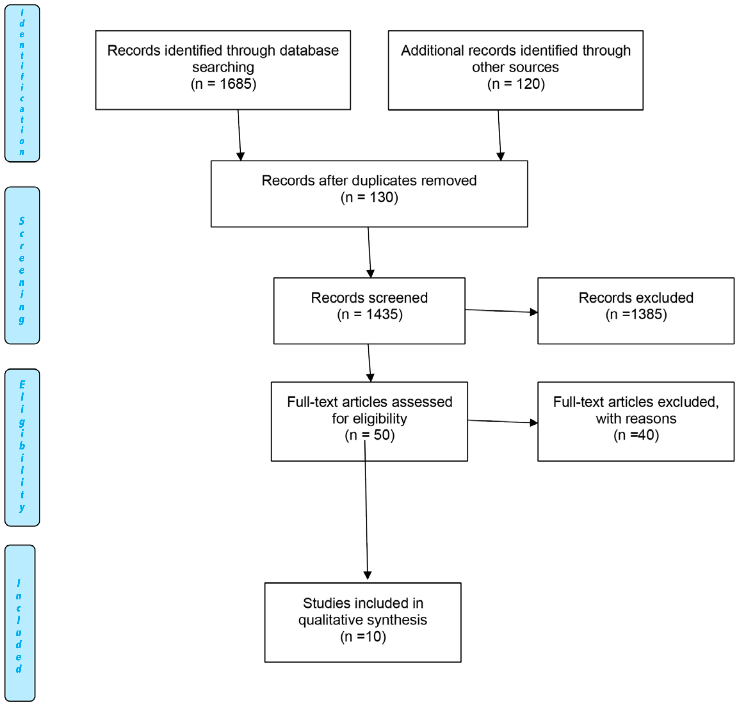

Figure 1: Study inclusion and exclusion flowchart.

RESULTS

Coronary The systematic search of the databases identified a total of 1,686 potentially relevant articles. After the removal of duplicates and the application of inclusion and exclusion criteria, 10 studies were included in this systematic review, comprising 6 randomized clinical trials, 2 systematic reviews with meta-analysis, 1 feasibility trial, and 1 retrospective study, totaling 5,246 participants.

The studies were published between 2016 and 2025, with the mean age of participants ranging from 53 to 85 years. Seven studies focused on total knee arthroplasty (TKA), two on total hip arthroplasty (THA), and one included both procedures. According to the Oxford classification, two studies presented level 1a evidence, six studies were classified as level 1b, and two studies as level 2b.

Figure 1: Study inclusion and exclusion flowchart.

AUTHOR/YEAR	TYPE OF STUDY	SAMPLE	INTERVENTION	RESULTS	LEVEL OF EVIDENCE
Ueyama et al., 2023	Double-blind RCT	n=52 (unilateral TKA)	EAAs 9 g/day vs placebo (lactose), 1 week pre-op + 2 weeks post-op	Rectus femoris muscle area: 134% vs 114% (p<0.05); Quadriceps strength: 159% vs 125% (p<0.05) at 2 years	1b
Dreyer et al., 2018	Double-blind RCT	n=39 (primary TKA, 53–76 years)	EAAs 20 g twice daily vs placebo, 7 days pre-op + 6 weeks post-op	Quadriceps volume in the operated leg: -8.5% vs -13.4% (p=0.033); Contralateral quadriceps volume: -1.5% vs -7.2% (p=0.014)	1b
Lai et al., 2025	RCT	n=90 (TKA + T2DM)	Oral CHO 2 h or 4 h pre-op vs placebo	Insulin resistance at 2 h: 9.0 ± 3.4 vs 30.9 ± 10.5 (p<0.001); Postoperative hyperglycemia: 12% vs 34% (p<0.01)	1b
Alito & Aguilar-Nascimento, 2016	RCT	n=32 (THA, 26–85 years)	ACERTO protocol + immunonutrition (Impact® 600 mL/day, 5 days pre-op) vs traditional care	Length of hospital stay: 3 vs 6 days (p<0.01); Lower postoperative CRP in the intervention group (p<0.01)	1b
Khani et al., 2025	Systematic review and meta-analysis	n=903 (19 studies, TKA/THA)	Oral or IV protein/amino acid supplementation vs control	Quadriceps mass: MD 0.69 (95% CI 0.44–0.95); Hamstring mass: MD 1.04 (95% CI 0.52–1.55); No significant difference in strength	1a
Pradhan et al., 2025	Systematic review and meta-analysis	n=756 (10 studies, TKA/THA, 57–71.9 years)	Preoperative CHO vs control	Length of hospital stay: −0.47 days (95% CI −0.98 to 0.04, p=0.07); No significant differences in pain, nausea, or vomiting	1a
Simpson et al., 2019	Feasibility RCT	n=60 (TKA, 66.8 ± 8.6 years)	Multimodal package: weight loss + exercise + insoles + analgesia (12 weeks) vs standard care	Weight loss: 11.2 kg vs 1.3 kg (p<0.001); Improved quality of life (0.078 ± 0.195); Adherence 94%	2b
Kadado et al., 2022	RCT	n=153 (primary TKA)	CHO vs placebo vs control (no beverage)	No differences in pain, nausea, or length of hospital stay; 90-day readmission: 0% vs 5.9% vs 11.5% (p=0.047)	1b
Gonçalves et al., 2020	Retrospective study	n=3,015 (older adults, TKA/THA)	Immunonutrition (200 mL three times daily, 5 days pre-op + 5 days post-op) vs control	Length of hospital stay: 32.0 ± 19.4 h vs 56.0 ± 26.4 h (p<0.001); Infectious complications: 2.2% vs 4.6% (p<0.001); OR 0.45 (95% CI 0.30–0.68)	2b
He et al., 2022	RCT	n=94 (TKA, >65 years)	OECNS (electrolytes + CHO) 2 h pre-op vs traditional fasting	Preoperative hunger: 0.43 ± 0.10 vs 1.19 ± 0.21 (p<0.05); Anxiety: 9.04 ± 2.71 vs 11.21 ± 3.02 (p<0.05); POD1 hyponatremia: 6.4% vs 21.3% (p=0.036)	1b

RCT = Randomized Controlled Trial; TKA = Total Knee Arthroplasty; THA = Total Hip Arthroplasty; EAA = Essential Amino Acids; CHO = Carbohydrates; T2DM = Type 2 Diabetes Mellitus; OECNS = Oral Electrolyte and Carbohydrate Supplementation; CRP = C-Reactive Protein; SMD = Standardized Mean Difference; CI = Confidence Interval; OR = Odds Ratio.

DISCUSSION

Two double-blind randomized clinical trials (level 1b) specifically evaluated essential amino acid supplementation. Ueyama et al.[6] demonstrated that supplementation with 9 g/day for 3 perioperative weeks resulted in superior recovery of rectus femoris muscle area at 2 years and improved quadriceps strength.

Dreyer et al., using a higher dose (20 g twice daily) over a longer period (7 days preoperatively plus 6 weeks postoperatively), observed significant preservation of muscle volume measured by magnetic resonance imaging. The intervention group exhibited less loss of quadriceps volume in both the operated leg and the contralateral leg.[7]

The meta-analysis by Khan et al. (level 1a), including 19 studies with 903 patients, confirmed the benefits of protein and amino acid supplementation for preserving muscle mass. The analysis demonstrated a significant reduction in muscle atrophy of the quadriceps femoris and hamstrings. However, the effects on muscle strength were inconsistent, with no significant differences between groups.[8]

Lai et al. (level 1b) specifically evaluated 90 patients with type 2 diabetes mellitus undergoing TKA. Administration of oral carbohydrates 2–4 hours before surgery resulted in a dramatic reduction in postoperative insulin resistance.[9] The group receiving carbohydrates 2 hours before surgery exhibited significantly lower insulin resistance compared with placebo, representing a 71% reduction. The incidence of postoperative hyperglycemia was also lower.

He et al. (level 1b) evaluated 94 older patients (>65 years) receiving combined electrolyte and carbohydrate supplementation (OECNS) 2 hours preoperatively. The results demonstrated significant improvement in perioperative comfort, with reductions in preoperative hunger, anxiety, and a lower incidence of postoperative hyponatremia.[10]

The meta-analysis by Pradhan et al. (level 1a), including 10 studies with 756 patients, did not demonstrate a statistically significant reduction in length of hospital stay with preoperative carbohydrate loading (mean difference of −0.47 days), although a favorable trend was observed. No significant differences were found in postoperative pain, nausea, or vomiting.[11]

Alito and Aguilar-Nascimento (level 1b) demonstrated that the ACERTO protocol combined with immunonutrition (Impact® 600 mL/day for 5 preoperative days) resulted in a significant reduction in hospital stay (median of 3 vs. 6 days, $p < 0.01$) and lower postoperative C-reactive protein levels.[12]

Gonçalves et al. (level 2b), in a retrospective study involving 3,015 older patients, observed that perioperative immunonutrition significantly reduced length of hospital stay (32.0 ± 19.4 h vs. 56.0 ± 26.4 h, $p < 0.001$) and infectious complications (2.2% vs. 4.6%, $p < 0.001$). Logistic regression analysis demonstrated a 55% reduction in the likelihood of infectious complications.[13]

Kadado et al. (level 1b) evaluated 153 patients allocated to three groups (carbohydrates, placebo, and control). Although no differences were observed in immediate postoperative outcomes, a significant reduction in 90-day readmissions was found: 0% in the carbohydrate group versus 5.9% in the placebo group versus 11.5% in the control group.[14]

Simpson et al. (level 2b) evaluated a 12-week multimodal protocol including weight loss, exercise, insoles, and analgesic adjustment in 60 patients awaiting TKA. The intervention group achieved significant weight loss (11.2 kg vs. 1.3 kg, $p < 0.001$) and clinically meaningful improvements in health-related quality of life. Overall adherence was 94%, varying among the different components: exercise, weight loss, analgesic adjustment, and insoles.[15]

All 10 studies reported an adequate safety profile for the nutritional interventions. No serious complications related to supplementation were reported. Minor adverse events were rare and included mild gastrointestinal discomfort and transient nausea. Adherence to the protocols was consistently high, ranging from 91% to 100% among studies reporting this outcome.

Considerable heterogeneity was observed among studies regarding supplementation protocols, study populations, and methods used to assess outcomes. This heterogeneity was particularly evident in studies evaluating length of hospital stay and muscle strength, limiting the ability to perform meta-analyses.

Most studies had relatively short follow-up periods, with the exception of Ueyama et al. (2 years). The durability of the benefits and their impact on long-term quality of life remain uncertain. Studies with extended follow-up are needed to establish the true value of these interventions.[6]

Based on the current evidence, differentiated protocols may be proposed:
For the General Population:
- Essential amino acids: 15–20 g/day, initiated 1 week preoperatively and maintained for 4–6 weeks postoperatively
- Preoperative nutritional assessment to identify patients at risk

For Patients with Diabetes:
- Mandatory carbohydrate loading: 2 hours before surgery
- Intensive glycemic monitoring during the first 24 hours
- Consideration of essential amino acid supplementation

For Older Patients (≥65 years):
- Immunonutrition: 5 preoperative days
- Electrolyte supplementation combined with carbohydrates
- Monitoring of electrolyte imbalances

For Patients with Overweight/Obesity:
- Multimodal preoperative protocol including weight loss, exercise, and optimization of comorbidities
- A 12-week preparation period whenever feasible

CONCLUSIONS

The evidence identified in this review indicates that perioperative nutritional interventions are safe and effective in improving multiple outcomes following hip and knee arthroplasty. The benefits are most consistent in the preservation of muscle mass and metabolic modulation, with emerging evidence supporting reductions in complications and improvements in patient experience. Personalizing interventions based on specific patient characteristics represents an opportunity to optimize benefits and establish nutritional supplementation as a standard component of perioperative care in arthroplasty.

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Spell Check: Dario Alvares
Translation: Soledad Montalbetti
Received: 18/05/26. Accepted: 22/06/26 Published in: 02/07/2026.