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(Review Article)

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Current evidence on multimodal prehabilitation before total joint arthroplasty: A narrative review

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Abstract

Objective: To critically synthesize current evidence on unimodal and multimodal prehabilitation before total hip arthroplasty (THA) and total knee arthroplasty (TKA).

Methods: This narrative review included 34 publications comprising systematic reviews, randomized controlled trials, observational studies, clinical guidance documents, and conceptual papers. The evidence was organized according to intervention component, type of arthroplasty, patient risk profile, delivery model, and clinical outcomes, while methodological limitations were assessed qualitatively.

Results: Exercise showed the clearest potential to improve preoperative physical function, strength, walking capacity, and cardiorespiratory fitness, but postoperative benefits were inconsistent. Nutritional interventions improved protein intake or attenuated perioperative muscle loss without consistent functional improvement. Psychological strategies may reduce anxiety, catastrophizing, and early pain in selected patients, whereas education mainly improved knowledge and preparedness. Evidence for pain, postoperative function, length of stay, quality of life, and healthcare utilization was mixed; evidence for complications, readmission, and cost-effectiveness was insufficient. TKA predominated in the literature, and THA-specific postoperative evidence remained limited.

Conclusion: Current evidence does not support mandatory intensive multimodal prehabilitation for every arthroplasty candidate. A risk-stratified approach integrated with enhanced recovery pathways is more defensible, with components selected according to documented physical, nutritional, psychological, and accessibility needs.

Keywords: Total joint arthroplasty; Prehabilitation; Total hip arthroplasty; Total knee arthroplasty; Multimodal intervention; Enhanced recovery

1. Introduction

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) reliably reduce pain and improve function in advanced joint disease, but recovery varies in speed and completeness. Preoperative weakness, limited mobility, impaired cardiorespiratory fitness, frailty, poor nutrition, psychological distress, and barriers to care may be modifiable contributors. However, systematic reviews demonstrate a variable and generally low-certainty impact on prehabilitation, with a higher prevalence of TKA compared to THA and inconsistent adoption across patient populations[1–4].

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Surgical prehabilitation has been proposed as one or more interventions delivered between diagnosis and surgery to increase functional capacity or physiological reserve and facilitate recovery[5]. Contemporary frameworks combine exercise with nutritional, psychological, and educational support, although content and intensity vary considerably[6,7]. Prehabilitation also overlaps with routine optimization and Enhanced Recovery After Surgery (ERAS) pathways, which already include education, anaemia management, smoking cessation, early mobilization, and criteria-based discharge[8]. It should use the available waiting period constructively, without becoming an unjustified reason to delay indicated arthroplasty[9,10].

This narrative review evaluates the concept, components, and delivery of multimodal prehabilitation before THA and TKA; synthesizes effects on patient-important and service outcomes; examines procedure-specific evidence and patient selection; and considers integration with ERAS, limitations of the evidence, and priorities for future research.

2. Materials and Methods

A structured narrative review was conducted using a predefined corpus assembled before manuscript drafting. Eligible publications involved adults undergoing elective primary THA, TKA, or a combined population and evaluated an intervention delivered partly or entirely before surgery. Exercise, nutrition, psychological preparation, education, lifestyle or medical-risk optimization, and home-based or digital delivery were considered. Systematic reviews and meta-analyses, randomized trials, observational studies, clinical guidance, and foundational papers relevant to definition or implementation were eligible. Revision or emergency arthroplasty, protocols without outcome data, and reports without a relevant preoperative exposure were excluded. Companion reports and overlapping populations were interpreted as related evidence rather than independent cohorts.

The final cited corpus comprised 34 sources published from 2017 to 2026. Information on population, procedure, design, intervention timing and dose, comparator, adherence, outcomes, and methodological limitations was extracted. Pure prehabilitation, completed before surgery, was distinguished from perioperative programmes that continued postoperatively. Evidence was synthesized by intervention component, THA or TKA, patient-risk profile, delivery model, and outcome. Greater interpretative weight was given to systematic reviews and randomized evidence; observational associations were interpreted cautiously. Statistical significance was separated from clinical importance when patient-relevant thresholds were available. Because of substantial clinical heterogeneity, a new meta-analysis or formal certainty assessment was not performed.

3. Results and Discussion

3.1. Concept and rationale

Prehabilitation is conceptually different from postoperative rehabilitation because it aims to increase reserves before the stress of surgery occurs. In arthroplasty, the term has ranged from a single educational or psychological session to several weeks of progressive training. For clarity, unimodal prehabilitation targets one principal domain, whereas multimodal prehabilitation combines two or more interacting domains. Programmes that begin before surgery but continue afterward are perioperative interventions; their postoperative effects cannot be attributed solely to the preoperative phase[5–7].

The rationale is that a patient with greater physical and psychological reserve may tolerate postoperative inflammation, catabolism, pain, and temporary immobility more effectively. Exercise provides an adaptive stimulus, adequate nutrition supports that response, and psychological or educational strategies may improve self-efficacy and engagement. This interaction supports multimodality, but direct superiority over a well-designed single-component programme has not been established. Moreover, advanced osteoarthritis may limit weight-bearing exercise, and programme benefit depends on the available time, adherence, symptom tolerance, and the quality of usual care.

3.2. Components of multimodal prehabilitation

Exercise is the most extensively studied component. Programmes combine resistance, aerobic, balance, mobility, and task-specific training, but dose, supervision, progression, and adherence vary widely[1–3]. Two relatively substantial TKA trials found no meaningful improvement in pain, strength, range of motion, functional independence, or longer-term activity after exercise and education[11,12]. Smaller studies provide more favourable signals: remotely supervised multicomponent exercise improved strength, mobility, and range of motion in a selected bilateral TKA sample[13], while low-impact high-intensity interval training improved peak oxygen uptake without evaluating postoperative recovery[14].

Exercise can therefore modify selected preoperative targets, but an optimal universal prescription and reliable postoperative effect have not been demonstrated.

Nutritional optimization aims to support exercise adaptation and limit perioperative muscle loss. Essential amino-acid supplementation beginning before TKA and continuing postoperatively attenuated muscle-volume loss but did not consistently improve strength or mobility[15]. In patients with obesity and muscle weakness, a pilot exercise-and-dietetic programme markedly increased attainment of a protein target and improved preoperative mobility, yet recruitment and completion were difficult and postoperative outcomes were unchanged[16]. These findings favour screening for malnutrition, low protein intake, or probable sarcopenia rather than routine supplementation for all patients.

Psychological interventions include mindfulness, hypnosis, cognitive-behavioural strategies, pain neuroscience education, and expectation management. Brief mind–body sessions reduced immediate preoperative pain-related distress and anxiety[17]. A small perioperative mindfulness-based cognitive behavioural study suggested earlier improvement in pain, with no sustained between-group difference[18]. In TKA candidates selected for pain catastrophizing, education or multimodal physiotherapy reduced catastrophizing and improved selected early outcomes, although the small sample, attrition, and multiple comparisons limit certainty[19]. Psychological support therefore appears most appropriate when screening identifies anxiety, catastrophizing, fear of movement, or low self-efficacy.

Patient education is a foundational component of arthroplasty care. A meta-analysis found small improvements in knowledge, anxiety, and postoperative pain but no consistent effects on discharge, quality of life, or complications[20]. Individual physical-therapy education shortened the time to functional discharge readiness without reducing hospital stay or improving six-week function[21]. Video education improved immediate knowledge and satisfaction[22], and a THA education programme reported selected early benefits but included postoperative reinforcement[23]. Education should thus be valued for informed expectations, home preparation, and self-management, not presented as a stand-alone guarantee of better recovery.

Digital and home-based approaches are delivery models rather than independent therapies. Technology-assisted programmes have shown favourable pooled effects on selected functional outcomes, but their content was heterogeneous and randomized evidence was at high risk of bias[24]. A large digital platform cohort reported shorter hospitalization and more home discharge, although self-selection, motivation, health literacy, and access could explain part of the association[25]. Hybrid delivery may reduce travel while preserving professional supervision, but services must accommodate limited connectivity, digital literacy, cognition, vision, hearing, and language needs.

3.3. Effects on clinical outcomes

The clearest benefits occur before surgery. Exercise may improve strength, walking tests, or cardiorespiratory fitness, and targeted nutrition or psychology can modify protein intake, muscle volume, anxiety, or catastrophizing. These outcomes indicate target engagement, not necessarily better postoperative recovery. In older THA candidates, exercise and education improved preoperative gait speed and quality of life without affecting postoperative outcomes[26]. Larger neutral randomized TKA trials similarly weaken the assumption that improved readiness automatically changes the recovery trajectory[11,12].

Pain, postoperative function, range of motion, and quality of life are inconsistent. Psychological strategies may improve immediate distress or early pain in selected patients, while exercise reviews report small effects at some time points and no clear difference at others[1–3,17–20]. Range-of-motion differences are generally small and often below plausible clinical importance. Some observational studies suggest faster early milestones, but benefits frequently diminish by later follow-up. Thus, prehabilitation may accelerate part of early recovery without altering the eventual functional plateau.

Length of stay and discharge destination depend strongly on the local pathway. Education-class cohorts reported shorter stays or more home discharge, particularly in selected high-risk TKA patients, but attendance was nonrandom and the absolute differences were sometimes only several hours[27,28]. In more than 20,000 patients, education was not associated with adjusted length of stay, although an association with home discharge persisted for THA[29]. A small high-risk pilot supported the feasibility of home prehabilitation and earlier inpatient independence but used historical controls[30]. These data are hypothesis-generating rather than causal.

Evidence for complications, emergency visits, and readmission is insufficient because most trials were underpowered for uncommon events. Medicare analyses found no association with emergency attendance, readmission, or institutional discharge; lower home-health use occurred alongside greater outpatient therapy, suggesting redistribution rather than elimination of care[31]. A recent patient-choice TKA cohort reported better early outcomes after a four-week home programme, but groups converged by 12 months and residual confounding remained likely[32]. Economic findings are similarly preliminary: selected studies reported savings based mainly on hospital or rehabilitation use without complete programme costs, quality-adjusted life-years, incremental cost-effectiveness ratios, or uncertainty analyses[11,28,33].

Overall, preoperative function, muscle-related outcomes, knowledge, and psychological preparedness are potentially beneficial. Pain, postoperative function, length of stay, discharge destination, quality of life, and healthcare utilization remain inconsistent. Range of motion shows no clear clinically important benefit, while complications, readmission, and cost-effectiveness remain insufficiently studied. A home-based meta-analysis similarly found a small reduction in TKA length of stay without consistent postoperative benefits across THA and TKA[34]. No outcome is consistently improved across procedures, intervention types, and study designs.

3.4. Differences between THA and TKA

TKA dominates the evidence base and supplies most positive signals for preoperative strength, mobility, psychological readiness, and selected early recovery outcomes[1,3,13,19,34]. It also supplies the strongest neutral randomized evidence[11,12]. THA research is smaller and often emphasizes preoperative outcomes; a network meta-analysis suggested possible benefits of selected exercise modalities, but sparse comparisons and low certainty limited treatment ranking[2]. The older-adult THA trial showed that even a higher-risk population can improve before surgery without gaining a postoperative advantage[26]. Combined analyses should therefore report procedure-specific effects and formal interaction tests. Evidence from TKA should not be transferred automatically to THA.

3.5. Patient selection and integration with enhanced recovery

Heterogeneous effects argue against one intensive package for all candidates. A proportionate pathway can offer universal, low-burden preparation—procedure-specific information, activity advice, mobility practice, home planning, and ERAS orientation—while reserving supervised exercise, dietetic treatment, psychological care, or multidisciplinary management for documented deficits[6,8,10]. Frailty, weakness, limited mobility, nutritional risk, sarcopenic obesity, clinically important distress, and predicted discharge difficulty are plausible selection domains. Frailty predicts prehabilitation use, but evidence that it modifies treatment benefit remains limited[4]. Objective high-risk selection is feasible, although it has not yet been validated as a treatment algorithm[30].

Screening should identify the mechanism of risk. A patient with weakness may need progressive resistance and functional training; low intake or probable sarcopenia may justify dietetic assessment; catastrophizing may warrant targeted psychological support; and absent home support may require early social and discharge planning rather than additional exercise alone[15,16,18,19,27]. Age or body mass index alone should not determine access. Utilization differences by rurality and socioeconomic characteristics and the potential digital divide require active monitoring so that prehabilitation does not widen inequity[4,25,26].

Within ERAS, prehabilitation should prepare patients to participate in early mobilization and self-management, not duplicate established pathway elements. Its incremental effect may be small where education, analgesia, mobilization, and discharge planning are already optimized[8]. The existing waiting period should be used without imposing an arbitrary delay; guidance does not support mandatory additional physical therapy after appropriate nonoperative treatment has failed[9]. Programmes should record recruitment, actual dose, adherence, adverse events, equity, patient experience, clinical outcomes, and full costs.

3.6. Limitations, clinical implications, and future research

Interpretation is limited by inconsistent definitions, mixed pure-preoperative and perioperative exposure, variable dose and supervision, small samples, missing data, heterogeneous comparators, and frequent reliance on patient-reported outcomes that cannot be blinded. Observational attendance or platform use is strongly confounded by motivation, referral, transport, social support, and digital access. Outcomes and assessment times vary, and statistical significance is often reported without patient-relevant thresholds. Systematic reviews also share many primary trials, so concordant conclusions do not represent independent replication. Finally, the present review used a predefined, non-exhaustive corpus and qualitative evidence classifications; it should not be interpreted as a systematic review or formal grade assessment.

Clinically, prehabilitation is best presented as personalized preparation rather than a guaranteed method to reduce pain, hospitalization, complications, readmission, or cost. Components should be chosen after assessment, adapted to pain and comorbidity, and delivered without delaying indicated surgery. Future studies need a common definition, reproducible intervention reporting, standardized preoperative and postoperative outcomes, and adequately powered multicentre trials. Trials should stratify THA and TKA, directly compare universal with risk-stratified care, distinguish target engagement from clinical recovery, and measure adherence, equity, and whole-pathway cost. Factorial or dismantling designs could identify the contribution and dose of individual components, while pragmatic ERAS based studies should test incremental effectiveness under contemporary care.

4. Conclusion

Multimodal prehabilitation before total joint arthroplasty has a coherent physiological and behavioural rationale and can improve selected measures of preoperative readiness. Exercise provides the strongest signal for physical capacity; nutrition, psychological preparation, and education may benefit appropriately selected patients. These changes do not consistently translate into better postoperative pain, function, length of stay, quality of life, or healthcare utilization, and evidence for complications, readmission, and cost-effectiveness remains insufficient. Current evidence therefore does not justify mandatory intensive multimodal prehabilitation for every THA or TKA candidate. A more defensible model integrates universal education and basic preparation within ERAS and directs additional components to documented physical, nutritional, psychological, or social needs without delaying indicated surgery.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares no conflict of interest.

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