INTERVENTION REPORTING IN TOTAL HIP OR KNEE ARTHROPLASTY PREHABILITATION TRIALS

INTERVENTION REPORTING IN PREHABILITATION TRIALS FOR OLDER ADULTS UNDERGOING TOTAL HIP OR KNEE ARTHROPLASTY

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LAY ABSTRACT

Reporting guidelines refer to a tool or checklist designed to help authors accurately report specific types of research. Clear and accurate research reporting is important to understand how the research was conducted and for translating findings into routine clinical practice. There are many different types of reporting guidelines that are available. The Template for Intervention Description and Replication (TIDieR) Checklist is a reporting guideline designed to improve the description of interventions in clinical research. In this thesis, we used the TIDieR checklist to assess how well prehabilitation trials for older adults undergoing hip or knee replacement surgery were reported in the literature. We screened 1278 research papers from MEDLINE, EMBASE, CENTRAL, and Google Scholar databases. A total of 84 research papers that were published from 1992 to 2024 met the inclusion criteria for this methodological review. We found most studies focused on exercise programs to help patients get stronger before surgery. Other research papers used prehabilitation programs that combined exercise with nutritional supplements, psychological support, and treatments like acupuncture. The research papers varied in how well they followed the TIDieR checklist. Of the 84 research papers examined, 45 showed moderate adherence to the TIDieR checklist, 29 were rated as good, and 10 were rated as poor. The most commonly reported TIDieR details were the name of the intervention (item 1) and why it was done (item 2). The least reported TIDieR details were modifications to the intervention (item 10) and information about the intervention providers (item 5). Overall, better research study reporting is needed to ensure others can understand and replicate these interventions.

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LIST OF ABBREVIATIONS

Abbreviation	Definition
AGREE II	Appraisal of guidelines for research & evaluation II
ARIMA	Auto-regressive integrated moving average
CENTRAL	Cochrane Central Register of Controlled Trials
CHEERS	Consolidated Health Economic Evaluation Reporting Standards
CONSORT	Consolidated Standards of Reporting Trials
EQ-5D	EuroQoL-5D
EQUATOR	Enhancing the QUAlity and Transparency Of health Research
HOOS	Hip Disability and Osteoarthritis Outcome Score
ITS	Interrupted time-series
KOOS	Knee Injury and Osteoarthritis Outcome Score
OA	Osteoarthritis
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO	International Prospective Register of Systematic Reviews
RCT	Randomized controlled trial
SD	Standard deviation
SPIRIT	Standard Protocol Items: Recommendations for Interventional Trials
STARD	Standards for Reporting of Diagnostic Accuracy
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology
THA	Total hip arthroplasty
TIDieR	Template for Intervention Description and Replication Checklist
TKA	Total knee arthroplasty
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index

DECLARATION OF ACADEMIC ACHIEVEMENT

The sole author of this thesis document is Ashlee Azizudin, who drafted all chapters of this thesis. The supervisory committee members, Dr. Alexandra Papaioannou, Dr. George Ioannidis, and Dr. Justin Lee provided feedback and guidance throughout all stages of the thesis. Study selection, data extraction, and quality assessment for the methodological review was completed by Ashlee and Dr. Patricia Hewston. Ashlee completed analyses and drafted the final manuscript, tables, figures, and appendices included in Chapters 2 and 3.

CHAPTER 1: INTRODUCTION

Transparent and accurate reporting increases the reliability, utility, and impact of clinical research.[1] Reporting guidelines for health research provide structured recommendations to enhance the clarity and reproducibility of research findings and support critical appraisal of research.[2,3] Inadequate reporting can also contribute to research waste, including the cost of economic and human resources.[4] The Enhancing the QUAlity and Transparency Of health Research (EQUATOR) network is a global initiative established to improve the reporting quality of health research with an accessible internet-based resource centre.[1] Since 1996, EQUATOR has compiled over 600 reporting guidelines, offering an accessible online resource to assist researchers in choosing the appropriate guidelines for their studies. The EQUATOR network defines reporting guidelines as "a checklist, flow diagram, or structured text to guide authors in reporting a specific type of research, developed using explicit methodology," providing a minimum list of required information that should be reported in a publication for comprehension, replication in future research, clinical decision-making, or inclusion in evidence syntheses.[5] These guidelines, ranging from animal pre-clinical research to health technology assessments, are sorted by clinical area (e.g., allergy, anaesthesia, cardiovascular, complementary and alternative medicine, genetics, infectious diseases, paediatrics, primary care, rehabilitation medicine, etc.). Despite the widespread availability of these guidelines for over two decades, the quality of reporting in most clinical research remains suboptimal.[6,7] A systematic scoping review reported that over 86% of studies assessing reporting guideline adherence found that clinical research failed

to meet recommended reporting standards.[6] This is concerning because poor reporting quality can undermine the validity and reproducibility of research findings and ultimately slow the translation of research into practice.

Brief Overview of Key Reporting Guidelines and Their Extensions

Many well-established guidelines have been developed to improve reporting quality and transparency across different research studies. The Consolidated Standards of Reporting Trials (CONSORT) statement is among the most widely recognized guidelines, providing a checklist of items specific to randomized trials.[8] A previous study mapping the content coverage of CONSORT and its extensions for randomized controlled trials (RCTs) found that relevant CONSORT guidelines can cover 81% of RCTs (i.e., CONSORT recommendations specific to different study designs, interventions, and types of data).[9] Academic journals may require that manuscript submissions adhere to relevant guidelines. This is usually indicated in the "Instructions to Authors" section of journals, but the extent to which journals enforce these guidelines may vary.[10] CONSORT was endorsed by 22%, 38%, and 63% of high-impact factor journals in 2003, 2007, and 2014, respectively.[10–12] Other reporting guidelines include the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) for trial protocols.[13] Beyond clinical trials, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) provides guidelines for transparent reporting of systematic reviews and meta-analyses.[14] For case reports, the CARE guidelines ensure a structured and standardized approach to documenting individual cases. For observational studies, the Strengthening

the Reporting of Observational Studies in Epidemiology (STROBE) provide recommendations to improve reporting of cohort, case-control, and cross-sectional studies.[15] In diagnostic research, the Standards for Reporting of Diagnostic Accuracy (STARD) supports clarity of studies reporting diagnostic accuracy.[16] For economic evaluations, the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) outlines key elements to include for transparent economic evaluations.[17] The Appraisal of Guidelines, Research and Evaluation (AGREE) II are used for clinical practice guidelines.[18,19] There are also guideline extensions that expand on existing guidelines, with additional recommendations for reporting specific study types, methodology, data, or other aspects of reporting.[9] The Template for Intervention Description and Replication (TIDieR) checklist is a CONSORT guideline extension designed to ensure that interventions are comprehensively described to allow replication.[20] Other examples of guideline extensions include the CONSORT extension to randomized pilot and feasibility studies,[21] the CONSORT-Outcomes 2022 Extension,[22] the PRISMA-P for systematic review protocols,[23] the PRISMA-NMA for network meta-analyses,[24] and the PRISMA-ScR for scoping reviews.[25] These guidelines can serve as frameworks for comprehensive and transparent reporting across various research studies.

Among the various reporting guidelines, the TIDieR checklist stands out as particularly relevant for this thesis, as it directly addresses the need for detailed and replicable descriptions of intervention reporting of prehabilitation trials for older adults undergoing total hip arthroplasty (THA) and total knee arthroplasty (TKA). Therefore,

the following section will focus on the TIDieR checklist development, its components, and its impact on research reporting.

Template for Intervention Description and Replication (TIDieR) Checklist

Previous research has reported that 40-89% of trial interventions were non-replicable.[26] This poses a barrier to knowledge translation, as replication and evidence synthesis are crucial preliminary steps in the knowledge translation process.[27,28] To address poor reporting of interventions in publications, the TIDieR checklist was introduced in 2014 as an extension of item 5 of the CONSORT 2010 statement and item 11 of the SPIRIT 2013 statement.[20] Item 5 ("Interventions") of the CONSORT 2010 checklist stipulates that the interventions for each group be described with "sufficient details to allow replication, including how and when they were assessed,"[29]; this description is the same as item 11a of the SPIRIT 2013 checklist. Items 11b through 11d of SPIRIT 2013 suggest that "criteria for discontinuing or modifying allocated interventions for a given trial participant," "strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence," and "relevant concomitant care and interventions that are permitted or prohibited during the trial," are reported, respectively, in trial protocols.[13] Since the publication of the TIDieR checklist in 2014, translations in Chinese, French, German, Italian, Portuguese, and Turkish have become available on the TIDieR website.[30] Furthermore, an elaboration of the TIDieR checklist for interventions to enhance vaccine communication and TIDieR-PHP for population health and policy interventions were published in 2022 and 2018, respectively.

A TIDieR Checklist Authoring Tool is also available on the TIDieR website to guide checklist completion and create a summary document.[31]

The TIDieR checklist consists of 12 items for reporting interventions: a brief name or phrase describing the intervention (item 1); any rationale, theory, or goal of the intervention (item 2); physical or informational materials provided to participants, used in intervention delivery, or for training of intervention providers, and where the materials can be accessed (item 3); the procedures, activities, and/or processes involved in the intervention (item 4); the intervention providers and their expertise, background, or specific training received (item 5); the modes of delivery (e.g., face-to-face or remote, individual or in groups) (item 6); the type(s) of location(s) where the intervention occurred, including relevant infrastructure or features (item 7); the number of times the intervention was delivered over a given period of time, including the number of sessions, and their duration, intensity, or dose (item 8); any tailoring of the intervention (item 9); any modifications to the intervention during the study (item 10); planned intervention adherence or fidelity assessments, and any strategies used to improve or maintain fidelity (item 11); and the extent to which the intervention was delivered as planned, if actual adherence or fidelity was measured (item 12).[20]

While the TIDieR checklist primarily focuses on trials, the developers also suggest that it can be applied across all evaluative study designs including observational studies, or systematic reviews.[20] The development process was informed by a methodological framework for the development of reporting guidelines established by the EQUATOR network[32] and included a literature review and a Delphi survey of a panel of

international experts.[20] It is recommended that randomized trial authors use the TIDieR checklist in conjunction with CONSORT upon submission of reports by completing both checklists and inserting "refer to TIDieR checklist" in item 5 of the CONSORT checklist.[20] Similarly, the TIDieR checklist can also be used in conjunction with the SPIRIT 2013 statement with a reference to the completed TIDieR checklist included in item 11, or in conjunction with checklists pertaining to other study designs evaluating interventions.[20]

Previous studies have evaluated the completeness of intervention reporting according to the TIDieR checklist.[33–36] An overview of reviews using the TIDieR checklist to assess trial intervention reporting quality found 56 articles covering a variety of intervention types (e.g., exercise and rehabilitation, social-psychological interventions, dietary interventions, medications), across different conditions (e.g., cancer, osteoarthritis, kidney disease), or by discipline (e.g., anaesthesiology, perioperative care, emergency medicine), setting (e.g., long-term care), or study type/methodology (e.g., cluster-randomized trials).[35] This overview found that the reporting quality across studies based on index articles was generally poor, except for the intervention name (item 1) and rationale (item 2).[35] Adherence was between a minimum of 25% to a maximum 75% for most of the other TIDieR items and was as low as 10% for modifications (item 10).[35] The study also found that reporting has not improved since the introduction of the TIDieR checklist in 2014; although most articles do not report the use of TIDieR guidance.[35] In addition to evaluating adherence to the TIDieR checklist, studies have also reported the effect of TIDieR on reporting quality over time.[35] In the overview of reviews article, 13

out of 56 (23%) articles evaluated change in reporting quality over time.[35] Four studies that explicitly compared reporting pre-and post-TIDieR found no improvement (n=3) or slight improvement (n=1), while the other 9 studies found no improvement, overall improvement, or improvement by certain TIDieR items, across the considered timeframe.[35] A cross-sectional, methodological study not included in the aforementioned overview examined 101 trials published in high-impact cardiology journals, and found that an average of 8.6 out of 12 TIDieR items were reported and there were no statistically significant differences in the mean percentage of TIDieR items completed, by month, for studies published pre- and post-TIDieR.[33]

TIDieR recommends the description of interventions be expanded in systematic reviews to improve the utility of reviews.[37] It can inform research question development and guide data extraction and synthesis by providing a template for essential intervention components to include in data extraction forms and summary tables.[37] A cross-sectional study evaluating 238 Cochrane surgical systematic reviews using an adapted TIDieR framework for describing interventions in systematic reviews (TIDieR-SR) found that reviews adhered to a median of 6 out of 8 TIDieR-SR items, but acknowledged that the generalizability of these findings may be limited by the exclusion of non-Cochrane systematic reviews.[38] While not mandated by Cochrane, the TIDieR checklist is referenced in the Cochrane Handbook for Systematic Reviews of Interventions, as a tool to consider for planning intervention groups in evidence syntheses.[39]

Overall, the TIDieR checklist and associated adaptations can provide a structured framework for reporting essential aspects of interventions across different study designs

or contexts.[40] Adoption of this framework could reduce variability in reporting and may be especially helpful for researchers describing complex interventions.[20,40,41]

The Role of Comprehensive Reporting in Prehabilitation Research

Given the critical role that detailed and replicable reporting plays in enhancing the translation of research knowledge, particularly in clinical interventions, the TIDieR checklist is essential for ensuring that prehabilitation strategies are thoroughly documented and can be consistently reproduced and implemented across different settings. Prehabilitation occurs before surgery or a medical procedure to improve a patient's functional capacity preoperatively and improve postoperative outcomes and recovery.[42–44] The focus is on preparing the body to better withstand the stress of surgery, reducing the risk of complications, and speeding up recovery. Functional capacity refers to an individual's maximal (or near-maximal) physical activity level that they can perform.[45] While perioperative guidelines lack consensus on which measurement tool should be used for functional capacity assessment in non-cardiac surgery,[46] it is understood that poor functional capacity prior to surgery is a risk factor for worse outcomes and postoperative complications, which can lead to decreases in health-related quality of life, especially among older patients.[47,48] Individuals who undergo surgery experience a reduction in functional status followed by a recovery stage in the postoperative period.[43] Postoperative complications may also hinder an individual's recovery time and reduce long-term independence.[43]

The goals of specific prehabilitation programs may vary based on the risk factor they aim to modify. For example, improving aerobic capacity and muscle mass to address physical inactivity, implementing preoperative smoking cessation or alcohol consumption strategies to address smoking or alcohol intake, providing protein supplementation to address nutritional deficiencies, or administering psychological or behavioural interventions to address anxiety and depression preoperatively.[43] Involvement of a multidisciplinary team (e.g., physiotherapists, dieticians, nutritionists, pharmacists, health psychologists) to deliver multiple prehabilitation components is considered an ideal approach.[43] A systematic review reported that 16/25 (64.0%) of economic evaluations of prehabilitation for elective surgery found it to be cost-effective, with the remaining 32.0% demonstrating greater effectiveness but higher costs for prehabilitation (n=8), or no cost-effectiveness (n=1).[49] By ensuring that prehabilitation interventions in such studies are thoroughly documented, researchers and clinicians can more effectively replicate and adapt these strategies across diverse patient populations and settings.

Prehabilitation for Total Hip and Knee Arthroplasty

The role of prehabilitation becomes even more critical in the context of major orthopaedic surgeries, such as THA or TKA. Total joint replacement is one of the most common elective orthopaedic procedures and is an effective intervention for the treatment of end-stage osteoarthritis (OA).[50] However, these procedures exert considerable stress on a patient's functional capacity, affecting both the musculoskeletal and cardiovascular systems.[51] In addition, while THA and TKA are effective in reducing pain, functional

limitations for patients may persist into the 1 year postoperative phase, and functional ability may remain lower than the level of age-matched healthy comparators.[52–55]

The global prevalence of OA was approximately 595 million in 2020, representing an increase of 132.2% (uncertainty interval 130.3%-134.1%) since 1990.[56] OA is a leading cause of disability in adults aged 60 and older, and is ranked as the seventh leading cause of years lived with disability in adults aged 70 and older.[56] Older patients are also at risk of more severe postoperative complications, longer length of stay in hospital, and smaller improvements in functional status compared to younger patients.[57] Preoperative frailty, which is increasingly common with older age, can further contribute to challenges with recovery due to systemic dysfunctions including immune, neuroendocrine, and metabolic dysfunction, and chronic inflammation.[58] Given these challenges, prehabilitation tailored specifically for older adults undergoing THA and TKA is crucial for optimizing recovery, minimizing complications, and improving overall quality of life.

Previous reviews evaluating the effect of prehabilitation on outcomes in patients undergoing THA or TKA have included 41 to 78 studies.[52,59] A previous review synthesizing the effect of prehabilitation on outcomes in patients undergoing orthopaedic surgery found moderate certainty evidence favouring prehabilitation for preoperative function, muscle strength, and flexion, and 6-weeks postoperative function in TKA patients, as well as preoperative muscle strength, abduction, and quality of life in THA patients.[59] Other outcomes in favour of prehabilitation consisted of low quality

evidence.[59] More trials are needed to provide high quality evidence to definitively determine the effect of prehabilitation on these outcomes.

Reporting of Non-Pharmacological Interventions in Orthopaedic Trials

Adequate reporting of non-pharmacological and complex interventions, such as prehabilitation, remains a persistent challenge in clinical research. The reporting of non-pharmacological interventions in orthopaedic trials, according to the Checklist to Evaluate a Report of a Nonpharmacological Trial, has also previously been found to be highly variable.[60] The TIDieR framework may provide additional benefits in describing interventions applied to older adult populations, given the complexity and variability of their needs, often requiring comprehensive assessments and coordinated, multidisciplinary approaches (akin to a "black box").[61] A scoping review on the reporting quality of 70 prehabilitation RCTs for orthopaedic, cardiac, cancer, colorectal, and other types of surgery, found the overall mean (SD) adherence to TIDieR was 62% (17.7%).[62] However, no previous studies have specifically described and evaluated THA or TKA prehabilitation intervention reporting using the TIDieR checklist.

Thesis Objective and Structure

The aim of this thesis is to evaluate the completeness of reporting in prehabilitation trials for older adults undergoing THA or TKA using the TIDieR checklist. Chapter 2 reports the methodology and findings of a methodological review on

this topic. Chapter 3 provides an extended discussion on the results of this study, future directions, and overall conclusions of the thesis.

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CHAPTER 2: Intervention Reporting in Prehabilitation Trials for Older Adults Undergoing Total Hip or Knee Arthroplasty: A Methodological Review

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Abstract

Background: Prehabilitation is defined as the process of improving an individual's functional capacity to tolerate an upcoming stressor. In the surgical context, potential benefits of prehabilitation include reducing length of stay in hospital, postoperative pain, and complications. The objective of this review is to evaluate the completeness of intervention reporting details and changes in quality of this reporting over time for total hip (THA) or knee arthroplasty (TKA) prehabilitation interventions using the Template for Intervention Description and Replication (TIDieR) Checklist.

Methods: MEDLINE, EMBASE, CENTRAL, and Google Scholar were searched from inception to May 3, 2024, to identify published articles or protocols of randomized controlled trials reporting prehabilitation interventions for adults undergoing elective THA or TKA. Two independent reviewers completed screening and data extraction.

Results: From 1278 unique search results, 191 full-text studies were assessed for eligibility, and 84 studies met inclusion criteria (n=54 TKA, n=15 THA, n=15 TKA/THA). Included studies were published from 1992 to 2024. Prehabilitation intervention modalities reported across studies included exercise (n=51), multimodal programs (n=14), behavioural (n=6), nutritional supplementation or weight loss (n=3), and other (n=10). The mean (standard deviation) TIDieR score was 7.7 (1.8), indicating moderate reporting quality overall. The proportion of studies reporting each item completely were as follows: name (100%), rationale (100%), materials (65%), procedures (85%), providers (25%), mode of delivery (75%), location (67%), dose and duration

(86%), tailoring (31%), modifications (5%), planned adherence (37%), and actual adherence (35%).

Conclusions: The reporting quality of interventions in the majority of prehabilitation RCTs was moderate. The TIDieR framework can be used to support evaluation and replication of prehabilitation for THA and TKA by identifying key intervention components. Quality of intervention reporting was similar between trials published before TIDieR was introduced in 2014 and post-TIDieR. This review highlights the varied landscape of THA/TKA prehabilitation.

Keywords: Prehabilitation; arthroplasty; osteoarthritis; methodological review; TIDieR

Background

Osteoarthritis (OA) is the most common form of arthritis and is among the most significant contributors to global disability burden.[1,2] OA is a common cause of joint pain that may result in reduced range of motion and mobility.[3] Total joint replacement (arthroplasty) has been demonstrated to be effective in patients with advanced end stage joint disease of the knee or hip, who still experience functional decline and disabling pain following non-surgical treatment.[3] Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are two of the most common procedures in Canada, with approximately 138,000 procedures per year incurring a cost over $1.4 billion annually, according to the 2021 Canadian Joint Replacement Registry.[4] Over 63,000 THA and 75,000 TKA procedures were completed from 2019 to 2020, and the number of procedures is expected to continue increasing.[4]

The focus of recent interventions on building resilience prior to surgery is commonly referred to as prehabilitation. Prehabilitation is defined as the process of enhancing an individual's functional capacity, to tolerate an upcoming stressor such as undergoing TKA or THA.[5,6] Potential benefits of prehabilitation include reduced length of stay in hospital, postoperative pain and complications, and faster recovery.[6,7] The concept of prehabilitation has shifted increasingly to a multimodal approach, including preoperative medication optimization, exercise, nutritional support, and psychological support.[6] A recent systematic review concluded that the quality of evidence for prehabilitation in TKA and THA patients is unclear and difficult to synthesize due to the diversity of interventions studied and outcomes reported across studies, indicating a need

for standardization of intervention terminology and core outcome sets.[8] The aim of this methodological review is to assess completeness of reporting and to provide a description of prehabilitation intervention reporting details using the standardized TIDieR (Template for Intervention Description and Replication) Checklist.[9]

Methods

This review is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria (Appendix A).[10] This review was registered on the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42024449613).

Study selection

Eligible populations were adults (≥18 years) with a mean population age of 55 years and older undergoing elective unilateral or bilateral THA or TKA. Interventions could be any type of prehabilitation intervention (e.g., exercise, nutrition, medication optimization, cognitive training, multimodal pre-surgery interventions) with a duration of ≥7 days. Studies only assessing standard patient education prior to surgery were excluded. Comparator groups were those consisting of usual pre-surgery care for THA or TKA, no prehabilitation intervention, or an active comparator. No limitations were placed on study outcomes. Only published randomized controlled trials (RCTs) or trial protocols were eligible for inclusion. Trial registries with no associated publications available were excluded. No restrictions were placed on language or geographical location.

Search and screening

MEDLINE, Embase, CENTRAL, and Google Scholar were searched from inception to May 3, 2024, to identify articles. The search strategy was developed in collaboration with a Cochrane-trained librarian using Medical Subject Headings and keywords related to preoperative rehabilitation and THA or TKA (Appendix B). AMA and PH screened all retrieved articles using Covidence software (Melbourne, VIC: Covidence)[11] and resolved disagreements through discussion according to the established eligibility criteria. During the screening stage, non-English language articles were translated to English using ChatGPT software (San Francisco, CA: OpenAI).[12] Articles were initially screened by title and abstract, and subsequently by full-text to confirm eligibility for inclusion.

Data extraction and synthesis

Data extraction was performed independently and in duplicate by AMA and PH. A standardized data extraction form was developed and piloted on Covidence software prior to initiation of data extraction. Data were extracted from the main manuscript and any included supplementary files, appendices, or trial protocol if available. Study characteristics obtained from each article and summarized included the following: primary author, date of publication, country, study objectives, inclusion and exclusion criteria, type of joint replacement, number of patients in total and by intervention group, age and sex, outcomes reported (e.g., performance-based measures, patient-reported outcomes including pain, activities of daily living, health-related quality of life, cognitive tests, falls, postoperative care and healthcare utilization metrics), outcome measurement

timepoints, Consolidated Standards of Reporting Trials (CONSORT)[13] endorsement, and TIDieR endorsement. A statement that the trial was reported according to the CONSORT or TIDieR guidelines was considered an endorsement. The TIDieR checklist consists of 12 items recommended at minimum for describing an intervention: 1) intervention name; 2) rationale; 3) materials; 4) procedures; 5) providers; 6) modes of delivery; 7) location; 8) dose and duration; 9) tailoring; 10) modifications during study; 11) planned fidelity of intervention; and 12) actual fidelity of intervention observed.[9] For trial protocols, items 10 and 12 are not applicable and cannot be described until study completion.[9]

Completeness of intervention reporting in prehabilitation RCTs was summarized by item and overall. Similar to previous studies using the TIDieR checklist, 1 point was assigned to an item for complete compliance, 0.5 for partial compliance, and 0 for noncompliance.[14,15] An overall TIDieR rating was assigned with total scores ≥9 indicating good reporting quality, 6-8 as moderate reporting quality, and <6 as poor reporting quality.[16] Radar graphs were generated with Visual Paradigm software (Hong Kong: Visual Paradigm International Ltd.)[17] using items with complete compliance.

Statistical analysis

An interrupted time-series (ITS) analysis was conducted in Statistical Package for Social Sciences (SPSS) software version 29.0.2.0 (Armonk, NY: IBM Corp),[18] using the autoregressive integrated moving-average (ARIMA) model, to determine if TIDieR reporting quality changed over time across studies. The following variables were used for analysis: mean TIDieR adherence (mean adherence calculated by year of publication),

time (in years) from the start of the observational period, and if the study was published pre- or post-TIDieR (pre-TIDieR coded as 0, post-TIDieR coded as 1).

Assessment of study quality

AMA and PH assessed study quality of the primary publications, independently and in duplicate, using the Cochrane Risk of Bias 2 tool for parallel group trials,[19] which consists of the following domains: risk of bias arising from the randomization process, risk of bias due to deviations from the intended interventions, risk of bias due to missing outcome data, risk of bias in measurement of the outcome, and risk of bias in selection of the reported result.[19] Overall risk of bias was rated as low risk of bias, some concerns, or high risk of bias. Risk of bias figures were generated using the Risk-of-bias VISualization (robvis) tool (Bristol, UK).[20]

Results

Study characteristics

There were 84 studies that met inclusion criteria (n=54 TKA, n=15 THA, n=15 TKA/THA) (Figure 1).[21–104] Study characteristics are summarized in Table 1. Articles were published from 1992 to 2024 (n=37 pre-TIDieR, 47 post-TIDieR), 10 (12%) of which were trial protocols.[24,25,27,37,44,46,51,53,55,56] Study samples had a minimum of 16 to a maximum 402 participants.[43,50] Of the remaining 74 primary publications, 8 had a published trial protocol available.[29,34,39–41,50,52,66] Most studies (n=74) were single-centre, except for 10 multi-centre trials.[25,29,44,46,50–52,61,63,99] There were 27 studies that limited

inclusion to older adults (i.e., aged ≥50),[23–27,29,33–35,37,39,40,43,45,49,51,55,62,66,67,71,76,78,82,86,87,103] 5 of which were specifically targeting older adults with frailty.[25,51,55,76,82] Most studies that reported the sex or gender of participants (n=73) comprised a majority female or woman population (n=55 [75%]).[21–23,26,29,32–34,36,39–41,43,45,47,50,54,57–62,64,65,68,69,72,74–76,78,80–85,87–102,104] Standard care was the most common comparator (90%), while some studies used active comparators including different prehabilitation exercise regimes (e.g., lower vs upper body, pool-based vs land based, tele-prehabilitation vs standard prehabilitation) (8%),[22,24,75,85,91,102,105] placebo controls (e.g., oral supplement placebo) (1%),[58] or dose-comparison concurrent controls (i.e., 2, 4, or 6 weekly sessions of exercise depending on study group assignment) (1%).[53] Outcomes reported included measures of physical function and mobility, pain and symptoms, quality of life, patient-reported outcomes, postoperative complications, and healthcare utilization. Common physical function and mobility measures included hip or knee range of motion (n=27),[21,26–28,33,34,38,40,45,47,48,57,60,64,65,67,70,72,74,78,81,84,87,88,95,97,98] the Sit-to-Stand Test (n=18),[22,24,32,37,38,44,51,62,65,66,71,72,76,81–83,85,86], Timed Up and Go (n=18),[21,24,26,30,33,34,40,41,45,46,51,57,60,65,67,76,82,93] 6-Minute Walk Test (n=14),[28,36,44,50,51,53,65,67,71,76,81,82,86,100] and Stair Climbing Test (n=14).[21,26,38,41,42,51,53,57,71,75,81,83,86,104] The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) (n=31),[24,25,27,29,32,33,35,38,41,46,48,50,52,57,58,63,67,71,75,78–80,83,85,88,91–95,101] pain numeric rating scale or visual analogue scale (n=25),[21,24,27,32,45,50,53,56,57,59,61,74,76–78,84–86,88,90,91,96,102,104,106] Knee Injury and Osteoarthritis Outcome Score (KOOS) (n=14)[21,28,30,34,36,38,40,47,53,56,64–66,72] and Hip Disability and

Osteoarthritis Outcome Score (HOOS) (n=6)[30,51,62,72,76,82] were among the most common pain and symptom measures. The EuroQoL-5D (EQ-5D) was the most frequently reported quality-of-life measurement across studies (n=19).[22,25,29,30,32,34,37,39,40,46,50–52,56,60,63,72,106,107] The most common outcome assessments were 1-week preoperative (n=17),[31,34–37,39,40,65,66,69,71,81,82,100,103,106,107] and 6-weeks (n=20),[21,30,33,34,39,40,51,59,64–66,70–72,75,80,83,87,106,107] 3-months (n=32),[24–28,38,41,42,51,53,54,56,57,62,64–66,69,71,72,75,77,78,83,86,88,91,94,95,97,100,103] 6-months (n=12),[28–30,36,50,54,62,70,78,95,106,107] and 12-months postoperative (n=13),[26,29,34,36,50,54,56,62,66,70,79,95,96] but varied from 12-weeks preoperative[37] to 2-years postoperative.[97] An endorsement of the CONSORT guidelines was present in 20 out of 82 (24%) of post-CONSORT studies,[23,27,29–32,39,41,42,46,51,53,62,66,72,75,79,96,106,107] while a TIDieR endorsement was present in 5 out of 47 (11%) of post-TIDieR studies.[25,29,39,53,106]

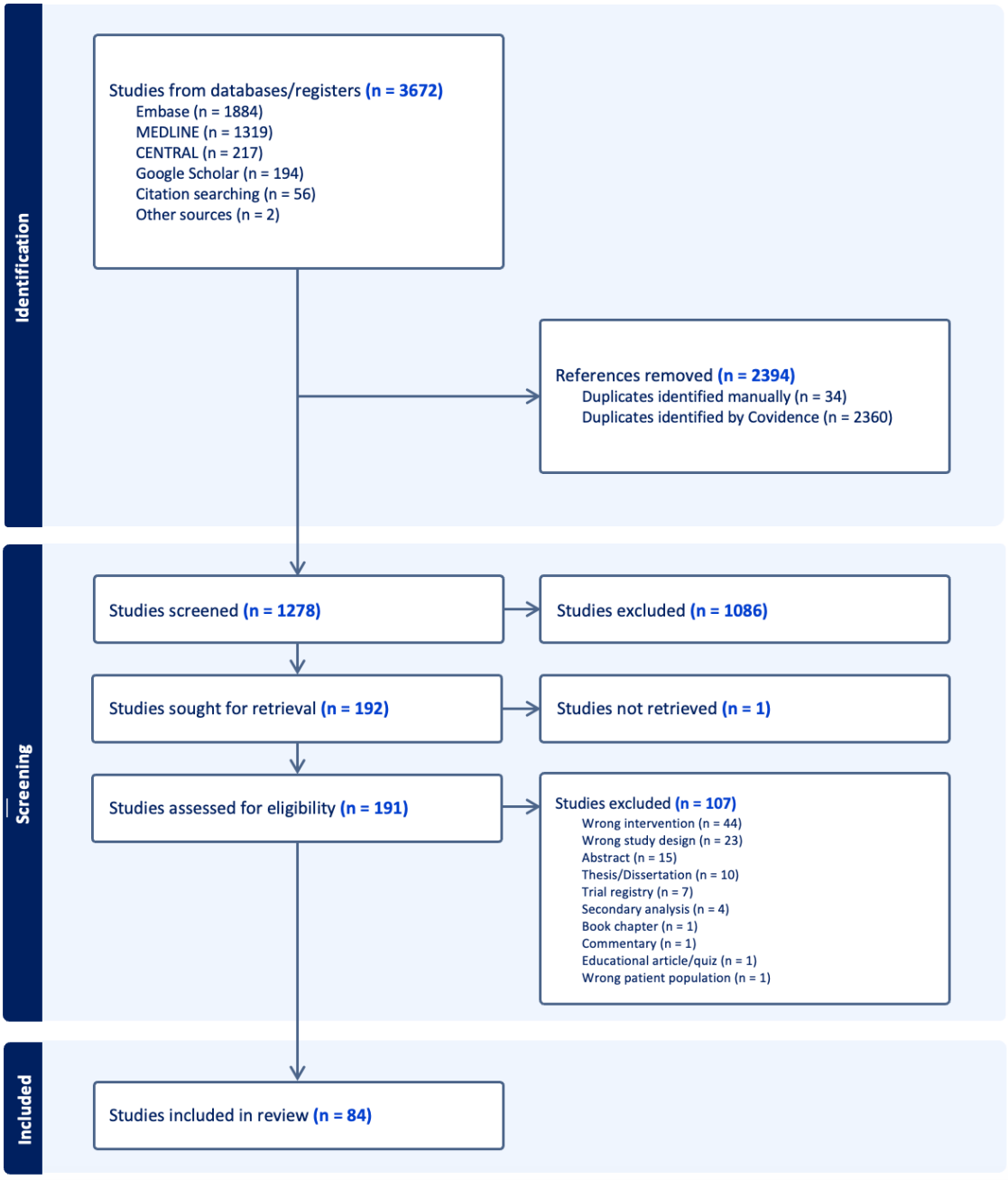

Figure 1. PRISMA flow diagram

Intervention characteristics

Intervention components according to the TIDieR checklist are described in Table 2. Exercise was the most common prehabilitation intervention modality investigated across studies (n=51).[21,22,24,26–28,30,31,33–35,40–43,48,51,53,54,57,59,60,62,64–67,70–76,78–82,84–88,90,93–95,97,100,103] Exercise types included strength, resistance, balance, flexibility, high-intensity interval training, resistance band exercises, aquatic exercises, acute neuromuscular exercise training, and tai chi. There were 14 multimodal programs, including exercise and behavioural interventions (e.g., social cognitive theory, social learning, pain coping, acceptance and commitment therapy) (n=4),[32,44,69,92] exercise and nutrition (n=2),[25,45] exercise and acupuncture (n=2),[77,91] and other combinations of various components including exercise, nutrition, weight management, analgesia review, medication review, psychological or behavioural components, pain management, home assessments, occupational therapy, social work, or equipment including mobility aids and orthotics.[29,46,55,89,96,98] Prehabilitation interventions that were solely behavioural or psychological included cognitive behavioural therapy, self-determination theory to reduce sedentary behaviour, and self-efficacy education, with aims such as reducing anxiety, dealing with pain, and improving exercise and lifestyle behaviours.[39,49,50,52,56,61] Nutritional prehabilitation interventions included vitamin E supplementation, protein supplementation, oral iron powder supplementation, and low-energy liquid diet with protein and fiber intake targeting weight loss.[23,36,58,108] Other types of interventions included acupuncture,[101,102,104] smoking cessation, spirometry, occupational therapy (i.e., home assessment and adaptive equipment), devices (i.e., neuromuscular electrical

stimulation and knee range of motion devices), and eHealth (e.g., online prehabilitation modules).[37,38,47,63,68,83,99]

The duration of interventions ranged from 7 days preoperative[31,68] to 10 months preoperative,[107] with most interventions lasting 4- or 6-weeks in duration. The dose and frequency of interventions was most often 2 to 5 times per week,[21,22,24,26,28,30,31,33–35,38,40–43,45,47,48,51–54,57,60,62,64,65,67,69–73,75,76,81,82,85–88,92,93,95–97,100,103,104,107] with most sessions 20 to 60 minutes in length.[21,22,24,26,28,31–35,37,38,40,45,47–52,56,59–62,65,67,72–74,76,80,82,83,85,88,91–93,100,101,103,104,107] Most interventions were delivered individually, whereas 9 were group-based,[29,62,65,72,77,85,88,91,96] and 5 were a mix of individual and group-based.[41,51,60,88,92] Most interventions (n=64 [76%]) were home-based or remote, or included a home-based component.[21,22,24–27,29,30,32,37–41,46–48,51–54,60,61,63,67–70,73,74,76,78,79,81–84,86,89,92,94,98,100,107] Strategies to measure adherence included diaries, follow-up calls, audio recordings, or sensors. Adherence measures reported included retention rate, average number of sessions completed per week, and self-reported goal adherence.[21,22,29,34,39,40,42,50,52,61,62,65–68,70–73,76,83–85,93–95,99,100,102]

Study quality

Approximately half of the primary publications (n=74) had an overall risk of bias rating of some concerns (n=36 [49%]),[22,23,26,28,30,32,33,36,39,45,48,49,52,54,58,63,66,69,72–75,78,81,83,85,86,88,90,92,93,96,98,100,101,103] while 21 (28%) and 17 (23%) studies were rated as low[29,34,35,40–42,50,57,60–62,65,70,76,77,79,82,87,94,95,99] and high risk of bias,[21,31,38,43,47,59,64,67,68,71,80,84,89,91,97,102,104] respectively (Figure 2). Protocols (n=10) were

not appraised for study quality. Individual study ratings for each risk of bias domain are summarized in Appendix C.

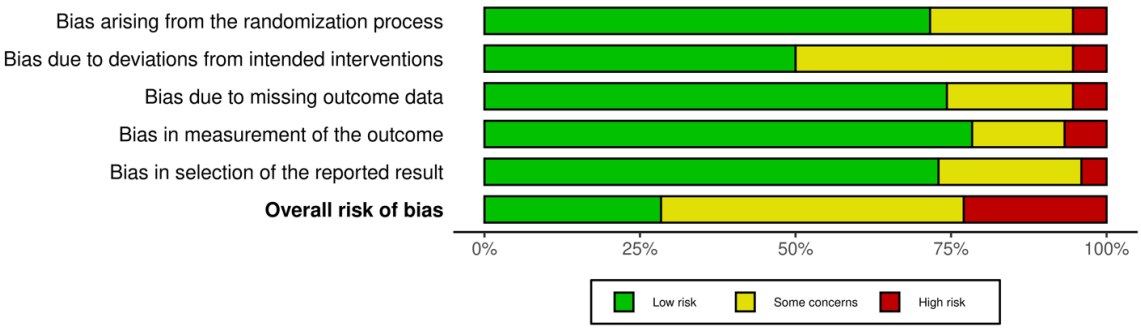

Figure 2. Risk of bias summary figure

Adherence to the TIDieR Checklist

The mean (SD) overall TIDieR score across all studies was 7.7 (1.8), indicating moderate reporting quality. Most studies had moderate (n=45)[22,23,25–27,30,31,33,34,36–38,42–44,47,50,56–60,63,69,70,74,75,77,78,81,83,84,86,87,89,91,92,94–96,98–102] or good (n=29)[21,24,25,29,32,35,39–41,45,46,51–53,55,61,62,65–68,71–73,76,82,85,93,103] overall reporting quality. Poor reporting quality of TIDieR items was found in 10 studies.[28,49,54,64,79,80,88,90,97,104] The percentage of studies reporting each item completely (i.e., score of 1) from highest to lowest was as follows: name (100%), rationale (100%), dose/duration (86%), procedures (85%), mode of delivery (75%), location (67%), materials (66%), planned adherence (37%), actual adherence (35%), tailoring (31%), providers (25%), and modifications (5%) (Table 3). Studies published post-TIDieR (n=47)[21–67] had a mean (SD) overall score of 8.1 (1.8) compared to 7.3 (1.7) in the 37 studies published pre-TIDieR (Figure 3).[68–104] Protocol papers scored a mean of 9.0 (0.8) overall compared to primary publications with a mean of 7.6 (1.8) (Figure 4). Studies that endorsed TIDieR had a higher mean overall score (9.9 [1.3])

compared to those that did not endorse TIDieR (7.9 [1.8]) or were published before TIDieR (7.3 [1.7]) (Figure 5). Studies with low risk of bias, some concerns, and high risk of bias had a mean overall TIDieR score of 8.0 (1.7), 7.5 (1.9), and 7.1 (1.9), respectively (Figure 6). Interrupted time-series analysis found that the introduction of TIDieR in 2014 did not have a statistically significant effect on reporting quality, with no significant difference between pre-TIDieR and post-TIDieR periods (p=0.256).

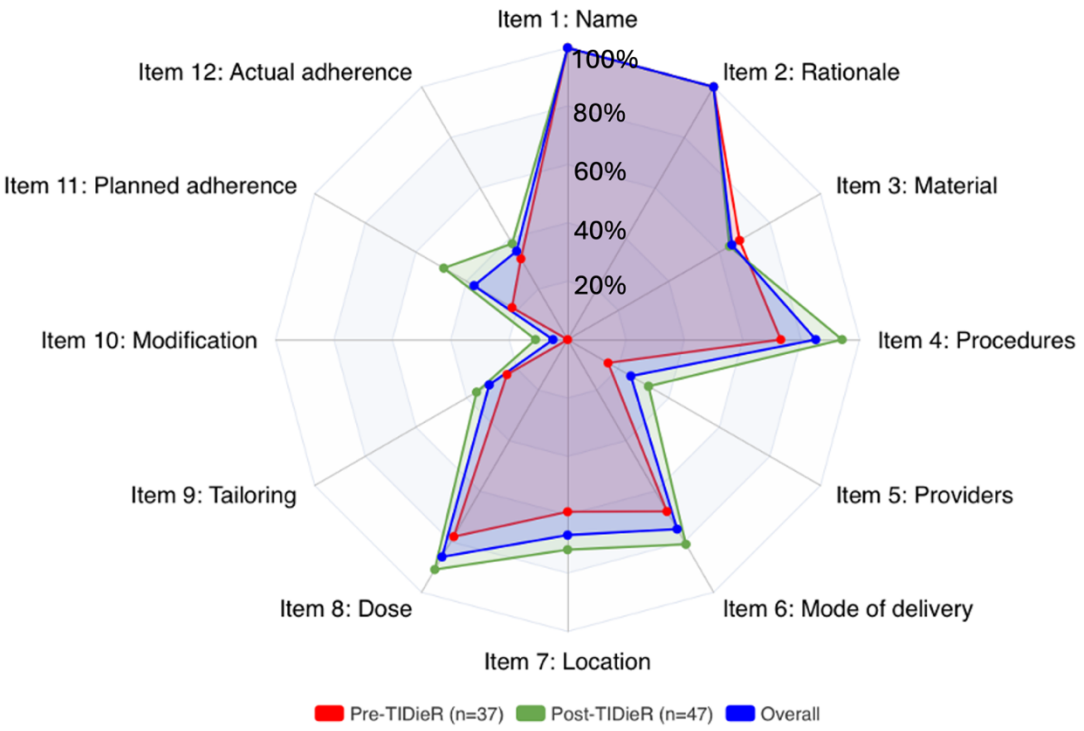

Figure 3. Radar graph of TIDieR adherence in pre-TIDieR vs post-TIDieR studies.

TIDieR Item	Pre-TIDieR (n=37), % adherence	Post-TIDieR (n=47), % adherence	Overall (n=84), % adherence
Item 1: Name	100	100	100
Item 2: Rationale	100	100	100
Item 3: Material	68	64	65
Item 4: Procedures	73	94	85
Item 5: Providers	16	32	25
Item 6: Mode of delivery	68	81	75
Item 7: Location	59	72	67
Item 8: Dose	78	91	86
Item 9: Tailoring	24	36	31
Item 10: Modification	0	11	5
Item 11: Planned adherence	22	49	37
Item 12: Actual adherence	32	38	35

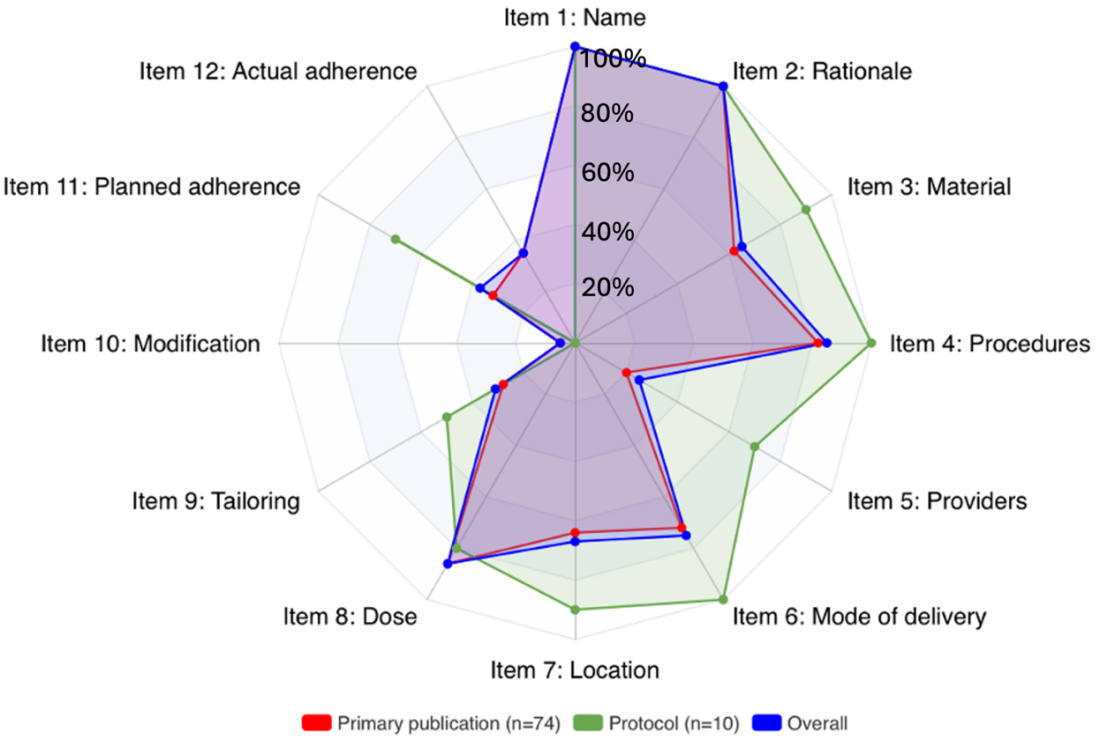

Figure 4. Radar graph of TIDieR adherence in primary publications vs protocol papers.

TIDieR Item	Primary publication (n=74), % adherence	Protocol (n=10), % adherence	Overall (n=84), % adherence
Item 1: Name	100	100	100
Item 2: Rationale	100	100	100
Item 3: Material	62	90	65
Item 4: Procedures	82	100	85
Item 5: Providers	19	70	25
Item 6: Mode of delivery	72	100	75
Item 7: Location	64	90	67
Item 8: Dose	86	80	86
Item 9: Tailoring	28	50	31
Item 10: Modification	5	N/A	5
Item 11: Planned adherence	32	70	37
Item 12: Actual adherence	35	N/A	35

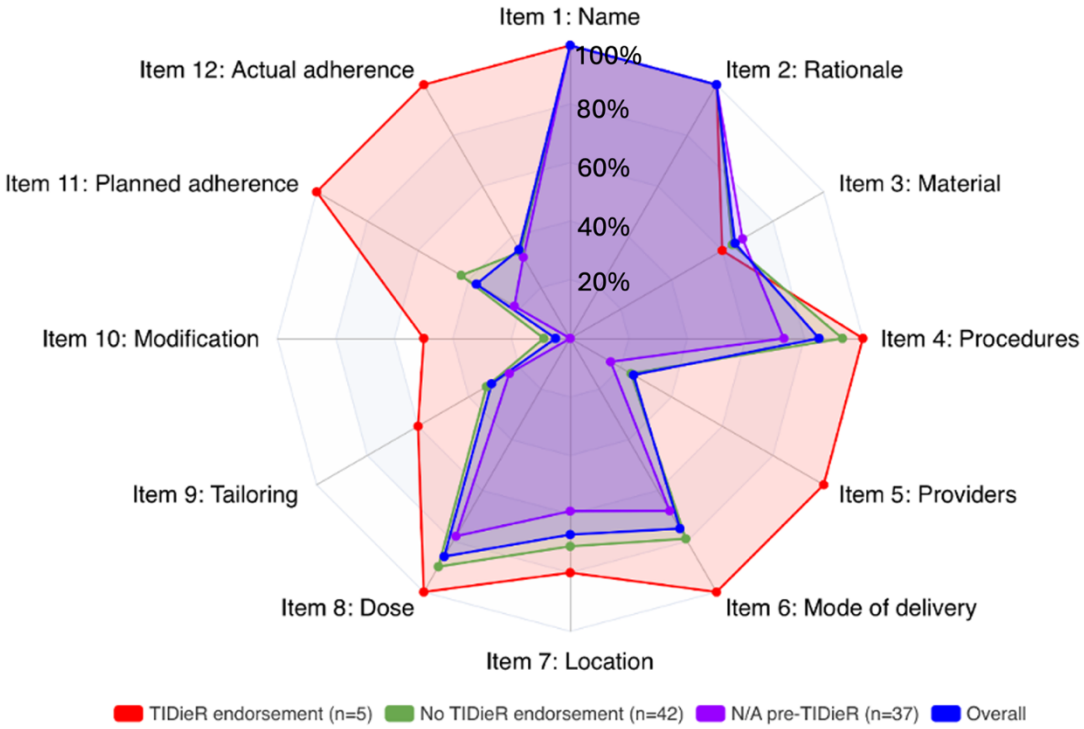

Figure 5. Radar graph of TIDieR adherence by TIDieR endorsement.

TIDieR Item	TIDieR endorsement (n=5), % adherence	No TIDieR endorsement (n=42), % adherence	N/A pre-TIDieR (n=37), % adherence	Overall (n=84), % adherence
Item 1: Name	100	100	100	100
Item 2: Rationale	100	100	100	100
Item 3: Material	60	64	68	65
Item 4: Procedures	100	93	73	85
Item 5: Providers	100	24	16	25
Item 6: Mode of delivery	100	79	68	75
Item 7: Location	80	71	59	67
Item 8: Dose	100	90	78	86
Item 9: Tailoring	60	33	24	31
Item 10: Modification	50	9	0	5
Item 11: Planned adherence	100	43	22	37
Item 12: Actual adherence	100	34	32	35

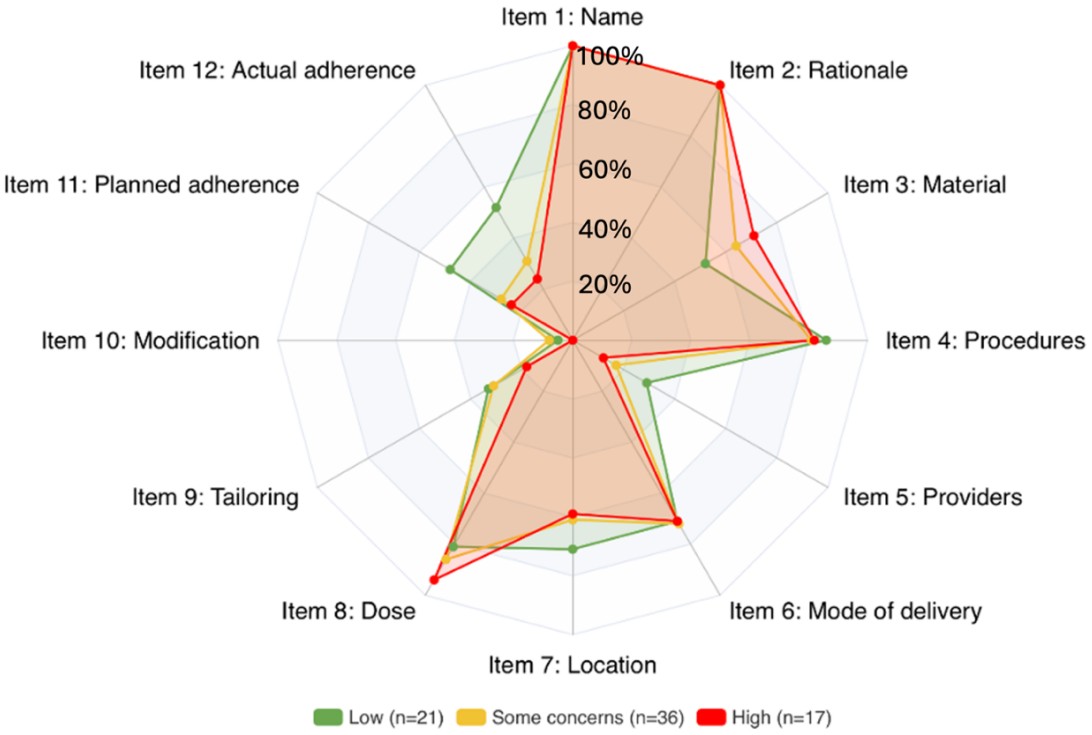

Figure 6. Radar graph of TIDieR adherence by study risk of bias.

TIDieR Item	Low risk of bias (n=21), % adherence	Some concerns (n=36), % adherence	High risk of bias (n=17), % adherence
Item 1: Name	100	100	100
Item 2: Rationale	100	100	100
Item 3: Material	52	64	71
Item 4: Procedures	86	81	82
Item 5: Providers	29	17	12
Item 6: Mode of delivery	71	72	71
Item 7: Location	71	61	59
Item 8: Dose	81	86	94
Item 9: Tailoring	33	31	18
Item 10: Modification	5	8	0
Item 11: Planned adherence	48	28	24
Item 12: Actual adherence	52	31	24

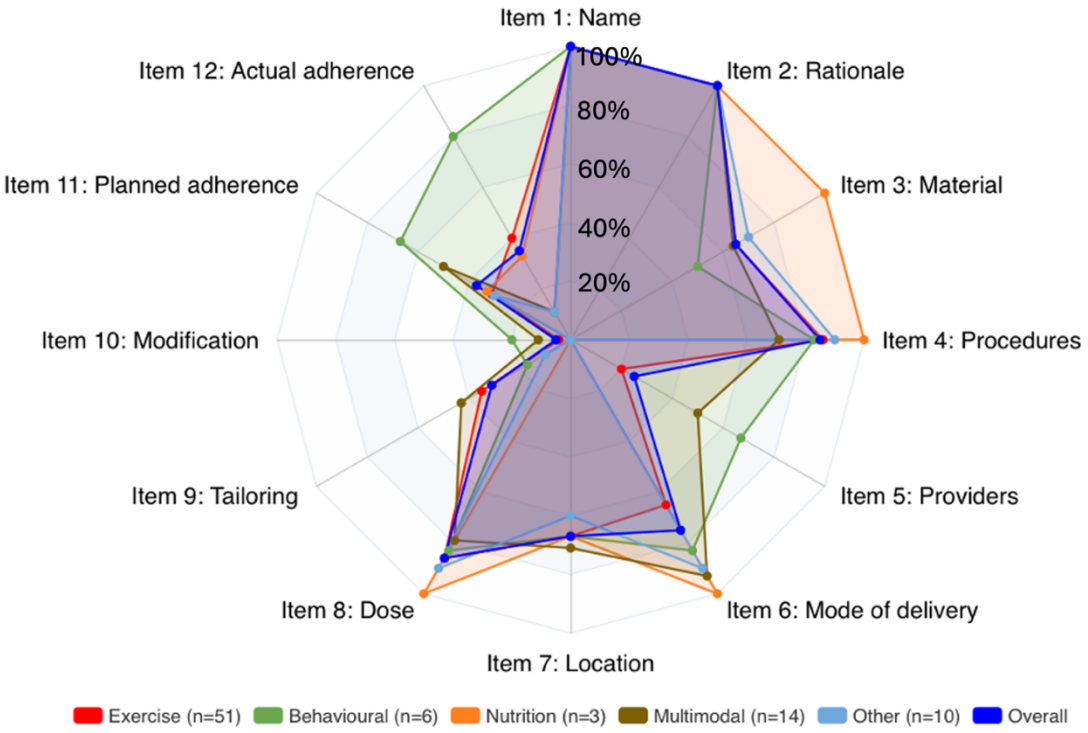

Figure 7. Radar graph of TIDieR adherence by intervention modality.

TIDieR Item	Exercise (n=51), % adherence	Behavioural (n=6), % adherence	Nutrition (n=3), % adherence	Multimodal (n=14), % adherence	Other (n=10), % adherence	Overall (n=84), % adherence
Item 1: Name	100	100	100	100	100	100
Item 2: Rationale	100	100	100	100	100	100
Item 3: Material	65	50	100	64	70	65
Item 4: Procedures	86	83	100	71	90	85
Item 5: Providers	20	67	0	50	0	25
Item 6: Mode of delivery	65	83	100	93	90	75
Item 7: Location	67	67	67	71	60	67
Item 8: Dose	86	83	100	79	90	86
Item 9: Tailoring	35	17	0	43	10	31
Item 10: Modification	4	20	0	11	0	5
Item 11: Planned adherence	31	67	33	50	30	37
Item 12: Actual adherence	40	80	33	11	11	35

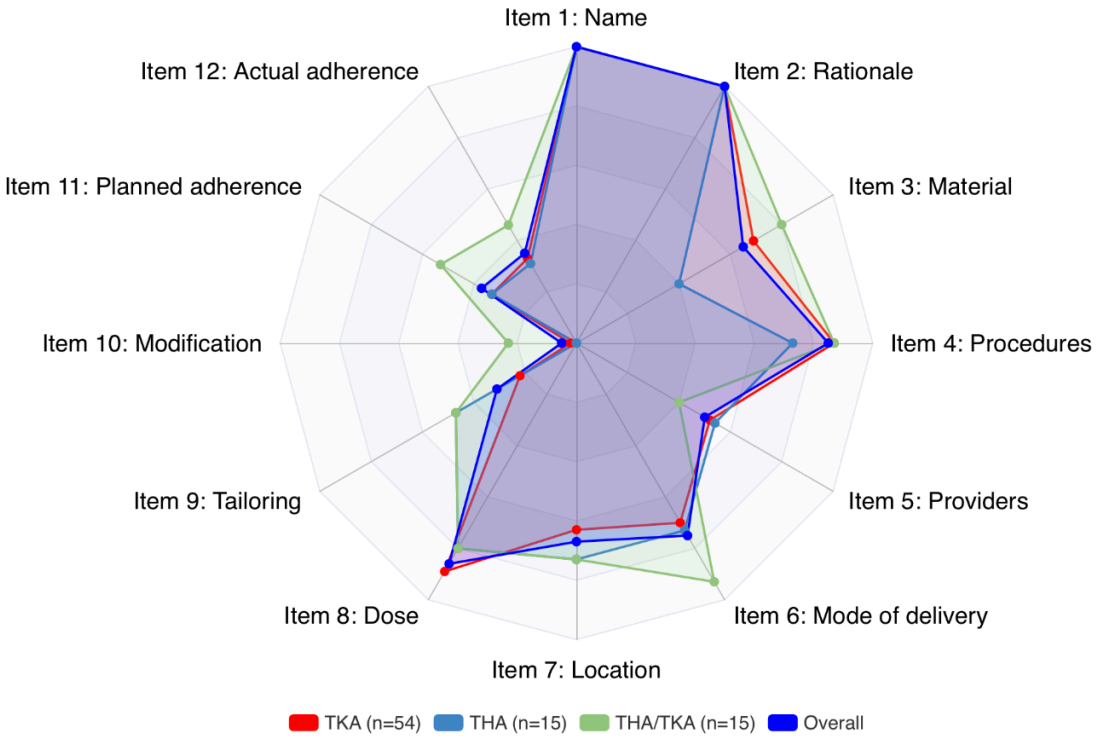

Figure 8. Radar graph of TIDieR adherence by joint replacement type.

TIDieR Item	TKA (n=54), % adherence	THA (n=15), % adherence	THA/TKA (n=15), % adherence	Overall (n=84), % adherence
Item 1: Name	100	100	100	100
Item 2: Rationale	100	100	100	100
Item 3: Material	69	40	80	65
Item 4: Procedures	87	73	87	85
Item 5: Providers	26	27	20	25
Item 6: Mode of delivery	70	73	93	75
Item 7: Location	63	73	73	67
Item 8: Dose	89	80	80	86
Item 9: Tailoring	22	47	47	31
Item 10: Modification	2	0	23	5
Item 11: Planned adherence	33	33	53	37
Item 12: Actual adherence	33	31	46	35

Discussion

This methodological review included 84 prehabilitation RCTs, including patients undergoing TKA (64%), THA (18%), or a mixed population of both surgery types (18%). The landscape of prehabilitation is highly varied, with most prehabilitation studies evaluating exercise interventions, but also other modalities including behavioural or psychological interventions, nutritional interventions, and multimodal interventions. The overall reporting quality of prehabilitation RCTs for older adults undergoing THA or TKA is moderate, and the TIDieR checklist did not significantly influence the quality of reporting in studies published after its introduction, with no significant difference in reporting quality pre- and post-TIDieR.

The mean (SD) overall TIDieR score across all studies was 7.7 (1.8), with a minimum score of 4 to a maximum score of 12, indicating moderate reporting quality. This is similar to findings of previous studies assessing quality of reporting in studies according to the TIDieR checklist, reporting average TIDieR scores of 8.6 (1.3), 7.2 (min-max 2-11) and 8 (min-max 6-12).[14,16,109] There were 45 prehabilitation RCTs that had moderate overall reporting quality (54%), with 29 (35%) and 10 (12%) having good and poor reporting quality, respectively. A previous study of 35 RCTs using the same cutoffs for reporting quality according to TIDieR, also found the majority of studies demonstrated moderate reporting quality (60%), followed by 23% good quality and 17% poor quality.[16] Furthermore, similar results for the scoring of individual TIDieR items was also found in previous studies, with the intervention name (item 1) and rationale (item 2) being the highest reported items, and tailoring (item 9), modifications (item 10),

and adherence (items 11 and 12) being among the lowest reported items in RCTs.[14,16,109] Although there were few studies that explicitly endorsed the TIDieR checklist, they had higher TIDieR adherence than those without a TIDieR endorsement, or those published before TIDieR was introduced. ITS analysis found no significant effect of the TIDieR checklist on quality of reporting post-TIDieR as compared to pre-TIDieR. However, this analysis may be limited by the small number of observations, with 15 pre-TIDieR (i.e., 2001-2015) and 9 post-TIDieR (i.e., 2016-2024) observation timepoints.[110] These pre- and post-TIDieR periods were selected for the ITS analysis based on previous research, allowing for a run-in period of approximately 2 years for the uptake of the TIDieR checklist (i.e., post-TIDieR period beginning in 2016).[14] A previous review examining the reporting quality of prehabilitation RCTs for various types of surgeries (e.g., orthopaedic, non-oncologic, oncologic) also found that mean adherence to TIDieR did not change significantly over time.[111]

Strengths of this methodological review include the use of broad inclusion criteria and lack of language restrictions. Although there were no non-English language articles that met inclusion criteria upon translation during the screening process, this could reduce the potential for language bias. No limitations were placed on study outcomes or the types of prehabilitation interventions included, allowing for a comprehensive summary of THA and TKA prehabilitation research, and highlighting the heterogeneity among interventions and outcomes. This review is larger than a previous review evaluating the reporting quality of prehabilitation interventions which included 70 RCTs, 19 of which were in populations undergoing orthopaedic surgery.[111]

Since the TIDieR checklist was not originally designed as a rating scale for reporting quality, there may be limitations to the use of a TIDieR summary score representing overall reporting quality.[112] However, this methodology has been used in a number of previous studies.[112] Furthermore, previous studies using Rasch analysis have determined that the sum of individual items from the TIDieR checklist can be used to create a single overall TIDieR score.[113,114] In addition, cutoffs defining overall reporting quality were selected in accordance with previous research,[16] but this criteria may not directly correspond to the level of replicability of a given intervention. Another limitation of this study was that the reporting quality of the comparators was not evaluated according to the TIDieR checklist. Most comparators were usual pre-surgical care (e.g., education) and described with less detail compared to the study intervention. It is important to highlight inadequacies in the quality of reporting of comparators, as usual care can vary across institutions.

The demand for THA and TKA is increasing, with projections for THA to increase by 174% and TKA by 673% in the United States by 2030, and a 40% increase for THA and TKA in the United Kingdom by 2060.[115,116] With the demand for THA and TKA greatest in older patients who are at risk of worse postoperative outcomes, prehabilitation may be important to optimize their preoperative functional status, improve postoperative outcomes, and mitigate complications, warranting further research in this area. Use of the TIDieR checklist can support this endeavour by providing a template to improve reporting of prehabilitation intervention components, particularly those which are often underreported, such as tailoring and adherence (items 9-12).

Declarations

Abbreviations

ARIMA: Auto-regressive integrated moving average

CENTRAL: Cochrane Central Register of Controlled Trials

CONSORT: Consolidated Standards of Reporting Trials

EQ-5D: EuroQoL-5D

HOOS: Hip Disability and Osteoarthritis Outcome Score

ITS: Interrupted time-series

KOOS: Knee Injury and Osteoarthritis Outcome Score

OA: Osteoarthritis

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PROSPERO: International Prospective Register of Systematic Reviews

RCT: Randomized controlled trial

SD: Standard deviation

SPSS: Statistical Package for Social Sciences

THA: Total hip arthroplasty

TIDieR: Template for Intervention Description and Replication Checklist

TKA: Total knee arthroplasty

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index

Availability of Data and Materials

All relevant data are included in this manuscript.

Competing Interests

The authors declare no competing interests.

Funding

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CHAPTER 3: CONCLUSION

Future Implications

The majority of previous reviews that have evaluated reporting quality in clinical research according to established reporting guidelines (e.g., CONSORT, STROBE) have reported suboptimal reporting in publications across various health disciplines.[1] Previous reviews evaluating CONSORT adherence in published RCTs demonstrate varied reporting of interventions (item 5), with adequate reporting of this item sometimes as low as 50%.[2–5] The results of this thesis also indicate a need for improved reporting of interventions. To address this issue, some have suggested that intervention-specific TIDieR extensions are introduced (e.g., rehabilitation interventions).[1] However, separate reporting guidelines and extensions can lead to significant workload for researchers and peer reviewers.[6,7] Other strategies to improve TIDieR adherence, such as broader dissemination strategies, endorsement by journals, or directly incorporating the TIDieR items into the CONSORT checklist, may provide more feasible alternatives to address insufficient intervention reporting.[6] Increasing adherence to the TIDieR checklist can facilitate more effective research, particularly for complex interventions like prehabilitation for THA and TKA, where reporting quality can be improved.

Conclusions

Chapter 1 of this thesis identified the importance of reporting guidelines and provided a brief overview of current major reporting guidelines and extensions. The contents of the TIDieR checklist, a reporting guideline for describing interventions in

evaluative studies, was introduced, and its applications to describing complex interventions such as prehabilitation were described. Chapter 2 contains the design and results of a methodological review examining the reporting quality of interventions, according to the TIDieR checklist, in 84 prehabilitation RCTs including older adults undergoing THA or TKA. The main finding of this study is that on average, THA and TKA prehabilitation RCTs were of moderate reporting quality overall, and the introduction of the TIDieR checklist did not have a significant impact on reporting quality in studies published post-TIDieR as compared to pre-TIDieR studies. This thesis further contributes to the literature on adherence to research reporting guidelines, highlighting suboptimal reporting of key intervention components including tailoring of interventions, strategies to assess adherence, and reported measures of adherence. Comprehensive and transparent reporting of interventions is critical for research replicability, evidence syntheses, and implementation of findings into clinical practice. Overall, improved research study reporting is needed to ensure others can understand and replicate these interventions.

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Table 1. Study characteristics of THA/TKA prehabilitation trials

Study, year (country)	Trial design	Joint replacement type	Inclusion criteria	Exclusion criteria	Intervention	Comparator	Outcomes	Outcome measurement timepoints	No. of participants	Age of participants, years	Female/ woman (n, %)	CONSORT endorsement (Y/N)	TIDieR endorsement (Y/N)
Gränicher 2024 (Switzerland)	Single-centre, unblinded, pilot/feasibility trial	TKA, unilateral	Aged ≥18 years, awaiting primary unilateral TKA	BMI>35 kg/m^2; patella alta (Caton Deschamps Index >1.2), muscle weakness due to neurological diagnosis, known/suspected non-compliance (e.g. dementia, reject treatments), depression/psychiatric disorders, acute pain exacerbations/ inflammation, patellar instability, non-German speaking	Exercise and education-based prehabilitation	UC: TKA brochures (i.e., information about surgical and rehabilitation procedures) and no additional preoperative treatment. Asked to keep same activity level during preoperative stage and not to start new therapy	2MWT, 5x Sit-to-Stand, Grip strength, KOOS, Knee ROM, Pain NRS, Stair Climb Test, Tegner Activity Scale, TUG	Baseline, preoperatively, 6-weeks postoperative, 12-weeks postoperative	20 (10 intervention ,10 control)	72.7 (6.0)	15 (75)	Y	N
Roxburgh 2024 (New Zealand)	Single-centre, unclear blinding, phase not specified	THA/TKA, unilateral/ bilateral not specified	Met threshold for elective primary arthroplasty (or expected to within the next year), radiographic evidence of severe OA, ability to travel to study center to complete all sessions	Contraindication to non–physician-supervised maximal exercise testing, stable or unstable angina, myocardial infarction within last 3 months, implantable cardioverter defibrillator and/or pacemaker, revision arthroplasty, staged bilateral TJA, pathology limiting upper-limb exercise, medical condition deemed by anesthetist or cardiologist as risk to participation	Upper-limb high-intensity interval training or passive heat therapy to optimize cardiorespiratory fitness vs home - based exercise	AC: Home-based exercise program with resistance band (same exercises performed by heat group, 15-20 min, 3 days/week) with biweekly calls from study researcher	30-sec Sit-to-Stand, anaerobic threshold, anthropometrics, daily step count (accelerometer), Duke Activity Status Index, EQ-5D, heart rate, isometric strength, oxygen pulse, Oxford Hip Score/Oxford Knee Score, peak $\dot{V}O_2$, physical function, power output, respiratory exchange ratio, SF-12	Baseline, post-intervention	93 (30 heat therapy, 30 HIIT, 33 home-based exercise)	66 (7) heat, 71 (9) HIIT, 67 (8) home-based exercise	41/78 (53)	N	N
Briguglio 2023 (Italy)	Single-centre, unblinded, phase not specified	THA/TKA, unilateral/ bilateral not specified	Caucasian aged ≥60 years, male or female sex, with ASA scores ≤3	Blood disease, iron disorders, neuropsychiatric condition, chronic kidney disease, tumors, myeloproliferative disorder, use of iron-based supplements, past adverse reactions to	Oral iron powder supplement	UC: “Control”; not described further	Red blood cells, hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin, iron, transferrin, ferritin, vitamin B6, B9,	Baseline, hospital admission, before surgery, after treatment period of 45 ± 15 days	58 (29 intervention, 29 control)	71.8 (6.9)	37 (64)	Y	N

				supplements, revision surgery			B12, C-reactive protein						
Guida 2023 (Italy)*	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Males aged 65-80 years, scheduled TKA according to perioperative Fast-Track protocol (probable home discharge, ≥1 cohabitating person w/o known cognitive or motion impairments, tablet/computer/internet familiarity and access, informed consent)	Scheduled revision of knee arthroplasty, lower limb surgery/fractures within 6 months, congenital/ post-traumatic morphological alterations of knee, rehabilitative program within 6 months for functional knee recovery, neurological/muscular/oncological diseases, Human immunodeficiency virus/hepatitis B/hepatitis C/TPHA infection, cognitive impairment reported in clinical anamnesis, known allergic reactions to local anaesthetic, anticoagulants	Home-based virtual reality tele-prehabilitation (Tele-PRE) programme	AC: Standard prehabilitation (Control-Older). During 6-weeks preoperative, exercise sessions 5x/week (5 min warm-up, 30 min mobility/strength /balance, 5 min cool-down. Booklet with exercises, diary to track exercises, and printed educational content 1x/week (e.g., recovery strategies)	Blood sampling, International Physical Activity Questionnaire, Max strength, muscular biopsy, Oxford Knee Score, Pain NRS, satisfaction interview, SF-12, Sit-to-Stand, TUG, WOMAC	Baseline, surgery, 7 days postoperative, 15 days postoperative, 3-months postoperative	Target 48 (24 intervention, 24 control)	N/A	N/A	N	N
Khalid 2023 (UK)*	Multicentre, single-blind, pilot/feasibility trial	THA/TKA, unilateral/ bilateral not specified	Aged ≥65 years, scheduled for primary THA/TKA, ≥12 weeks until surgery, frail according to Groningen Frailty Indicator (score ≥4)	Contraindications to study treatments (e.g. low-protein diet, comorbidities precluding exercise), participating in another study that may affect study outcomes or does not permit co-enrollment, unable or unwilling to provide informed consent	Joint PRehabilitation with Exercise and Protein (Joint PREP)	UC: Varies between National Health Service trusts but may involve education classes, physiotherapy, group exercise, occupational therapy, surgeon review pre- and postoperatively. Recorded preoperative exercise/nutrition programs	Changes to protein/exercise, Clinical Frailty Scale, EQ-5D-5L, exercise beliefs and self-efficacy, Global Physical Activity Questionnaire, Groningen Frailty Indicator, ICEpop CAPability measure for Older people (ICECAP-O), intervention acceptability/feasibility, Protein Screener 55+, WOMAC	Baseline, 12-weeks post-randomization, 3-months postoperative	Target 200 (intervention/control numbers not stated)	N/A	N/A	N	Y
Sun 2023 (China)	Single-centre, single-blind, phase not specified	TKA, unilateral	Aged >55 years, unilateral knee OA awaiting TKA, clear consciousness and ability to communicate,	History of hip/knee surgery, contraindications to exercise or diseases affecting leg activity,	Preoperative high-intensity strength training	UC: Routine nursing and rehabilitation procedures (e.g., education on the operation	Berg Balance Scale, Knee ROM, Knee Society Score, Stair Climb Test, TUG,	Baseline, 3-months postoperative, 12-months postoperative	100 (50 intervention, 50 control)	66.4 (8.3) intervention, 68.5 (7.9) control	23 (72) intervention, 23 (66) control	N	N

			provided consent to participate	incomplete follow-up data or withdrew from study midway	combined with balance training	method, risks, postoperative rehabilitation, postoperative exercises to enhance leg strength knee mobility							
Zhang 2023 (China)*	Single-centre, single-blind, phase not specified	TKA, unilateral	Aged >50 years, clinical symptoms of knee OA confirmed by X-ray, primary unilateral TKA, 100mm pain VAS) ≥30, able to understand and cooperate with test requirements, possess smart device (smartphone, tablet computer or desktop), WeChat account	TKA contraindications (e.g., local/systemic infection), psychiatric diseases, opposite TKA required within 3 months, JointCloud cannot be used because of subjective and objective reasons (e.g., patient/ family member(s) do not have a smart device, or patient is illiterate)	JointCloud online management platform for patients undergoing TKA	UC: Standard preoperative exercise, patient education, provision of multimodal analgesia and early mobilisation	American Knee Society Score, Cost-benefit analysis, Knee ROM, Knee extensor muscle strength, Pain VAS, Patient Health Questionnaire-9 Depression Screening Scale, WOMAC	Baseline (1-month preoperative), 3-days preoperative, 1-month postoperative, 3-months postoperative	Target 186 (93 intervention, 93 control)	N/A	N/A	Y	N
Franz 2022 (Germany)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	End-stage gonarthrosis	Not specified	Cycling ergometer-based training protocol (2 intervention groups)	UC: Standard clinical treatment without a specialized prehabilitation protocol	Blood pressure, Sit-to-Stand, heart rate, KOOS, Knee ROM, 6MWT, and unilateral 6-RM leg extension	Baseline, intervention week 3, 5-days preoperative, 3-months postoperative, 6-months postoperative	30 (10 BFR group, 10 AC group, 10 control)	63.5 (8.1)	12 (40)	N	N
Nguyen 2022 (France)	Multicentre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Aged 50-85 years, knee OA according to American College of Rheumatology criteria, for which TKA was scheduled, written informed consent to participate, affiliation with a health insurance program	Institutionalization, history of homolateral TKA, chronic inflammatory joint disease, cognitive or behavioral disorder, insufficient proficiency in French language, scheduled TKA for non-knee OA indication	Multidisciplinary prehabilitation	UC: Information booklet, standard advice at discretion of orthopaedic surgeon at each center (not recorded). Pharmacological & non-pharmacological co-interventions allowed and recorded	Cost-utility ratio, EQ-5D, functional independence in 4 ±1 days after surgery (i.e., transfer from lying to sitting, sitting to standing, walking 30m, stairs), knee pain in the last 48 hours, number of steps in the previous week, safety (AEs, hospitalizations), WOMAC	4 (1) days postoperative, 6-months postoperative, 12-months postoperative	262 (131 intervention, 131 control)	68.6 (8.0)	178 (68)	Y	Y
Pacheco-Brousseau 2022 (Canada)	Single-centre, single-	THA/TK, unilateral	Aged ≥18 years, WOMAC functional subscale <66.5/100,	Previously diagnosed lower-limb problems limiting capacity for	Home-based preoperativ	UC: Preoperative patient education with booklet	EQ-5D, Feasibility, hip abductor strength	Baseline, preoperative, 6-weeks	27 (13 intervention	61.1 (38.4–2.0) intervention	7 (54) intervention, 5	Y	N

	blind, pilot/feasibility trial		undergoing unilateral THA/TKA due to OA	exercise program, joint revision, bilateral arthroplasty, same-day discharge, surgery <10 weeks after recruitment, pregnancy (or suspected), unable to commit to study follow-ups, no fixed address, cognitive impairment precluding questionnaire completion	e strengthening exercise program specific to THA/TKA	(e.g., surgery and recovery, anesthesia, surgery approaches, postoperative education, early mobilization and ambulation, analgesia, discharge, postoperative ROM exercises)	(THA)/quads strength (TKA), HOOS, KOOS, muscle mass (DXA), muscle strength (dynamometer), TUG	postoperative, 6-months postoperative	, 14 control)	, 60.1 (37.4–85.5) control	(36) control		
Risso 2022 (UK)	Single-centre, unblinded, pragmatic exploratory trial	TKA, unilateral	Aged >18 years, severe knee OA, undergoing primary TKA	Rheumatic or ongoing neurological disorders, conditions affecting function such as amputation, reduced mental capacity affecting abilities to follow prescribed exercises, undergoing TKA for diseases other than OA	Acute prehabilitative neuromuscular exercise-conditioning (APNEC) in patients electing TKA	UC: Current practice (no exercise)	Knee extensor strength	Baseline (11-weeks preoperative), 2-weeks preoperative, 1-week preoperative, 48 h post-intervention, 1-week post-intervention	29 (15 intervention, 14 control)	71.1 (8.1)	4/9 (44) intervention, 5/12 (42) control	Y	N
Terradas-Monllor 2022 (Spain)	Single-centre, single-blind, pilot/feasibility trial	TKA, unilateral/ bilateral not specified	Scheduled for TKA due to symptomatic primary OA, moderate to severe knee pain (40 mm on 100 mm VAS), Pain Catastrophizing Score ≥20, willingness to participate in study, ability to read and understand Spanish/Catalan	Scheduled for revision surgery, unicompartmental arthroplasty, diagnosis of major depression, inflammatory arthritis	Home-based preoperative multimodal physiotherapy for patients undergoing TKA who catastrophize about pain	UC: Multidisciplinary, group-based, biomedical preoperative education session, early inpatient physiotherapy, home-based postoperative physiotherapy	Pain VAS, Sit-to-Stand, WOMAC, EQ-5D-5L, feasibility outcomes, Pain Catastrophizing Score, BMI, Charlson Comorbidity Index, Tampa Scale of Kinesiophobia (TSK-11), Chronic Pain Self-Efficacy Scale, Y-Balance Test	Baseline (8-12 weeks preoperative), post-intervention follow-up up to 9 weeks after baseline	33 (11 therapeutic education (TPE), 8 multimodal physiotherapy (MPT), 14 control)	72.5 (4.5) TPE 71.1 (5.1) MPE intervention, 72.7 (5.8) control	7 (64) TPE, 6 (75) MPT, 11 (79) control	Y	N
An 2021 (South Korea)	Single-centre, single-blind, phase not specified	TKA, bilateral	Aged 65-75 years, scheduled bilateral TKA, control of comorbidities, walk >10 m without help, average vision and hearing, consent to participate with prior	Medical instability (e.g., uncontrolled hypertension, arrhythmia, unstable cardiovascular status), inflammatory arthritis, scheduled TKA revision, history of knee surgery within 6 months,	Unimodal preoperative telerehabilitation	UC: Surgical procedure guidelines, postoperative progress monitoring, discharge destination	Isokinetic strength assessment (i.e., quadriceps strength, knee flexion, knee extension), Knee ROM, pressure	Post-intervention, 4-weeks preoperative, 6-weeks postoperative	60 (20 telerehabilitation, 20 patient education, 20 control)	71.1 (3.30) telerehabilitation, 70.1 (2.4) patient education, 70.4 (2.6) control	60 (100)	N	N

			consent from surgeon, no cognitive impairment, good communication ability, smartphone app familiarity	neurological disorders (e.g., Parkinson's disease, stroke), neurological damage to the lower extremity		determination, quadriceps exercise intervention (recommended several times daily)	pain threshold, TUG, WOMAC						
Domínguez-Navarro 2021 (Spain)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Aged 60-80 years, waiting list for primary TKA, referred by surgeon, advanced idiopathic knee OA (radiographic score >3 on Kellgren–Lawrence scale), sufficient time until surgery (5–8 weeks) to perform 12 sessions of training	Cognitive/physical baseline status (MMSE – Spanish version <20, <21 Berg Balance Scale) that prevented patients from participating in assessments or interventions, systemic illness (i.e., cancer, coronary disease), surgical complications contraindicating physical activity	Preoperative strengthening or preoperative strength plus balance training	UC: No experimental preoperative intervention	Berg Balance Scale, EQ-5D, Functional reach test, Knee ROM, Knee strength, KOOS, Single Leg Stance, TUG	Baseline (5-8 weeks preoperative), 1-week preoperative, 2-weeks postoperative 6-weeks postoperative, 12-months postoperative	82 (28 strength training, 26 strength and balance training, 28 control)	70.8 (5.4) strength, 70.4 (6.4) strength & balance, 70.2 (5.6) control	58.3% strength, 65.0% strength and balance, 66.7% control	N	N
Kim 2021 (United States)	Single-centre, single-blind, pilot/feasibility trial	TKA, unilateral	Aged >50 years, scheduled for primary TKA, Mobility Assessment Tool scores ≤58 for men and ≤50 for women	Knee replacement for non-OA indications, revision, bilateral or emergency surgery, not willing to undergo water exercise, major hearing or vision deficits, exercising >3x/week, participating in another clinical trial, cannot understand questionnaires/directions due to cognitive impairment or language barriers	Aquatic prehabilitation for TKA	UC: Brochure on perioperative nutrition in addition to standard care (e.g., optimization of underlying medical problems, perioperative infection prevention)	Geriatric Depression Scale, high-sensitivity C-reactive protein, IL-6, Montreal Cognitive Assessment (MoCA), Mobility Assessment Tool-Short Form, National Surgical Quality Improvement Project, SPPB, TNF-alpha, WOMAC	1-week preoperative, 4-weeks postoperative	43 (20 intervention, 23 control)	67.1 (6.2)	19 (44)	N	N
Liljensøe 2021 (Denmark)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	OA, scheduled for primary TKA, BMI ≥ 30, motivated for weight loss	Rheumatoid arthritis, planned bariatric surgery	Preoperative intensive weight loss therapy 8 weeks prior to surgery, and 12-months postoperatively (diet group)	UC: Standard care and surgery protocol for TKA, no information on benefit of losing weight preoperatively nor nutritional instructions from study staff	Blood pressure, total body composition, bone mineral density (DXA), duration of anesthesia and surgery, heart rate, caregiver assistance, KOOS, lipid status (total cholesterol, HDL, LDL, triglyceride), mobilization,	1-week preoperative, 8-weeks postoperative, 6-months postoperative, 12-months postoperative	77 (38 intervention, 39 control)	65 (46–81) intervention, 65 (46–85) control	27 (71) intervention, 27 (71) control	N	N

							secretion from surgical wound, serum leptin, SF-36, 6MWT						
Miller 2021 (Canada)*	Single-centre, single-blind, pilot/feasibility trial	THA, unilateral/ bilateral not specified	Aged ≥50 years, hip OA, undergoing single THR in >12 weeks, internet access	Cannot communicate and complete questionnaires in English, anticipate health condition or procedure resulting in surgery cancellation, receiving physical therapy for hip symptoms, previous THA, already received prehabilitation	Hip Instructional Prehabilitation Program for Enhanced Recovery (HIPPER)	UC: 2-hour educational live webinars and booklet, per current practice in OASIS (e.g., exercise, nutrition, equipment, hip precautions)	Sit-to-Stand, equipment checklist, EQ-5D-5L, Feasibility, HADS, Oxford Hip Score, Physical Activity Scale for the Elderly, Self-Efficacy for Rehabilitation Outcome Scale, and System Usability Scale	12-weeks preoperative, 7-10 days preoperative, 30 days postoperative	Target 40 (20 intervention, 20 control)	N/A	N/A	N	N
Şavkin 2021 (Turkey)	Single-centre, single-blind, phase not stated	TKA, unilateral	Aged 50-75 years, scheduled for unilateral TKA for primary OA, ability to cooperate and understand verbal and written instructions	Revision TKA surgery, ASA score >3, previous major orthopedic surgery in either lower extremity, neurologic disease, diagnosed psychiatric problems, hypnotic and/or anxiolytic medication usage, dementia, implanted pacemaker or defibrillator, dermatologic problems affecting lower extremity	Preoperative neuromuscular electrical stimulation (NMES)	UC: 6-week waiting list for surgery without any preoperative intervention	30-sec Sit-to-stand, 40-m fast-paced walk test, KOOS, Knee ROM, Length of stay, quadriceps muscle strength, Stair Climb Test, Short Form, and World Health Organization Quality of Life Instrument	Baseline preoperatively (after NMES application or 6-week surgical waiting period), 4-weeks postoperative, 12-weeks postoperative	54 (32 intervention, 22 control); 20 intervention, 20 control completed follow-up	64.1 (5.1) intervention, 64.3 (5.5) control	2 (10) intervention, 1 (5) control	N	N
Aunger 2020 (UK)	Single-centre, unblinded, pilot/feasibility trial	THA/ TKA, unilateral/ bilateral not specified	Aged ≥60 years, listed for elective THA/TKA, capable of providing informed consent as determined from their medical records, able to regularly access a phone at pre-specified times, able to speak English	Severe neuromuscular or cognitive impairments, significant comorbid disease constituting risk to participation in physical activity, inability to comply with intervention	A novel behavioural INTErvention to REduce Sitting Time in older adults undergoing orthopaedic surgery (INTERESTT)	UC: Regular orthopaedic care including only some physiotherapy postoperatively	Albumin, activity/sedentary behaviour (ActivPal3), Basic Psychological Needs in General Scale, cholesterol, C-reactive protein, cortisol, EQ-5D-5L, feasibility, HDL, HBA1c, Katz Index of Independence in Activities of Daily Living, LDL, Oxford Joint Score, Physical	Baseline, 1-week preoperative, 6-weeks postoperative	35 (24 intervention, 11 control)	73.14 (5.78)	20 (57.1)	Y	Y

							Activity Questionnaire Short Form, Mini Nutritional Assessment Short Form, SPPB, triglycerides, transferrin, vitamin D3						
Blasco 2020 (Spain)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Aged 60–80 years, undergoing TKA, >21 on Berg Balance Scale, 20 in MMSE to understand physiotherapist's instructions, physically capable	Central/vestibular limitation affecting balance, presenting with postoperative complications of knee surgery, such as deep venous thrombosis	Preoperative balance training	UC: No preoperative intervention, instructed to continue normal activities	Berg Balance Scale, EQ-5D, Functional Reach Test, isometric quadriceps strength, Knee ROM, KOOS, Single Leg Stance, TUG	Baseline (5-8 weeks preoperative), 1-week preoperative, 6-weeks postoperative	86 (29 home intervention, 28 hospital intervention, 29 control)	72.3 (4.5) home intervention, 70.2 (7.2) hospital intervention, 70.9 (9.5) control	15 (58%) control, 19 (73%) home, 19 (76%) hospital	N	N
Doiron-Cadrin 2020 (Canada)	Single-centre, single blind, pilot/feasibility trial	THA/TKA, unilateral	Aged >18 years, undergoing TKA/THA, severe hip/knee OA, Quebec residents covered by Quebec public healthcare insurance, French-speaking, access to high-speed internet connection	Inflammatory arthritis, scheduled for bilateral surgery/revision of previous TJA or large diameter head hip prosthesis (>36 mm), lower limb surgery in past 6 months, receiving compensations from Quebec Workers' Compensation Board, severe psychiatric, neurologic or cardiac disorder, other disorder that could interfere with the programs	In-person prehabilitation and teleprehabilitation	UC: Hospital's usual documentation before TJA (i.e., information regarding pre- and postoperative course and medication use)	Global Rating of Change Scale, Lower Extremity Functional Scale, SF-36, Self-Pace Walk, Stair Test, TUG, and WOMAC	Baseline, 12-weeks postoperative	34 (12 teleprehabilitation intervention, 11 in-person intervention, 11 control)	69.9 (9.1) teleprehabilitation, 61.3 (8.1) in-person intervention, 66.7 (9.2) control	7 (64) teleprehabilitation, 10 (83) in-person intervention, 8 (73) control	Y	N
Gränicher 2020 (Switzerland)	Single-centre, single-blind, pilot/feasibility trial	TKA, unilateral	Aged ≥18 years, receiving unilateral TKA	Muscle weakness due to secondary neurological diagnosis, BMI >33.0 kg/m^2, depression, patellar instability, patella alta (Caton Deschamps Index > 1.2), inflammation (e.g., swelling, warming, acute pain/redness), planned osteotomy of tibial tuberosity	Preoperative exercise	UC: Asked to keep activity level same as before the baseline measurement and not to start a new therapy/training preoperatively	Daily preoperative pain, healthcare utilization, Knee ROM, Length of stay, Lysholm Score, metabolic equivalent, Patient Global Impression of Change, Stair Climb Test, Tegner Activity Scale	Baseline (4-weeks preoperative), immediately before surgery, 3-months postoperative	20 (10 intervention, 10 control)	67.4 (7.4)	8 (40)	N	N

Kusumadewi 2020 (Indonesia)	Single-centre, unclear blinding, phase not specified	TKA, unilateral	Aged 55-75 years, scheduled unilateral TKA for grade 3-4 knee OA (Kellgren-Lawrence criteria), Q angle <14°, BMI 18.5-29.9 kg/m^2, Barthel Index >80, walk with/without walking devices, own smartphone with WhatsApp, live in/near Semarang, reimbursed by social health provider	Scheduled for TKA revision, genu valgus abnormalities, non-sedentary level of physical activity, history of heart disease, malignant hypertension, uncontrolled diabetes, surgery 3 months before TKA, drugs such as Nitrats, digitalis or phenothiazides, MMSE score <24, muscle strength with manual muscle testing <4, pain that could not be tolerated at the time of exercise (NRS >5)	Prehabilitation exercise using resistance bands	UC: Conventional therapy (ergocycle and TENS)	SF-36	Baseline, 4-weeks preoperative, 8-weeks postoperative	16 (8 intervention, 8 control)	67 (57 – 75) intervention, 67.5 (56 – 70) control	8 (100) intervention, 6 (75) control	N	N
March 2020 (Australia)*	Multicentre, single-blind, pilot/feasibility trial	TKA, unilateral	Aged ≥18 years, waiting list for elective primary unilateral TKA for OA at participating hospitals, attending preadmission clinic appointments at the same site as their surgery	Preoperative cognitive impairment screened using the Graphical Mini-Cog, reside outside the Western Sydney Local Health District, scheduled for revision/unicompartmental/bilateral TKA, further orthopaedic surgery planned in next 6 months, acute psychological distress at time of screening, current use of illicit substances or alcohol intake >14 units per week	Knee Osteoarthritis Management with Physiotherapy informed by Acceptance and Commitment Therapy (KOMPACT)	UC: 1-hour education class at the physiotherapy department plus supporting manual at 2-months preoperative (usual clinical pathway for TKA), usual postoperative physiotherapy on ward at least once daily to improve mobility and knee ROM	30-sec Sit-to-Stand, 6MWT, Depression Anxiety and Stress Score-21, Brief resilience scale, Chronic Pain Acceptance Questionnaire-8, Committed Action Questionnaire-8, EQ-5D-5L, Feasibility, Health services, International Physical Activity Questionnaire-Elderly, Length of stay, Oxford Knee Score, Pain NRS, Pain Self-efficacy Questionnaire-2, Postoperative complications, SF-36	Baseline (6-8 weeks preoperative), 1-2 weeks preoperative, 6-weeks postoperative, 6-months postoperative	Target 51 (34 intervention, 17 control)	N/A	N/A	Y	Y
Rittharomya 2020 (Thailand)	Single-centre, single-blind, phase not specified	TKA, unilateral/bilateral not specified	Aged 60-79 years, waitlist for TKA, surgery planned for > 3 months out at time of enrollment, no prior knee surgery, no	Acute illness causing admittance to a hospital during the study, unable to maintain compliance throughout study	Preoperative Quadriceps Exercise and Diet Control	UC: Offered PEDCP after the study completed	Knee ROM, Mini-Osteoarthritis of Knee and Hip Quality of Life, Pain NRS, quadriceps muscle	Baseline, 2-weeks preoperative, 8-weeks preoperative,	96 (48 intervention, 48 control)	49 (53%) in 60-69 year age group, 43 (47%) in 70-79 year age group	82/92 (89%)	N	N

			cognitive impairment, independently perform activities of daily living, no uncontrolled or serious medical illness, no gait problems		Program (PEDCP)		strength, Self-Efficacy Expectation Questionnaire, Socio-demographic and Health Information Form, TUG	12-weeks preoperative					
Simpson 2020 (UK)*	Multicentre, unclear blinding, pilot/feasibility trial	TKA, unilateral/ bilateral not specified	Aged 18-85 years, undergoing TKA, for OA, one of the following threshold criteria: BMI ≥ 30 kg/m^2; unable to perform straight-leg raise (no extensor lag); not taking an appropriate level of analgesia; not using shock-absorbing footwear. Able to consent and willing to comply with the study protocol, sufficient time for intervention before surgery and postoperative follow-up	Revision/fully constrained knee arthroplasty, replacement for non-OA diagnosis, second contralateral procedure planned within study timeframe, procedures done purely for pain relief (e.g., patients with no walking capacity), in another study with behaviour change related to diet, physical activity, etc., under active review with a clinician for physiotherapy, unable to understand verbal/written information in English, pregnant until > 4 months post-partum, breastfeeding, additional exclusion criteria for participants eligible for weight-loss component	Osteoarthritis Preoperative Package for care of Orthotics, Rehabilitation, Topical and oral agent Usage and Nutrition to Improve ouTcomes at a Year (OPPORTUNITY)	UC: Standard care at local treatment centre	Cost drivers, EQ-5D, feasibility, identification of key, management of comorbidities, Oxford Knee Score, postoperative complications, qualitative interviews, self-efficacy questionnaires, satisfaction with knee pain and function, TUG, WOMAC	Baseline, post-intervention (week 16), postoperative follow-up	Target 60 (40 intervention, 20 control)	N/A	N/A	Y	N
Stone 2020 (United States)	Single-centre, unclear blinding, phase not specified	TKA, unilateral/ bilateral not specified	Aged >18 years, measurable knee flexion contracture in the supine position, deficit limiting active and passive ROM at ≥10 degrees measured by a goniometer	Previous surgery on the knee including tibial osteotomy, botulinum toxin treatment within last 4 months, neuromuscular pathologies, quinolone medication, pregnancy or nursing; fractures, osteomyelitis or orthopedic infection, extensor mechanism dysfunction, knee joint neuropathy, previous stroke or brain injury, inability to participate in physical therapy	KneeMD medical device	UC: Standardized preoperative physical therapy and home exercise programs for at least 4 weeks prior to surgery, and 2-3 physical therapy visits weekly in addition to daily home exercise program for a minimum 6	Change in maximal active extension during perioperative period, Knee ROM, Knee Society Function Scores, KOOS, postoperative flexion contracture	Baseline, preoperatively, 2-weeks postoperative	115 (56 intervention, 59 control)	68.4 (8.9) intervention, 69.0 (8.0) control	30/46 (65) intervention, 34/55 (62) control	N	N

						weeks postoperatively							
Wang 2020 (China)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Scheduled TKA, no venous thrombosis	Severe complications unsuitable for surgery, movement disorders in other joints which may affect rehabilitation, quit after study began	Otago exercise program (OEP)	UC: Regular orthopaedic nursing measures (e.g., health education, perioperative functional exercise, telephone follow-up)	Barthel Index, Hospital for Special Surgery Knee Score, Knee ROM, Modified Falls Efficacy Scale, WOMAC	Baseline, 3-days postoperative, 1-week postoperative, 2-weeks postoperative	220 (110 intervention, 110 control)	Not reported	46 (46) intervention, 44 (44) control	N	N
Medina-Garzón 2019 (Colombia)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Aged 50-75 years, scheduled knee replacement under two months, acceptance to participate in the study	Intellectual cognitive Disability, surgical procedure different to arthroplasty or knee replacement, and the patient's refusal to participate in the research	Nursing Intervention to Diminish Preoperative Anxiety	UC: Conventional management of education in the health institution	Amsterdam Preoperative Anxiety and Information Scale (APAIS)	Baseline, post-intervention	56 (28 intervention, 28 control)	76.3 (16.1) intervention, 73.7 (16.6) control	14 (50) intervention, 15 (56) man control	N	N
Riddle 2019 (United States)	Multicentre, single-blind, definitive trial	TKA, unilateral	Aged ≥45 years, OA diagnosis, knee arthroplasty scheduled 1-8 weeks after consent, score ≥16 on Pain Catastrophizing Scale, read and spoke English	Revision surgical procedure, hip/knee arthroplasty within previous 6 months or planned 6 months after, inflammatory arthritis (e.g., rheumatoid), bilateral knee arthroplasty, scored ≥20 on a depression screener or ≤2 points on a cognitive screener	Knee Arthroplasty Pain Coping Skills Training (KASTPain)	UC: Routine care	6MWT, EQ-5D-5L, Global Rating of Change Scale, Pain Catastrophizing Scale, Pain NRS, SPPB, WOMAC Healthcare utilization	Baseline, 2-months postoperative, 6-months postoperative, 12-months postoperative	402 (130 pain coping skills, 135 arthritis education, 137 control)	63.2 (8.0)	267 (66)	N	N
Svinøy 2019 (Norway)*	Multicentre, single-blind, phase not stated	THA, unilateral/ bilateral not specified	Aged ≥70 years, living at home (municipalities within South-Eastern Norway Regional Health Authority), scheduled elective primary THA due to end-stage OA, Harris Hip Score <60, able to comprehend instruction during exercise sessions, able to complete questionnaires independently	Rheumatoid arthritis, medical contraindications for exercise, scheduled for revision of hip arthroplasty, unable to speak and understand the Norwegian language, neurological conditions affecting gait, already participating in the AktivA programme elsewhere	Prehabilitation for older patients with OA (AktivA)	UC: Standard care given by recruiting hospitals	6MWT, adherence, EQ-5D, gait speed, healthcare utilization, HOOS, Length of stay, Stair Climb Test, Sit-to-Stand Test, TUG	Baseline (within 1 week pre-intervention), post-intervention prior to surgery, 6-weeks postoperative, 3-months postoperative	Target 96 (48 intervention, 48 control)	N/A	N/A	Y	N
das Nair 2018 (UK)	Multicentre, single-blind,	TKAm unilateral/ bilateral	Aged >18 years, listed for TKA, knee OA (European League	Comorbid severe psychiatric conditions,	Brief psychologic	UC: Standard care delivered by	Beck Anxiety Inventory, Beck Depression	Baseline, 4-months post-randomizatio	50 (25 intervention	65.7 (8.6) intervention	23 (46)	N	N

	Pilot/feasibility trial	not specified	Against Rheumatism criteria), anxiety or depression (score of >7 on Hospital Anxiety and Depression Scale subscale)	inflammatory arthritis, currently receiving psychological intervention	al intervention based on cognitive behavioural therapy	each clinical service, no specific focus on the patients' psychological state	Inventory, EQ-5D-5L, Intermittent and Constant Osteoarthritis Pain scale, WOMAC	n, 6-months post-randomization	, 25 control)	, 66.7 (9.9) control			
Husted 2018 (Denmark)*	Single-centre, single-blind, phase not stated	TKA, unilateral/ bilateral not specified	Aged ≥45 years, primary TKA due to knee OA, based on knee pain NRS ≥3 in last week, Kellgren-Lawrence grade ≥2; eligible for home-based, knee-extensor strength exercise, resident in one of three municipalities (København, Hvidovre or Brøndby), able to speak and understand Danish	Exercise contraindicated, neurological disorder, diagnosed systemic disease (ASA score ≥4), terminal illness, severe bone deformity demanding use of non-standard implants, weekly alcohol consumption above national recommendations (>7 units for women, >14 units for men)	Preoperative quadriceps strength training (QUADX-1)	DC: Dose-comparison concurrent controls	6MWT, AEs, exercise adherence, facilitators and barriers (qualitative interviews), Knee extensor strength, KOOS, need for surgery, Oxford Knee Score, Pain NRS, Stair Climb Test	Baseline, 12-weeks post-intervention, 1-8 days postoperative, 3-months postoperative	Target 140	N/A	N/A	Y	Y
Jahic 2018 (Bosnia and Herzegovina)	Phase/centres/blinding not stated	TKA, unilateral/ bilateral not specified	Diagnosis of gonarthrosis	Systemic inflammatory disease, diabetes mellitus, concomitant lower extremity deformities, could not tolerate protocol of pre- and postoperative treatment	Home-based exercise program	UC: No prehabilitation	BMI, Function Score, Knee Score	6-weeks preoperative, before/after surgery, 3-months postoperative, 6-months postoperative, 12-months postoperative	20 (10 intervention, 10 control)	59.0 (9.5) median age males 59.7 (6.3) median age females	14 (70)	N	N
Negm 2018 (Canada)*	Single-centre, single-blind, pilot/feasibility trial	THA/TKA, unilateral	Aged ≥60 years, pre-frail (score of 1 or 2) or frail (score of 3–5) on Fried frailty phenotype), elective unilateral THA/TKA, surgery wait times between 3-10 months	Renal insufficiency (due to potential contraindication of additional protein), neuromuscular disorder, active cancer, inflammatory arthritis	FitJoints	UC: May include recommendations from orthopaedic surgeon to attend exercise programs, fitness & educational classes, physiotherapy referral, pool therapy, or weight loss program before surgery, no support from study kinesiologist	Discharge destination, EQ-5D, feasibility, Fried Frailty Phenotype, GERAS Fit-Frailty Index, Healthcare utilization, height, hospital readmission, Length of stay, medication and supplements, Mini-Cog, Oxford Hip Score, Oxford Knee Score, Postoperative complications,	Baseline, 1-week preoperative, 6-weeks postoperative, 6-months postoperative	Target 62 (31 intervention, 31 control)	N/A	N/A	Y	N

							self-reported falls, SPPB, weight						
Birch 2017 (Denmark)*	Single-centre, single-blind, phase not specified	TKA, unilateral	Aged ≥18 years, able to speak and understand Danish language, provide informed consent, primary diagnosis of OA, scheduled for elective unilateral TKA, aged, Pain Catastrophizing Score >22	Severe depression diagnosed with the Major Depression Inventory, scheduled for revision/unicompartmental arthroplasty, planning contralateral knee arthroplasty within 1 year from operation, inflammatory arthritis	Physiotherapist delivered cognitive-behavioral patient education	UC: Multidisciplinary information meeting ~1 week preoperative, 4 postoperative follow-ups (1, 2, 4-weeks, 3-months), some receive physical rehabilitation in community	EQ-5D-3L, KOOS, Oxford Knee Score, Pain Catastrophizing Scale, Pain Self-Efficacy Questionnaire, Pain VAS, psychological factors, SF-36	Baseline, 3-months postoperative, 12-months postoperative, self-reported healthcare visits 0-3 months postoperative	Target 56 (28 intervention, 28 control)	N/A	N/A	N	N
Calatayud 2017 (Spain)	Single-centre, single-blind, phase not specified	TKA, unilateral	Scheduled for unilateral TKA	Pain in contralateral limb (maximum pain, ≥4/10 during daily activities), hip/knee replacement in previous year, medical condition in which exercise contraindicated, disease affecting functional performance	High-intensity preoperative training for TKA	UC	10-cm VAS, isometric knee strength and ROM, SF-36, Stair Climb Test, TUG, WOMAC; postural control (from secondary analysis paper Calatayud et al., 2019)	Baseline (8-weeks preoperative), post-intervention, 1-month postoperative, 3-months postoperative	50 (25 intervention, 25 control)	66.8 (4.8) intervention, 66.7 (3.1) control	37/44 (84)	N	N
Tantavisut, 2017 (Thailand)	Single-centre, definitive trial	TKA, unilateral/ bilateral not specified	Aged ≥18 years, clinical diagnosis knee OA according to ACR criteria, severe knee OA (grade 3-4) as defined by Kellgren-Lawrence classification, TKA within 2 months (60 [2] days) after enrollment	Bleeding disorder, current use vitamin E-containing drugs/dietary supplements, anticoagulants, anti-platelet therapy, vitamin E allergy	400 IU of vitamin E	PC: Oral placebo	Ferric reducing antioxidant power assay, Knee Society Score, malondialdehyde, Nitrite, Postoperative complications, Trolox equivalent antioxidant capacity assay, tissue nitrotyrosine, vitamin E, WOMAC	Baseline, post-intervention (2 months of drug administration), 2-weeks postoperative	72 (36 intervention, 36 control)	69.2 (1.3) intervention, 69.5 (1.3) control	27/29 (93) intervention, 17/26 (65) control	N	N
Alghadir 2016 (India)	Single-centre, single-blind, phase unspecified	TKA, not specified unilateral/ bilateral	Primary knee OA diagnosis based on American College of Rheumatology criteria	History of rheumatoid arthritis, cognitive impairment, ankylosing spondylitis	Preoperative physical therapy	UC: Postoperative physical therapy alone	Pain and function VAS, Lower extremity functional scale	Baseline, 3-weeks postoperative, 6-weeks postoperative	50 (25 intervention, 25 control)	63.3 (9.4)	32 (64)	N	N
Cavill 2016 (Australia)	Single-centre, single-blind,	THA/TKA, unilateral/ bilateral	Elective THA/TKA, Risk Assessment and Prediction Tool	Reside outside relevant catchment areas, surgery <4 weeks from Surgical Review Clinics, unable to	THA/TKA prehabilitation	UC: Education including expectations daily	EQ-5D-3L, Knee ROM, Length of stay, number requiring inpatient	Baseline, 8-weeks postoperative	64 (32 intervention, 32 control)	65.3 (9.6) intervention, 67.0 (9.4) control	33 (52)	N	N

	Pilot/feasibility trial	not specified	(RAPT) (Oldmeadow et al., 2004) score ≥6	follow commands, revision surgery, unable to mobilize without a wheelchair, corticosteroid injection in the previous six months, RAPT score <6.		postoperative progress, discharge (day, levels of functioning, destination, equipment. No preoperative exercise program	rehabilitation, Patient Specific Functional Scale, TUG						
Cooke 2016 (Australia)	Multicentre, single-blind, pilot/feasibility trial	THA/TKA, unilateral/bilateral not specified	Aged >18 years, scheduled hip/knee replacement in South East Queensland, Australia, provided informed consent, able to watch a DVD	Unable to read or write English, cognitive or mental impairment preventing completion of self-report surveys	Pre-operative self-efficacy education	UC: Routine in-hospital pre- and postoperative care, including all care provided by healthcare professionals (i.e., nursing, wound care, physiotherapy, pain management)	Feasibility, General Self-Efficacy Scale, healthcare utilization, Pain NRS, self-efficacy and relaxation method utilisation, State-Trait Anxiety Inventory - Form Y	2-6 weeks preoperative, 1-day preoperative, day of surgery, 2-days postoperative, discharge or 4-days postoperative (whichever first), 10-14 days post-discharge, 6 weeks post-discharge	91 (45 intervention, 46 control)	67 (36–86)	52/82 (63)	N	N
Hermann 2016 (Denmark)	Single-centre, single-blind, phase not specified	THA, unilateral/bilateral not specified	Aged ≥50 years, diagnosed with primary hip OA, scheduled for THA	Arthritis not diagnosed as OA, uraemia, cancer, treatment with systemic glucocorticoids 55mg for >3 months in last 5 years, present or previous hip fracture, other lower extremity fracture within 1 year prior to inclusion, body weight >135 kg, severe walking deficits (dependency of two crutches/walker for mobilization), not speaking Danish language	Supervised preoperative progressive explosive-type training program	UC: Standard preoperative information by hip surgeon, meeting with nurses and physiotherapists, handout suggesting low-intensity home-based training program without specific resistance training exercises, no restrictions in engaging exercise programs	5x Sit-to-Stand, 20m gait speed, body composition (DXA), HOOS, isometric muscle strength for knee- and hip extension (dynamometer), Stair Climb Test	Baseline, 3-months postoperative, 6-months postoperative, 9-months postoperative, 12-months postoperative	80 (40 intervention, 40 control)	70.4 (7.6)	52 (65)	Y	N
Jepson 2016 (UK)	Multicentre, single-blind,	THA, unilateral	Primary unilateral THA, OA as primary indication, no previous	Inflammatory arthritis, primary indication for	Preoperative occupationa	UC: Usual National Health Service care for	Aberdeen Impairment, Activity limitation	Baseline, 4-weeks postoperative	44 (21 intervention	66 (10.8)	20 (45)	N	N

	pilot/feasibility trial		lower limb joint replacement, no planned additional lower limb joint replacement surgery within 12 months, sufficient understanding of English to complete questionnaires (or proxy completion by representative with sufficient English)	surgery was pain relief only, unable to provide informed consent	l therapy to optimise recovery for patients undergoing primary total hip replacement for osteoarthritis (PROOF-THR)	elective THA; preoperative multidisciplinary education package given in hospital; occupational therapists provided adaptive equipment post-surgery	and Participation Restriction measure, EQ-5D, Healthcare utilization (Client Service Receipt Inventory), Hospital Anxiety and Depression Scale, ICEpop CAPability measure for Older people (ICECAP-O), Nottingham Extended Activities of Daily Living, WOMAC	, 26-weeks postoperative	, 23 control)				
Mat Eil Ismail 2016 (Malaysia)	Single-centre, unblinded, phase not specified	TKA, unilateral	Aged ≥45 years, live within convenient distance of physiotherapy facility, diagnosed with unilateral/bilateral primary knee OA, undergoing unilateral TKA	Systemic inflammatory arthritis, degenerative diseases of hip/ankle joint or spine, comorbidities with inability to tolerate moderate physical exertion, premorbid knee joint stiffness, history of cardiovascular accident, cognitive, psychological or language impairment	Preoperative physiotherapy	UC: No physiotherapy	Knee ROM, KOOS, Postoperative complications	Baseline, preoperative, 6-weeks postoperative, 3-months postoperative	50 (24 intervention, 26 control)	64.6 (47.0–79.0)	43 (86)	N	N
Skoffer 2016 (Denmark)	Single-centre, single-blind, definitive trial	TKA, unilateral	Scheduled for primary unilateral TKA, radiographically and clinically diagnosed with OA, reside in Aarhus municipality, able to transport to training	Aged <18 years, heart disease or uncontrolled hypertension, neuromuscular or neurodegenerative conditions, unable to comprehend protocol instructions	Unilateral progressive resistance training	UC: Instructed to live as usual for 4 weeks preoperatively. Postoperatively followed the same PRT protocol as the intervention group.	10-meter walk test, 30-sec Sit-to-Stand, 6MWT, Feasibility, Health-related quality of life, muscle strength, Knee joint pain, effusion, unilateral leg press, KOOS, Knee ROM, TUG	Baseline (6-weeks preoperative), 1-week preoperative, 1-week postoperative, 6-weeks postoperative, 12-weeks postoperative	59 (30 intervention, 29 control)	70.7 (7.3) intervention, 70.1 (6.4) control	36 (61)	N	N
Huber 2015 (Switzerland)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Aged 55-90 years, waiting list for primary TKA, sufficient time before the operation date for minimum 8 sessions of the training program, understood German, lived at home	Revision surgery, inflammatory arthritis, cognitive impairments, absence before/after surgery, inability to walk at least 3 meters with/without walking aid	Preoperative neuromuscular training (NEMEX-TJ	UC: Knee school sessions separately organised for participants of the intervention and control group, latter	Sit-to-Stand, KOOS	Baseline (6-12 weeks preoperative), 1-week preoperative, 6-weeks postoperative, 3-months postoperative	45 (22 intervention, 23 control)	68.8 (8.0) intervention, 71.9 (8.1) control	11 (50) intervention, 10 (44) control	Y	N

						attended three sessions		, 12-months postoperative					
Zeng 2015 (China)	Single-centre, single-blind, Pilot/feasibility trial	THA, unilateral	Aged 60-69 years, end-stage hip OA, posttraumatic arthritis or osteonecrosis, unilateral chronic hip pain and disability unresponsive to conservative treatment, fully informed consent to the patients in the preoperative exercise program and testing procedures, stable health and fit for anesthesia, able to appoint a regular family member as training partner during preoperative exercise program period	History of hip infection, congenital dislocation of the hip, bilateral hip disease or inflammatory arthritis, moderate level of exercise contraindicated, preclusion of safe participation in exercise program or prevented completion of the study (uncontrolled diabetes or hypertension, congestive heart failure, severe COPD, myocardial infarction or stroke in the past 3 months, active treatment for cancer, severe systemic disease, or major psychiatric disease), significant neuromuscular disease, unable to walk at least 150 m in 6 min without a cane or assistive device, walking with support of assistive devices, exercised regularly (≥20 min >1x/week), TC training within 1 year, bilateral joint replacements or revision, unable to complete study	Preoperative home-based combined Tai Chi and Strength Training (TCST)	UC: 1:1 preoperative education programs (surgery, anesthesia techniques, avoiding hip dislocation, benefits of activity, use of assistive devices approximately one week before surgery, and an information booklet)	6MWT, Hip ROM, Single Leg Stance, TUG, WOMAC	Baseline, 3-days post-enrolment, within 3 days preoperative, 13-weeks postoperative, 26-weeks postoperative	97 (48 intervention, 49 control)	65.2 (22.6) intervention, 64.8 (22.5) control	15/32 (47) intervention, 13/27 (48) control	N	N
Bergin 2014 (United States)	Single-centre, no blinding statement, phase not specified	THA/TKA, unilateral/ bilateral not specified	Aged ≥18 years, scheduled THA/TKA, able to communicate in English language, attended Joints in Motion class within 1-4 weeks of surgery, signed informed consent	Require an additional surgical procedure or anesthesia and not expected to be able to conduct or comply with IS postoperatively, such as patients with cognitive or neurological deficits or whose acuity level would prohibit study compliance	Preoperative incentive spirometry (IS) education (POISE intervention)	UC: Hospital preoperative Joints in Motion class; complete only the postoperative daily study diaries	Average hours IS return to baseline volume, Average pain at baseline IS volume return, costs per group, intervention helpfulness rating, Length of stay, Postoperative pulmonary/non-pulmonary complications	Baseline, discharge, study completion	140 (71 intervention, 69 control)	61.6 (8.3) intervention, 65.7 (8.7) control	58%	N	N/A (pre-TIDieR)

Brown 2014 (United States)	Single-centre, no blinding statement, phase not specified	TKA, unilateral	Not specified	Symptomatic coronary artery disease (i.e., uncontrollable angina or MI within past year, cardiac dysrhythmias requiring therapy, congestive heart failure, severe aortic stenosis, dissecting/ventricular aneurysm, acute myocarditis, pericarditis, subacute endocarditis, or acute rheumatic fever, systemic/pulmonary emboli within past 3 months, acute thrombophlebitis or intracardiac thrombi, recent significant change in resting EKG, uncontrolled hypertension, peripheral vascular disease, COPD, other chronic disease preventing moderate intensity exercise, cerebrovascular disease resulting in permanent disability, anti-anginal medications, aged <40, unable to read and/or understand English, unable to participate in protocol for 10 weeks	Exercise program based on social cognitive theory	UC: 2- to 3-hour educational program ~2-weeks preoperative	Outcome expectations for exercise, Self-efficacy to exercise	Baseline, 1-week preoperative, 1-week postoperative, 2-weeks postoperative	31 (16 intervention, 15 control)	60 (8.3) intervention, 67 (9.5) control	10 (45) intervention, 12 (56) female control	N	N/A (pre-TIDieR)
Matassi 2014 (Italy)	Single-centre, single-blind, phase not specified	TKA, unilateral	Aged 18-90 years, inflammatory OA, planned primary unilateral TKA, moderate to severe pain in affected knee, signed consent form, plans to be available for follow-up through 1-year postoperative, stable health allowing safe participation in intervention	BMI >35, physical activity needs less than moderate, previous hip or knee replacement in last 6 months, failed total or unicondylar knee replacement, high tibial osteotomy of the affected knee, active infection, physical, emotional or neurological conditions compromising study compliance, grade three collateral ligament insufficiency, knee	Preoperative home exercise program	UC: Regular activities until surgery	Clinical Rating System, days before reaching 90° of knee flexion, Knee ROM, Knee Society, Length of stay	Baseline, preoperative, 6-weeks postoperative, 6-months postoperative, 12-months postoperative	122 (61 intervention, 61 control)	66 (7.2) intervention, 67 (7.7) control	59 (48)	N	N/A (pre-TIDieR)

				flexion <80°, fixed flexion deformity >20°, varus or valgus alignment greater >10° unless correctable to <10°, immunosuppressive disorder/therapy, autoimmune diseases including inflammatory arthritis, pregnancy, intra-articular steroid infiltration in affected knee within 6 weeks of baseline, recent fracture (3 months) of upper or lower extremity, inability to understand study (dementia, language problem), physiotherapy for affected knee during preceding 6 months									
van Leeuwen 2014 (Netherlands)	Single-centre, single-blind, pilot/feasibility trial	TKA, unilateral/ bilateral not specified	Aged >55 years, awaiting TKA	ASA score >2, contraindications for training the lower limbs, contraindications for electrical stimulation (unstable epilepsy, cancer, skin abnormalities, pacemaker)	Preoperative strength training for elderly patients	UC: Treatment according to OA guidelines from the Dutch association of orthopaedics & Dutch physiotherapy association (KNGF) (e.g., advice, exercise/ activities of daily life, walking with aids, mobility, aerobics, but no resistance training)	5x Sit-to-Stand, 6MWT, feasibility, Stair Climb Test, torque measurements of knee extensor & flexor muscles, WOMAC	Pre-intervention, 6-weeks post-intervention, 1-week preoperative; 6-weeks postoperative, 12-weeks postoperative	22 (11 intervention, 11 control)	71.8 (7.5) intervention, 69.5 (7.1) control	10 (45)	N	N/A (pre-TIDieR)
Villadsen 2014 (Denmark)	Single-centre, single-blind, definitive trial	THA/TKA, unilateral	Aged ≥18 years, understood Danish, scheduled for primary unilateral THA/TKA for severe symptomatic OA	Current/previous fractures in/adjacent to joint, inflammatory arthritis and comorbidity (e.g., severe heart disease, neurological deficits) contraindicating exercise and testing, scheduled for bilateral TJA in the same	Neuromuscular exercise (NEMEX-TJR) program	UC: Educational package (i.e., operating procedure, expected postoperative progression, exercises) & 3-hour in-clinic information	20m walk, 5x Sit-to-Stand, EQ-5D, HOOS, KOOS, Knee/hip ROM	Baseline, 6-weeks postoperative, 3-months postoperative	165 (84 intervention, 81 control)	67.9 (8.6) intervention, 66.9 (8.3) control	92 (56)	Y	N/A (pre-TIDieR)

				procedure, unable to attend exercise sessions		session led by health professional 1-week preoperatively. No limitations on exercise habits/other treatment							
Brown 2012 (United States)	Single-centre, blinding unclear, pilot/feasibility trial	TKA; unilateral/bilateral not specified	Not stated	Not stated	Prehab for TKA	UC: Received the usual pre- and postoperative care	SF-36	3-months postoperative	32 (17 intervention, 15 control)	Not reported	Not reported	N	N/A (pre-TIDieR)
Huang 2012 (Taiwan)	Single-centre, no blinding statement, phase not specified	TKA, unilateral	Scheduled unilateral, primary TKA for advanced OA, ability to follow rehabilitation program, interval of 4 weeks between enrolment surgery for sufficient time for intervention	Inflammatory arthritis (e.g., rheumatoid/psoriatic arthritis), any medical condition in which moderate exercise contraindicated (e.g., heart failure/hypertension), scheduled to have bilateral replacement	Preoperative rehabilitation education program	UC: No limits on usual activities/ exercises. All participants participated in standard rehabilitation program 1x/day for 40 min, structure dependent on post-TKA functional status	Knee ROM, Length of stay, Pain VAS, Postoperative complications, total medical expenses of hospitalization for TKA (preoperative care, prosthesis, operation, postoperative costs)	Baseline, 2-days postoperative, 5-days postoperative (discharge)	243 (126 intervention, 117 control)	70 (7.3)	71.6%	N	N/A (pre-TIDieR)
McKay 2012 (Canada)	Single-centre, no blinding statement, pilot/feasibility trial	TKA, unilateral	Primary diagnosis of knee OA, ambulatory with or without a walking aid, exhibited unilateral/bilateral OA symptoms	Scheduled additional, unrelated surgery within 3 months of TKA, undergone surgery 3 months before recruitment, contraindications for exercise, revision surgery	Prehabilitation exercise training program on quadriceps strength for TKA (lower body experimental program)	AC: Upper body control program: same 10-min aerobic warm-up as intervention group, circuit of bilateral upper body exercises (lat pull, chest press, elbow flexion, elbow extension) for 2 sets x 8 reps starting at 60% of 1RM; performed on HUR fitness equipment (Ab Hur Oy, Kokkola, Finland)	Arthritis self-efficacy scale, Flat surface walk test, isometric quadriceps strength, SF-36, Stair Climb Test, WOMAC	Baseline, post-intervention, 6-weeks postoperative, 12-weeks postoperative	22 (10 intervention, 12 control)	63.5 (4.9) intervention, 60.6 (8.1) control	50% intervention, 67% control	Y	N/A (pre-TIDieR)

Oosting 2012 (Netherlands)	Single-centre, single-blind, pilot/feasibility trial	THA, unilateral/ bilateral not specified	Aged >65 years, Elective THA for OA (minimum waiting period of 3 weeks), score ≥2 on the frailty index Identification of Seniors at Risk	Unable to understand Dutch, inadequate cognitive functioning (i.e., unable to understand instructions), revision of THA, dementia or severe heart disease	Preoperative home-based physical therapy	UC: Single group session supervised by a physical therapist 3 weeks before surgery (e.g., information about operation, crutches, postoperative exercises)	6MWT, Feasibility, HOOS, Iowa Level of Assistance Scale, Length of stay, Longitudinal Aging Study Amsterdam Physical Activity Questionnaire, Pain VAS, Patient-Specific Complaints questionnaire, Postoperative complications Sit-to-Stand, TUG	Baseline, 2-4 days before admission, discharge, 6 weeks after discharge	30 (15 intervention, 15 control)	76.9 (6.3) intervention, 75.0 (6.3) control	24 (80)	N	N/A (pre-TIDieR)
Soni 2012 (UK)	Single-centre, single-blind, definitive trial	TKA, unilateral/ bilateral not specified	TKA due to OA, unilateral or bilateral knee pain lasting >3 months.	Anticoagulants/bleeding diathesis, needle-phobic, metal allergy, skin disease around the knee, within 3 months of receiving an intra-articular steroid injection, experiencing back/hip pain, rheumatoid arthritis, within 12 months of receiving acupuncture/ physiotherapy, pregnant	Acupuncture and physiotherapy	UC: Exercise and advice leaflet designed by consensus between the physiotherapy, rheumatology, & orthopaedic departments	50 m timed walk, AEs, analgesic use, Hospital Anxiety and Depression Scale, Oxford Knee Score, Pain VAS, weight	Baseline, 6-weeks post-intervention, 12-weeks post-intervention, 3-months postoperative	56 (28 intervention, 28 control)	66.9 (9.8) intervention, 69.9 (7.9) control	Unclear	N	N/A (pre-TIDieR)
Tungtrongjit 2012 (Thailand)	Single-centre, single-blind, phase not specified	TKA, unilateral	Aged ≥50 years, primary TKA for OA, idiopathic or secondary knee OA with grade 2-4 radiographic severity (modified Kellgren & Lawrence classification)	History of cerebrovascular accident, knee joint infection, postoperative wound infection, dehiscence, or knee trauma	Preoperative quadriceps exercise	UC: Continue normal activities until TKA	Knee ROM, Pain VAS, quadriceps strength, WOMAC	3-weeks preoperative, 1-month postoperative, 3-months postoperative, 6-months postoperative	60 (30 intervention, 30 control)	63 intervention, 65.9 control (SD not specified)	26 (87) intervention, 24 (80) control	N	N/A (pre-TIDieR)
Bitterli 2011 (Switzerland)	Single-centre, single-blind, phase not specified	THA, unilateral	Unilateral arthrosis or femoral head necrosis, first and unilateral total hip endoprostheses	Previous surgery on affected joint, fitted with hip, knee or ankle joint prostheses, double-sided THEP planned, undergoing the procedure in <3 weeks, only able to follow the training program for <15 days, neurological issues	Pre-Surgical Sensorimotor Training	UC: No therapy	Biodex Balance System (overall stability index, medial-lateral stability index), Length of stay, SF-36, WOMAC	1-day preoperative, 10-days postoperative, 4-months postoperative, 12-months postoperative	80 (39 intervention, 41 control)	66.8 (10.3)	31 (39)	Y	N/A (pre-TIDieR)

Gstoettner 2011 (Austria)	Single-centre, no blinding statement, phase not specified	TKA, unilateral	Severe unilateral knee OA, scheduled for TKA	Diseases influencing proprioception (e.g., neuromuscular or rheumatic diseases, diabetes mellitus, vestibular dysfunction), complaints in ≥1 of contralateral knee, hip or ankle joints	Preoperative proprioceptive training programme	Not described	60-m gait speed, Balance (Biodex Stability System), Knee Society Score, Postoperative complications, WOMAC	6-weeks preoperative, 1-day preoperative 6-weeks postoperative	38 (18 intervention, 20 control)	72.8 (65–78) intervention, 66.9 (61–75) control	16 (89) intervention, 14 (70) control	N	N/A (pre-TIDieR)
Swank 2011 (United States)	Single-centre, unclear blinding, phase not specifed	TKA, unilateral/ bilateral not specified	Severe OA with pain not responsive to medication, scheduled for TKA	History of uncontrolled angina, cardiomyopathy severe enough to compromise cardiac functioning, any other health problem prohibiting moderate exercise, taking nitrates, digitals, or phenothiazines	Resistance band, flexibility, and step exercise program	UC: Continue normal activities until TKA	6MWT, Sit-to-Stand, Stair Climb Test, Knee ROM	Baseline, 1-week preoperative	71 (36 intervention, 35 control)	63.1 (7.3) intervention, 62.6 (7.6) control	24 (67) intervention, 22 (63) control	N	N/A (pre-TIDieR)
Hoogeboom 2010 (Netherlands)	Single-centre, single-blind, pilot/feasibility trial	THA, unilateral/ bilateral not specified	Aged 70 years, scheduled for elective primary THA due to end-stage OA with minimum 3-week wait, Clinical Frailty Scale score of 2	Unable to communicate in Dutch, severe heart diseases	Short (3–6 weeks) tailored therapeutic exercise program	UC: One group-based education session 1-week preoperative about early mobilization, surgery and anaesthesia techniques, restricted movements, benefits of activity, proper use of crutches	6MWT, Feasibility, Heart rate, HOOS, Iowa Level of Assistance Scale, LASA Physical Activity Questionnaire, Length of stay, Patient-Specific Complaints questionnaire (physical functioning), Perceived exertion, Sit-to-Stand, TUG	Baseline, within 1-week preoperative, during each day of hospital stay postoperative - feasibility	21 (10 intervention, 11 control)	77 (3) intervention, 75 (5) control	7 (70) intervention, 7 (64) control	N	N/A (pre-TIDieR)
Walls 2010 (Ireland)	Single-centre, single-blind, pilot/feasibility trial	TKA, unilateral/ bilateral not specified	Undergoing TKA for end-stage knee OA	Inflammatory arthritis, BMI >40 kg/m^2, implanted pacemakers or defibrillators, dermatological conditions affecting thigh, recent participation in exercise/strength training program, neurological disorder, other lower limb impairment of function	NMES training	UC: individual instruction on knee ROM and quadriceps muscle strengthening exercises from physiotherapist; adherence not recorded	Sit-to-Stand, SF-36, Stair Climb Test, quadriceps strength & cross-sectional area, WOMAC	Baseline, preoperative, 6-weeks postoperative, 12-weeks postoperative	17 (9 intervention, 5 control)	65.4 (49-80)	11 (65)	N	N/A (pre-TIDieR)
Aoki 2009 (Japan)	Single-centre, single-	TKA, unilateral/ bilateral	Unilateral or bilateral OA, undergoing TKA	Unable to follow instructions and lie prone,	Home stretching exercise	UC: Maintain current level of physical activity	Gait speed (walk 10-m line	Baseline, admission	36 (17 intervention	73.3 (5.8)	36 (100)	N	N/A (pre-TIDieR)

	blind, phase not specified			self-reported severe cardiorespiratory disease, neurological disease, lower limb disorders other than knee OA			3x), Knee ROM, Pain VAS		, 19 control)				
Gill 2009 (Australia)	Single-centre, single-blind, phase not specified	THA/TKA, unilateral/ bilateral	Waiting list for joint replacement surgery of the hip or knee	Only tibial osteotomy was to be performed, currently completing physiotherapy program (not self-directed or with lay instructor), surgery scheduled before completion of 6-week program, contraindications to exercise as assessed by their local doctor, inadequate communication skills in English	Land-based versus pool-based exercise for people awaiting joint replacement surgery of the hip or knee	AC: Pool-based exercise	50-ft timed walk, 30-sec chair stand test, 7-point pain verbal rating scale, SF-36, WOMAC	Pre-intervention, post-intervention, 8-weeks post-intervention	86 (42 pool-based, 40 land-based exercise)	70.3 (9.8)	28 (67) pool-based, 23 (58) land-based	N	N/A (pre-TIDieR)
Topp 2009 (United States)	Single-centre, unclear blinding, phase not specified	TKA, unilateral	Aged ≥50 years, scheduled for unilateral TKA, and did not meet standard exclusion criteria for engaging in moderate intensity exercise	Not specified	Preoperative exercise intervention on knee pain, functional ability, and quadriceps strength	UC: Continue normal activities until TKA	4 functional tasks (e.g., 6MWT), Pain VAS, Sit-to-Stand, Stair Climb Test, quadriceps strength	Baseline, before surgery, 1-month postoperative, 3-months postoperative	54 (26 intervention, 28 control)	64.1 (7.1) intervention, 63.5 (6.7) control	7/14 (50) intervention, 10/20 (50) control	N	N/A (pre-TIDieR)
Evgeniadis 2008 (Greece)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Aged >60 years, idiopathic knee OA (ACR guidelines), scheduled primary TKA, radiological OA signs stages III/IV (Kellgren-Lawrence classification), no serious mental defects according to Short Portable Mental Status Questionnaire, no medical contraindications during exercise testing or program participation (ACSM Guidelines), no previous operations to lower extremities or	Declined to participate, severe OA to other lower extremities articulations, high cardiac complication risk factor according to American College of Sports Medicine Guidelines, postoperative complications or abandoned the exercise program	Preoperative therapeutic exercise before TKA; supervised 8-week home exercise program to strengthen lower extremities	UC: Standard preoperative evaluation, TKA, an inpatient rehabilitation program and follow-up	Active ROM, Iowa Level of Assistance Scale, SF-36	Baseline, 1-day preoperative, 3-days postoperative, 2-weeks postoperative, 6-weeks postoperative, 10-weeks postoperative, 14-weeks postoperative	72 (24 preoperative exercise, 24 postoperative exercise, 24 control)	68.8 (5.6) years	15/18 (83) intervention, 14/20 (70) control	N	N/A (pre-TIDieR)

			corticoid intrarticular knee injections for a 6-month period, no central or peripheral motor nerve defect, white race, Greek citizenship, speak Greek language										
Ferrara 2008 (Italy)	Single-centre, single-blind, phase not specified	THA, unilateral/ bilateral not specified	Primary end-stage hip OA	Cognitive deterioration evaluated with a MMSE ≤23, other joint prosthesis, hip congenital dysplasia, inflammatory arthritis (rheumatoid arthritis, systematic lupus erythematosus), Parkinson's disease, sensitive neuropathy	Preoperative physical therapy	UC: Standard post-surgery inpatient rehabilitation program (4-weeks progressive strengthening exercises of hip muscles, postural and educational nursing, hamstrings stretches, hip adductors, walking in progressive weight with crutches, educational programs)	Barthel Index, Hip abductors and quadriceps strength using the British Medical Research Council scale, Hip ROM, Pain VAS, SF-36, WOMAC	Baseline, 1-month post-intervention, 1-month postoperative, 3-months postoperative	23 (11 intervention, 12 control)	63.8 (9.0) intervention, 63.1 (6.9) control	7 (64) intervention, 7 (58) control	N	N/A (pre-TIDieR)
Sandell 2008 (UK)	Single-centre, no blinding statement, phase not specified	THA, unilateral/ bilateral not specified	Primary THA across four consultant's waiting lists within an National Health Service Healthcare Trust, potential for ≥6-month wait	Not specified	Multidisciplinary assessment and intervention for patients awaiting THA	UC: No additional treatment	Arthritis Impact Measurement Score 2, Nottingham Health Profile	Post-randomization, preoperative	89 (43 intervention, 46 control)	70.3 (8.1) intervention, 65.8 (10.6) control	23/33 (70) intervention, 18/30 (60) control	N	N/A (pre-TIDieR)
Vukomanovic 2008 (Belgrade)	Single-centre, no blinding statement, phase not stated	THA, unilateral/ bilateral not specified	Aged ≤70 years, primary & secondary OA, ability to walk up and down stairs, no need for using crutches, no experience walking with crutches (because of opposite hip arthroplasty or some other reasons), no	Intraoperative (femoral or acetabular fracture), postoperative complications (disorientation, anemia, circulatory collapse, orthostatic hypotension, chest pain, sustained hypertension, deep venous thrombosis, pulmonary	Short-term preoperative physical therapy and education	UC: No preoperative education/physical therapy, but both groups had same rehabilitation program postoperatively	Ability to perform nine basic activities and endurance while walking, Hip Harris Score, Japanese Orthopaedic Association Hip Score, Oxford Hip Score, Pain VAS	Admission, 1-3 days postoperative, discharge, 15-months postoperative	45 (23 intervention, 22 control)	60.1 (11.0) intervention, 56.2 (18.5) control	14 (70) intervention, 16 (80) control	N	N/A (pre-TIDieR)

			coexisting morbidity (e.g., severe cardiovascular, respiratory, neuromuscular, rheumatic disease or mental confusion)	embolism, hip dislocation) which compromised or delayed beginning of physical therapy after operation									
Williamson 2007 (UK)	Single-centre, single-blind, phase not specified	TKA (total or unicondylar, unilateral or bilateral)	Knee arthroplasty due to OA, unilateral or bilateral knee pain, pain lasting >3 months	Taking anticoagulants, within 2 months after receiving intra-articular steroid injection, back pain associated with referred leg pain, ipsilateral hip OA psoriasis or other skin disease in knee region, rheumatoid arthritis, received acupuncture or physiotherapy treatment in the last year	Acupuncture, physiotherapy (supervised exercise) for patients awaiting knee replacement	AC: Home exercise group given exercise and advice leaflet reflecting current practice	50-m walk, Hospital Anxiety and Depression Scale, Oxford Knee Score, Pain VAS, WOMAC	Baseline, 7 -weeks postoperative, 3-months postoperative	181 (60 acupuncture, 60 physiotherapy, 61 home exercise)	72.4 (7.7) acupuncture, 70.0 (8.8) physiotherapy, 69.6 (10) home exercise	33 (55) acupuncture, 31 (52), physiotherapy, 33 (54) home exercise	N	N/A pre-TIDieR
Nuñez 2006 (Spain)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Consecutive outpatients of all ages referred by the Orthopedic Surgery Department to TEFR Unit, knee OA according to the Kellgren-Lawrence criteria, on waiting list for TKA for <6 months, consented to participate	Functional illiteracy, inflammatory musculoskeletal disease, metabolic or neoplasic disease, severe psychopathology or comorbidity (severe enough to prevent completion of program)	Therapeutic education and functional readaptation (TEFR)	UC: conventional (pharmacological) treatment only	Analgesics/week, NSAIDs/week, number visits to general physician, cost of visits to general physician, SF-36, WOMAC	Baseline, 9 months (i.e., 6 months post-intervention)	100 (51 intervention, 49 control)	72.6 (6.2) intervention, 69.5 (6.8) control	39 (76) intervention, 32 (65) control	N	N/A (pre-TIDieR)
Rooks 2006 (United States)	Single-centre, single-blind, definitive trial	THA/TKA, unilateral	Scheduled for unilateral, primary THA/TKA for advanced OA, ability to answer questions in English, 8-12 weeks between enrollment and surgery	Inflammatory arthritis (i.e., rheumatoid arthritis, systemic lupus erythematosus), Parkinson's disease, medical condition in which moderate exercise contraindicated (i.e., uncontrolled diabetes or hypertension), scheduled bilateral joint replacements, extended out-of-town vacation during the 6 weeks prior to surgery	Short preoperative exercise intervention	UC: Preoperative education booklet (information to prepare for surgery, modify home to improve accessibility, risk of falling and injury)	1-repetition maximum leg press test, amount and type of pain medication, discharge location, distance walked on postoperative day 3 (< or >50 ft), Functional reach test, Length of stay, Preoperative complications, SF-36, TUG, WOMAC	Pre-intervention, post-intervention, 8-weeks postoperative, 26-weeks postoperative	108 (54 intervention, 54 control)	65 (11) hip 65 (8) knee intervention, 59 (7) hip 69 (8) knee control	60 (56)	N	N/A (pre-TIDieR)

Mitchell 2005 (UK)	Single-centre, single-blind, phase not specified	TKA, unilateral	Primary unilateral TKA for treatment of OA, surgeon consent to referral of patients on their waiting list, patient address within Sheffield community physiotherapy service boundaries	Revision procedures, bilateral or unicondylar knee replacements, TKA following severe trauma, onset of serious comorbidity or terminal illness while on waiting list (requiring cancellation/delayed treatment), contralateral knee replacement within preceding 12 months	Preoperative home physiotherapy for TKA	UC: Post-discharge physiotherapy (classes of 7-10 patients in gym; 1-2x/week + individual treatment sessions in outpatient department at physiotherapists' discretion	Healthcare utilization (National Health Service resource use), patient satisfaction, SF-36, WOMAC	Baseline, preoperative, 12-weeks postoperative	160 (80 intervention, 80 control)	70.0 (7.2) intervention, 70.6 (8.2) control	36 (63.2) women intervention, 30 (52.6) women control	N	N/A (pre-TIDieR)
Beaupre 2004 (Canada)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Diagnosis of noninflammatory arthritis, scheduled primary TKA, aged 40-75, willing to undertake intervention and follow-up, understand verbal and written English or have a translator	Not specified	Preoperative exercise and education program, unimodal	UC: Continued regular activities, not required to record exercise level nor forbidden to seek treatment	Healthcare utilization, Knee ROM, Length of stay, quadriceps and hamstring strength, SF-36, WOMAC	Baseline, post-intervention (4-weeks), 3-months postoperative, 6-months postoperative, 12-months postoperative	131 (65 intervention, 66 control)	67 (7) intervention, 67 (6) control	72 (55)	N	N/A (pre-TIDieR)
Berge 2004 (UK)	Single-centre, unclear blinding, phase not specified	THA, unilateral/ bilateral not specified	≥6 months wait for THA	Not specified	Pain management programme (PMP)	UC: Muscle-toning exercise and written information on chronic pain, OA, THA, postoperative advice (Arthritis Research Campaign leaflets: Osteoarthritis, A New Hip Joint, Pain and Arthritis [www.arc.org.uk])	4-min walk test, Analgesic use, Arthritis Impact, Measurement Scale, decision to delay surgery (at 3 months post-intervention), Pain NRS	Baseline, 3-months post-intervention, 12-months postoperative (minimum)	44 (23 intervention, 21 control)	71.6 (6) intervention, 71 (6.1) control	12 (63) intervention, 15 (79) control	N	N/A (pre-TIDieR)
Gocen 2004 (Turkey)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Undergoing THA with thrust plate prosthesis and cementless acetabular component	None received physical therapy for hip OA previously	Preoperative physiotherapy and education THA	UC: No preoperative exercises or education, same postoperative and education programme beginning	Climbing stairs and transferring activities, day on which patient started walking, Hip Harris Score, Hip ROM (abduction) VAS	Baseline (8-weeks preoperative), immediately preoperative, discharge, 3-months postoperative	60 (30 intervention, 30 control)	46.9 (11.5) intervention, 55.5 (14.4) control	38/59 (74)	N	N/A (pre-TIDieR)

						1-day postoperative as described by Flanagan et al; performed by a physical therapist blinded to the patients' groups		, 2-years postoperative					
Crowe 2003 (Canada)	Single-centre, single-blind, phase not specified	THA/TKA, unilateral	Poor function due to joint dysfunction, limited social support, and/or comorbid medical conditions	Functioning well despite joint dysfunction, managing their ADLs well with good caregiver support, limited English language skills, cognition problems, receiving joint replacement as management for cancer, revision or second joint replacement in <2 years	Individually tailored rehabilitation for clients undergoing hip or knee arthroplasty.	UC: One standard preoperative clinic visit (~7 hr) 1-2 weeks preoperative. Included required laboratory tests, physician and nursing assessments, brief education (hospital, preoperative medication, bowel preparation, postoperative phase)	Discharge destination, Length of stay, number of days to achieve following: independently get out of bed, joint flexion, walk 30 m, climb stairs (if needed at home), Postoperative complications, Spielberger State Anxiety Inventory	Baseline, preoperatively	133 (65 intervention, 68 control)	66.9 (11.9) intervention, 70.7 (10.7) control	51 (78) intervention, 55 (81) control	N	N/A (pre-TIDieR)
Møller 2002 (Denmark)	Multicentre, single-blind, phase not specified	THA/TKA, unilateral/bilateral not specified	Primary elective hip or knee alloplasty at three university-affiliated hospitals in Copenhagen were invited to enter the study, daily smoker	Weekly alcohol intake >35 units	Preoperative smoking intervention	UC: Standard care; little or no information about the risk of tobacco smoking or smoking cessation counselling	Intraoperative complications, Length of stay, Postoperative complications (i.e., death/morbidity requiring treatment within 4 weeks postoperative)	Observed from the day of surgery until either discharge/death in hospital	120 (60 intervention, 60 control)	66 (41–83) intervention, 64 (30–85) control	32 (57) intervention, 30 (58) control	N	N/A (pre-TIDieR)
Wang 2002 (Australia)	Single-centre, unblinded, phase not specified	THA, unilateral	Hip OA, inflammatory arthritis, or osteonecrosis of the hip, unilateral chronic hip pain and disability unresponsive to conservative treatment, provided informed consent to participate	History of hip infection, significant neuromuscular disease, malignancy, previous hip surgery, bilateral hip disease, poor general health	Perioperative exercise program	UC: No supervised or structured exercises beyond advice routinely provided by hospital physiotherapist	6MWT, 25-Meter Walk Test	Baseline (8-weeks preoperative), 1-week preoperative; 3-weeks postoperative, 12-weeks postoperative, 24-weeks postoperative	28 (15 intervention, 13 control)	68.3 (8.2) intervention, 65.7 (8.4) control	18 (64)	N	N/A (pre-TIDieR)

Haslam 2001 (England)	Single-centre, unblinded, phase not specified	THA, unilateral/ bilateral not specified	Waiting list for THA	Not specified	Acupuncture	AC: Exercise and advice for symptomatic treatment of OA of the hip	Modified WOMAC, Osteoarthritis index	Pre-intervention, immediately post-intervention, 8 weeks post-intervention	32 (16 acupuncture, 16 exercise)	66 (39-77) acupuncture, 68 (57-77) exercise	13 (81) acupuncture, 8 (67) exercise	N	N/A (pre-TIDieR)
Tillu 2001 (UK)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Consecutive patients waiting for TKA	Acupuncture treatment within 1 year, intra-articular steroid injection to knee within 3 months, non-idiopathic arthritis (e.g., sero-negative arthritis, neuropathic arthritis and rheumatoid arthritis)	Unilateral (most affected knee) versus bilateral acupuncture on knee function in advanced osteoarthritis of the knee	AC: Bilateral acupuncture	50-meter timed walk, Hospital for Special Surgery Knee Score, Pain VAS, time to climb 20 steps	Baseline, 2-months post-intervention, 6-months post-intervention	45 (22 unilateral acupuncture, 22 bilateral acupuncture)	72 (53-90) unilateral acupuncture, 73 (64-92) bilateral acupuncture	18 (82) unilateral group, 17 (77) bilateral group	N	N/A (pre-TIDieR)
D'Lima 1996 (United States)	Single-centre, unclear blinding, phase not specified	TKA, unilateral	Aged >55 years, primary diagnosis of OA/rheumatoid arthritis, residence within convenient distance of the facility, needing unilateral TKA	Cognitive, psychological, or language impairment, major cardiovascular impairment (e.g., labile hypertension, unstable angina), history of cerebral ischemia (e.g., stroke, transient ischemic attack)	Experimental physical therapy (group 2), experimental cardiovascular (group 3)	UC: Met physical therapist pre-operatively for 45 min, materials for postoperative exercise, no recommendations for preoperative physical therapy or exercise	Arthritis Impact Measurement Scale, Hospital for Special Surgery Knee-Rating Scale, Length of stay, Quality of Well Being	6-weeks preoperative, 1-week preoperative, 3-weeks postoperative, 12-weeks postoperative, 24 weeks postoperative, 48 weeks postoperative	30 (10 physical therapy, 10 cardiovascular conditioning, 10 control)	68.5 (4.6) physical therapy, 71.6 (6.6) cardiovascular conditioning, 69.5 (6.5) control	14 (47)	N/A (pre-CONSORT)	N/A (pre-TIDieR)
Christensen 1992 (Denmark)	Single-centre, single-blind, phase not specified	TKA, unilateral/ bilateral not specified	Aged up to 75 years, on county waiting list for TKA due to osteoarthrosis	Other connective tissue diseases affecting knee, neurological diseases, psychiatric disorders, acupuncture treatment within 1 year, knee-joint steroid injections within 3 months of study start	Acupuncture treatment of severe knee osteoarthrosis	UC: No treatment control-group during weeks 1-9	50-meter timed walk, Hospital for Special Surgery Knee Rating, Pain VAS, time taken to climb 20 steps on a staircase	9 pain evaluations, 5 objective evaluations (time to walk/climb stairs)	32 (14 intervention, 15 control)	69.2 (48-75) years	21 (66)	N/A (pre-CONSORT)	N/A (pre-TIDieR)

Abbreviations: AC=Active comparator, AE=Adverse event, ASA=American Society of Anesthesiologists, BMI=Body Mass Index, COPD=Chronic obstructive pulmonary disease, DXA=Dual-energy X-ray absorptiometry, EQ-5D=EuroQoL-5D, HDL=High-density lipoprotein, HOOS=Hip Disability and Osteoarthritis Outcome Score, IS=Incentive spirometry, KOOS=Knee Injury and Osteoarthritis Outcome Score, LDL=Low-density lipoprotein, MMSE=Mini-Mental State Examination, MWT=Minute Walk Test, NMES=Neuromuscular electrical stimulation, NSAID=Nonsteroidal anti-inflammatory drug, OA=Osteoarthritis, PC=Placebo Control, ROM=Range of motion, SF-12=12-Item Short Form Survey, SF-36=36-Item Short Form Survey, SPPB=Short Physical Performance Battery, TEFR=Therapeutic education and functional readaptation, THA=Total hip arthroplasty, TIDieR=Template for Intervention Description and Replication Checklist, TKA=Total knee arthroplasty, TJA=Total joint arthroplasty, TUG=Timed Up and Go, UC=Usual care, VAS=Visual analogue scale, Western Ontario McMaster Osteoarthritis Index=WOMAC
*Trial protocols

Table 2. Description of intervention characteristics according to the TIDieR checklist

Study, year	Item 1: Name	Item 2: Rationale/Theory/Goal	Item 3: Materials & Access	Item 4: Procedures	Item 5: Providers (expertise, backgrounds training)	Item 6: Modes of delivery	Item 7: Location, infrastructure	Item 8: Dose, duration, period	Item 9: Tailoring	Item 10: Modifications (N/A to protocols)	Item 11: Planned adherence/fidelity assessment	Item 12: Actual adherence/fidelity assessment (N/A to protocols)
Gränicher 2024	Exercise- and education-based prehabilitation before TKA	Reduce risk factors for prolonged recovery time and allow faster return to daily activities	Detailed exercise procedures available in Supplementary Material 1	• Warm-up, exercise training and/or education and a cool-down component. Number of repetitions and sets recorded for each exercise. • Patient education based on general checklist available to every PT (e.g. pain education & management, perioperative procedures, wound-healing, mobility in ADLs, walking with aids and transfers.	Specially trained team of experienced PTs supervised	Individual	Clinic- and/or home-based	30 min sessions, minimum 2 sessions/week, 4–8-week duration	PT selected exercises from standardized catalogue with highest possible intensity based on ACSM recommendations; exercises and difficulty selected based on patients' needs, impairments, goals regarding knee functioning	NR	Participation rate (i.e., recruitment rate, consent rate ≥72%, retention rate ≥88%), adherence & safety of intervention (≥80% of the planned sessions completed and no AE/ SAE in relation with the study procedure	No AEs or SAEs. Retention rate=90% and 90% of intervention group completed all individually scheduled therapy (7 sessions (2-11)), 1 declined to attend due to COVID-19 face mask requirement
Roxburgh 2024	Upper-limb high-intensity interval training (HIIT) or passive heat therapy to optimize cardiorespiratory fitness vs home-based exercise	Low impact interventions to improve cardiorespiratory fitness, optimizing preoperative risk factors	HIIT: Cross-trainer (NordicTrack e12.2, Logan, UT), arm ergometer (Schwinn Windjammer, Vancouver, WA), elastic bands, swimming attire	HIIT: • Light-intensity 3- to 5-min warm-up. Initial sessions began with 6 × 60-s intervals at 90%–100% peak VO_2, separated by 90-s active recovery (very light intensity); duration of exercise intervals remained constant throughout the intervention, with the number of intervals increasing to 8 and recovery duration decreasing to 60 s based on participant progress • Exercise intensity was set during an initial HIIT familiarization session according to a protocol described by Phillips et al. • Cross-trainer was the preferred modality for all cardiopulmonary exercise testing (CPETs); arm ergometer only used if former not tolerated by participant	Study researcher	Individual in-person heat/HIIT, independent at home	NR	Heat: 20-30 min bathing 3x/week for first 3 weeks; HIIT: up to 36 sessions (3x/week, for 12 weeks)	NR	NR	NR	Heat, HIIT, and home-exercise participants completed 36 (11), 33 (11), and 40 (23) sessions, respectively (p=0.312). Home participants performed median 3 (2–4) sessions/week (20 reps x 10 exercises/sessi

				Heat: • Participants seated (in swimming attire) in a temperature-controlled spa (40.0±0.3°C) with water approximately midsternal level. After hot-water immersion, 10-20 min of light-intensity whole-body resistance exercise using elastic resistance bands (calisthenics); 8-10 exercises progressively increasing reps of each on individual basis								on; Heat group (16 reps x 10 exercises 3x/week; 9 HIIT participants completed training on cross-trainer, 16 on arm ergometer
Briguglio 2023	Oral iron powder supplement	Supplement could improve laboratory parameters related to iron metabolism, primarily hemoglobin concentration	The oral supplement was a water-soluble powdered mixture of micronized and micro-encapsulated iron saccharate	Participants provided with 60 satchets of supplement at recruitment to consume daily at mid-morning by dissolving the powder in 200 mL of water	NR	Individual, oral administration	NR	Daily sachet of an iron-based powder for 45 ± 15 days before surgery	NR	NR	Patients filled out a consumption diary and return the leftover sachets on the day of hospital admission	NR
Guida 2023	Home-based virtual reality tele-prehabilitation (Tele-PRE) programme for male patients waiting for TKA	Candidates for TKA could benefit from a tele-prehabilitation program (accessibility of care, costs, faster achievement of postoperative outcomes)	TeleCockpit workstation for clinician (PT) to create & manage exercise prescriptions, monitor adherence; Virtual Reality Rehabilitation System (VRRS) Home Tablet, with mobile application for the home exercises; VRRS Khymu, accelerometers; VRRS Balance board	• Trained at baseline to use devices and instructed to perform sessions when at least one cohabitating person is home, in a room allowing safe movements, and respecting their pain and perceived effort • 5-min warm-up: Knee bending and extension in lying position, knee extensions while sitting, tiptoes in standing position, marching on site • 30-min working phase (mobility, strength, balance): hip bending keeping knee extended in lying position, hip motion in space planes (imagining of drawing numbers with the tiptoe), hip abduction keeping the knee extended side lying, knee bending and hip extension in standing position, half squat, half lateral lunge, monopodalic standing, weight shifting (also on unstable surfaces) • 5-min cool-down: free walk, leg swings while sitting	Physiotherapist	Individual, remote (Virtual Reality system)	Home-based	40 min sessions, 5 sessions/week, 30 sessions total during the 6 weeks preoperatively	Exercise volume increased during the 6 weeks according to the patient's perceived effort at end of each session (self-administered Borg CR-10 scale <5 suggests increasing workload) and managed weekly by clinician	N/A	Phone call 1x/week by physiotherapist to promote retention and report issues related to program	N/A
Khalid 2023	Joint PRehabilitation with	Target frailty preoperatively via	• Exercise booklets	• Initial 1:1 appointment with physiotherapist (in person/virtual) to introduce intervention & develop home-	Physiotherapists (experienced	Individual	In-person/virtual	12 weeks of individualized exercises;	Risk assessment conducted	N/A	Participants telephoned by physiotherapist	N/A

	Exercise and Protein (Joint PREP)	exercise and protein supplementation to improve postoperative outcomes	• Online platform to support home-exercise program (optional) • Therabands • Exercise step and/or gym ball • ProSource jelly (NUTRINOVO, Wiltshire, UK) or alternative protein powder (Pulsin, Gloucester, UK)	based exercise program; risk assessment to inform exercise & progression (difficulty & repetitions) • Participants receive telephone calls every 2 weeks to gradually increase their levels of moderate physical activity • Exercises and resources based on NEMEX-TJR program (La Trobe University, Australia), including warm-up, pelvic lifts, sit-ups, lunges, sideway lunges, knee flexion and extension, hip abduction and adduction, chair stands, step-ups, and cool down • Consume 20 g of additional protein in the form of one pot of jelly (118 ml) each day for 12 weeks prior to their surgery	with TJA) delivering intervention attend half-day training session from study nutritionist & physiotherapist and provided with training manual		initial appointment followed by home-based w/ contact and support	protein (118 ml/day for 12 weeks) within 3 hours after exercise (advised to consume the protein between meals to minimize effect on appetite)	to inform adaptation of exercises and progression schedule to ensure they are tailored to individual physical capabilities and minimise risk		at 1, 2, 4, 6, 8, and 10 weeks; in final telephone call, continuation of home exercise program until surgery (if relevant) discussed	
Sun 2023	Preoperative high-intensity strength training combined with balance training	Improve patient's preoperative knee strength & balance through short-term, intense training. Decreased joint position perception & reduced balance may contribute to early postoperative falls and may impair the patient's ADLs	Patients instructed to train preoperatively at home through an online video training and supervision module to enhance their cooperation and reduce time and medical costs	• One training session before formal preoperative training; patients tested for 1–4 days after the training content and methods until they and assessor satisfied with mastery • Warm-up exercises • Strength and balance program focused on knee flexor-extensor strength; weight on knee gradually increased from 0 to maximum of 2 or 3 kg. • Strength training (5 sets x 10 reps, 60-s rest between 2 sets) followed by manual therapy, proprioceptive training, ice compression; intensity regulated by weight and based on 10-rep maximum. Exercises included knee extension and flexion; hip extension, adduction, and abduction; standing balance • 5-min light static stretching of hip abductors, knee flexors, ankle plantar flexors and extensors	Physiotherapist	Individual	Home-based; unclear where initial visits conducted	1 hr sessions, 5 days/week, for 4-weeks preoperative	NR	NR	NR	NR
Zhang 2023	JointCloud (JC) online management platform	ERAS enhanced recovery after surgery	JC (attached to WeChat app on smartphone) includes patient	• RA teaches patients how to use JC • JC unlocks content according to different periods: patient education and prehabilitation content 1 month	RA, technology provider (to	Individual, remote	Home-based – telemedicine	JC content unlocks 1-month preoperative	NR	N/A	Electronic questionnaire collection can reduce the time	N/A

	for patients undergoing TKA	concept and exercises recommended by AAOS and AAHKS guidelines	& doctor dash-board; extracts daily step data from WeChat	preoperative; admission content 1-week preoperative; rehabilitation content on surgery date • Preoperative exercise includes quadriceps sets, straight leg raises, ankle pumps, assisted knee bends, knee straightening, sitting supported knee bends); patient can use the counting and timing plug-in at the bottom of the video to assist with exercise, and complete questionnaires sent by the physician • Physicians check JC dashboard every 3 days. If any adverse events/questions, patients can directly contact doctors through WeChat	set-up program)			; specific prehabilitation dose & duration not described			and cost of gathering data; JC and RA will remind patient to complete questionnaire	
Franz 2022	Cycling ergometer-based training protocol (2 prehabilitation groups, 1 control)	Improve pre- and postoperative muscle mass, strength, quality of life	NR	• Starts at an intensity of 20 W on cycling ergometer; increased by 20 W every 3 minutes • The additional blood flow restriction exercise protocol applied during the cycling exercise on both lower limbs periodically three times per leg for a duration of 1 min (first week) to 6 min (sixth week)	NR	NR	NR	2x/week for 50 min, for 6 weeks	Ergometer intensity determined based on calculated exercise heart rate (HER)	NR	NR	NR
Nguyen 2022	Multidisciplinary prehabilitation for TKA	Improve functional independence and activity limitations postoperative based on recommendations of the MRC for the development of complex nondrug interventions; minimally burdensome and easily transposable to community-based setting	Educational material included standardized slideshows, DVDs (available in eAppendixes 3-8 in Supplement 2 of Nguyen et al., 2022)	• 30 minutes of education followed by 60 minutes of exercise therapy • Educational material: slideshows, exercise DVD, group discussions; positive effects of exercise therapy before TKA, work rehabilitation and social support, diet and weight management, management of stress and anxiety, return home • Exercise therapy program: 4 sessions supervised by a physiotherapist (e.g., muscle strengthening, lower limb stretching, endurance, proprioception, walking and balance exercises); and a home-based program	Healthcare practitioners (physiotherapist, social worker, dietician, psychologist, occupational therapist); received half-day face-to-face training with one of the investigators and provided with standardized slideshows to use during supervised sessions	Groups (4-6 participants), in-person	Investigating centre sessions + home-based exercise	90 min sessions; 4 educational sessions, 4 supervised exercise sessions, for at least 2 months preoperative	NR	NR	For the first participants, investigators qualitatively verified intervention fidelity across the 3 participating centers; did not implement measures to enhance participants' adherence to supervised sessions/home-based program and did not perform specific monitoring of the home-based program	43/131 (33%) did not attend any supervised sessions; one-third of the patients attended all supervised sessions

Pacheco-Brousseau 2022	Home-based preoperative strengthening exercise program specific to participant condition (THA/TKA)	Exercise program targeting specific muscle (i.e., hip abductor for hip OA, quadriceps for knee OA)	NR	3 sets of 10 repetitions, with a 1-min break between sets, five times a week, for a total of 8 weeks (Table 2 of Appendix in Pacheco-Brosseau et al., 2022): • Hip program: Supine hip glide (week 1), standing hip abduction (week 2), side-lying hip rotation (week 3), side-lying hip rotation with elastic (week 4), leg abduction with elastic (week 5), side-lying abductions (week 6) • Knee program: knee extensions supine (week 1), sitting knee extensions (week 2), partial squat (week 3), mini-squat (week 4), step-up (week 5), sit-to-stand (week 6)	Physiotherapist	Individual	Home-based	3 sets x 10 reps, 5x/week, for 8-10 weeks preoperative	Difficulty level of exercise increased weekly. Capacity & progress assessed weekly by physiotherapist, determined by (1) ability to perform and (2) Borg RPE scale rating ≥ 5	Duration reduced from 8 to 6 weeks due to surgery dates & duration burden; combined physiotherapy visits with outcome measure visits	NR	NR
Risso 2022	Acute prehabilitative neuromuscular exercise-conditioning (APNEC) in patients electing TKA	Less emphasis on neuromuscular performance in contemporary TKA prehabilitation; APNEC derived from pilot research involving micro- and meso-cyclical training theory in elite professional soccer	Calibrated machine, gravity-loaded (Life Fitness, model number FZLE-500023; www.lifefitness.com)	• Exercise-conditioning sessions for the ipsilateral knee extensors, sessions typically occurred at 10:00am, 1:00pm; 4:00pm; 1 exercise per session (4 reps per exercise, with 20 s rest periods [36 repetitions in total]) • Movements practised twice using an unloaded lever-arm (Fig. 1b, c, d and e), prior to exercise	NR	In-person	NR	Nine 20-min sessions on alternate days over 1 week (3 sessions/day, 3x/week)	Prescribed exercise stress ranged between 60-100% of daily voluntary strength capacity (one-rep maximum), assessed using 2 or 3, 2 sec concentric contractions and 15 min prior to first daily APNEC session	NR	NR	NR
Terradas-Monllor 2022	Home-based preoperative multimodal physiotherapy for	Address pain catastrophizing and pain, a risk factor for poor postoperative outcomes;	Booklet, chair for exercises	• Multimodal physiotherapy group (MPT) received eight home-based, one-on-one sessions of preoperative multimodal physiotherapy; consisted of therapeutic education (pain neuroscience education, and coping skills training including exercise training – strength, balance,	Physiotherapist	Individual, in-person	Home-based	MPT group: 8 sessions, 40-60 min at patient homes TPE group: 45 min	MPT group: more 'control' of progression; details not specified	NR	Compliance assessed 8-weeks post-intervention; timely recruitment, drop-out rates,	NR

	patients scheduled for TKA who catastrophize about their pain	provide coping strategies such as exercise training, self-mobilizations, and relaxation techniques to deal with symptoms		stability exercises divided into core, hip, knee, and global exercises, supervised therapeutic exercise (TEX), orthopaedic manual therapy (OMT); received greater supervision during exercise training and had further control of their exercise compliance and progression during an 8-week period • Therapeutic patient education (TPE) group received three preoperative education sessions (pain neuroscience education, and coping skills training), in addition to the usual care				sessions, 3 weeks, 2-3 months preoperative			number of participants completing the treatments, treatment compliance	
An 2021	Preoperative telerehabilitation	Benefits in early-phase outcomes after TKA	Smartphone/tablet access, Therabands (Thera-Band®, Hygienic Corporation, Akron, OH, USA), patient guidebook (exercise details)	Preoperative telerehabilitation group 30-min medium to low intensity exercise program: • Warm-up and cool-down: knee & ankle ROM exercises, slow walking for 5 min • Mobility exercises: straight leg raises, bridges, leg slides, knee press, passive ROM, mini squats • Flexibility: knee flexor/extensor stretching, leg slides • Strength: Elastic resistance bands for knee flexor/extensor and hip abductor training • Balance: tandem walk, trunk rotation. • Rest time was 20 s, additional rest time allowed upon fatigue/request Preoperative patient education group: Initial preoperative education session (i.e., home exercise safety and the protocol of intervention, then performed unsupervised self-home exercise (30 min per session, 2x/day, 5 days/week for 3 weeks, and the exercise timing was adjustable); same as telerehabilitation arm. Received physical therapist calls 1x/day	Physical therapist	Individual	Home-based, remote (smartphone/tablet two-way video call)	30 min sessions, 2x/day, 5 days/week, for 3 weeks preoperative (total 30 sessions)	Intensity of resistance adjusted to a moderate level for each patient	NR	NR	NR
Domínguez-Navarro 2021	Preoperative strengthening plus balance training for TKA	Based on DeLorme & Watkins's recommendations for progressive resistance exercise, balance & proprioceptive training based on principles	NR	Strength intervention: • 10-min warm-up stationary bicycle, no progression • 3 sets x 10 reps with 1-min rest between: isotonic activation of quadriceps, Colson chair for quadriceps, isotonic activation of hamstrings, Colson chair for hamstrings (progressions in electronic Supplementary Table 1, Domínguez-Navarro et a., 2021) • 5-min: Lateral abduction and adduction, no progression	NR	NR	Outpatient setting	Strength group: Twelve 30-40 min sessions, across 4 weeks Strength + balance group: Augmented with 15-20	NR	NR	NR	Participants adhered to the preoperative interventions for a mean of 11.2 (0.7) sessions

		by Fitzgerald et al.		• Cool-down: stretching 2 reps x 30s for each muscle, 10-min icing, no progression Balance and proprioception intervention (progressions in electronic Supplementary Table 2, Domínguez-Navarro et a., 2021): • 5 min each: side steps, treadmill walk, tandem walk, cross-walk, multiple direction changes, foam standing balance, Bohler standing balance, roller board, dynamometric platform exercises)				min balance and propriocepti ve training				
Kim 2021	Aquatic prehabilitati on for TKA	Preoperative water exercise to improve preoperative physical function will improve postoperative outcomes; improve range of motion, muscle strength, and resistance	Noodle/neopren e ankle cuff	10-min warm-up, 20-min joint range of motion for flexibility and strength, 20-min low intensity endurance (e.g., walking to prevent chilling and maintain and/or improve cardiovascular fitness, 10-min cool down	Aquatic therapist	In-person; does not specify if group-based	Pool at medical centre	60 min sessions, 3x/week, for 4-8 weeks preoperative	Depending on participant' s tolerance, resistance equipment (e.g., noodle and/or neoprene ankle cuff) added to increase exercise intensity	NR	Exercise log kept by aquatic exercise director to record compliance. Study coordinator called participants weekly to encourage adherence	NR

Liljensøe 2021	Preoperative intensive weight loss therapy	Reduce body weight by 5-10% preoperatively	Commercially available formula foods (Cambridge Weight Plan®, Northants, UK)	• Nutritional education: weekly group sessions led by experienced dietitian • Low-energy liquid diet (810kcal/day) using commercially available formula foods. Formula diets consisted of ready-to-use meals, bars, and sachets to mix with water or skimmed milk (7.5dL a day) to make shakes, soups, or porridge, consumed 4x/day • Patients advised to use a fiber supplement to avoid constipation • Program met all recommendations for daily nutrient intake of vitamins & minerals; daily intake of protein at least 79.7g, fat 12.0g, and fiber intake at least 13.3g a day	Dietician	Individual diet + group sessions	NR	Meals consumed 4x/day (total 810 kcal/day), for 8 weeks preoperatively; 1.5 h weekly group sessions.	NR	NR	NR	Few & mild AEs comparable to AEs reported in similar diet programs; one SAE due to large dose of antihypertensive medication; no perioperative complications

Miller 2021	Hip Instructional Prehabilitation Program for Enhanced Recovery (HIPPER)	Interactive, user-centered, eHealth, preoperative, THR education program based on adult learning principles	Website portal access and personalized encrypted login information	12 online, interactive modules: embedded videos, narrated slides, quizzes (material includes exercise, equipment needs and setup, pain management, nutrition, weight management). Participants encouraged to have a family member view with them.	Education consultant (expertise in designing courses with Articulate Storyline 360) monitors platform issues	Individual, remote	Home-based/location of choice	12 interactive online modules (~20 min each); duration unclear	NR	N/A	Research coordinator remotely monitors online analytics (e.g., login frequency, module progression); phones participant within 2 weeks if no online activity	N/A

Şavkin 2021	Preoperative neuromuscular electrical stimulation (NMES)	NMES is a therapeutic intervention to accelerate recovery and improve quadriceps function in patients undergoing TKA	Portable four-channel digital electrical stimulator (QuadStar® II – Multi-Modality Stimulator, USA) , Velcro	• Provided with NMES device for home use • Two 6×9 cm electrodes located at proximal & distal part of rectus femoris and vastus medialis; sitting position, hip at 90° flexion, knee at 60° flexion, the foot flat on floor, toes against wall or ankle fastened with Velcro to permit isometric muscle contraction. Contracted their quadriceps at each NMES stimulus • Stimulation parameters: biphasic, symmetrical, square waveform, frequency 50 Hz, pulse duration 400 µs, ramp-up time 2 s, contraction time 10 s, ramp-down time 2 s, rest time 30 s, for 20 minutes, 5 days a week for 6 weeks • Encouraged to use stimulator at maximum tolerated high intensity with visible muscle contractions	NR	Individual, independently	Home-based	20 min, 5x/week, for 6 weeks	NR	NR	Called at 2-week intervals to encourage stimulator use regularly	NR

Aunger 2020	INTEREST	Behaviour change intervention based on Self-Determination Theory; reducing sedentary behaviour prior to surgery can improve physical function and cardiometabolic health, leading to better post-surgical recovery	Custom-made sedentary behaviour booklet to aid in delivery of the education, goal setting, and environmental modification components, record adherence (available in supplementary material of published protocol)	• Motivational interviewing to reduce ambivalence towards sedentary behaviour • Education about sedentary behaviour and its negative health consequences • Goal-setting and environmental modification • Self-monitoring using a pedometer and recording of goal adherence • Biweekly phone calls to maintain participant motivation and address issues	Researcher with training in motivational interviewing, who designed the intervention and materials	Individual, in-person	Home-based (majority), or at research centre	Two visits/combined in single 120-min session followed by three 10-min biweekly phone calls, duration 8-10 weeks preoperative, up to 18 weeks	Goals and environmental modifications tailored to individual capacity for physical function and lifestyle	Goals and environmental modifications may be altered at any point by participant if they are finding it hard to achieve, e.g. adjust targets/frequency); researcher will stay informed of changes during phone calls	Treatment delivery assessed via deliverer self-ratings plus recordings of motivational interviews independently rated by expert in motivational interviewing; treatment receipt assessed by 2 independent assessors according to SMART criteria; treatment enactment assessed via booklets, adherence to action plans (6 goals & 3 environmental modifications)	16/21 (76.2%) recorded goal adherence section in booklet; 88% completion rate for goal adherence and 52.38% for environmental; mean of the per-participant average weekly self-reported goal adherence was 3.9 (0.7) out of 5 and 4.2 (0.7) for environmental modification; 8/19 (42.1) achieved/exceeded step targets
Blasco 2020	Preoperative balance training for TKA	Standard recovery program based on Brotzman principles, adapted to hospital standards according to muscular strengthening with isometric, isotonic, and resistance exercises, functional exercises, and	Foam, proprioception plate; home group participants instructed to exercise in corridor or in front of a table/chair for safety since equipment not available	• Hospital group: lower limb strengthening exercises and balance-oriented training (weeks 1-2: side-walk, treadmill walk, crosswalk, tandem walk exercises; week 3: multiple changes of direction, foam activities, proprioceptive work with proprioception plate; last 4 sessions: 5-min weight-bearing exercises and limits of stability testing. • Home group: Similar training volumes & exercises adapted to home setting; received training at home	Supervised by 2 physiotherapists with >15-20 years of experience	Individual, in-person	Hospital setting/home setting	60-min sessions, 3x/week on alternate days (total 12 sessions), 4-week duration	Loads are adapted to avoid subject fatigue; in the case that the physician considers that a participant should perform a greater number of sessions, the standard hospital	NR	Fidelity checklists based on five-stage model of adult skill acquisition by Dreyfus et al; ratings of fidelity recorded digitally on forms specific to each intervention session and phone call	83 (95%) received the intervention, no AEs related to intervention

		proprioception and balance exercises							protocol continues			
Doiron-Cadrin 2020	In-person prehabilitation/telepreh abilitation	Protocol based on Osteoarthritis Research Society International (OARSI) recommendations for the management of hip and knee OA and previous prehabilitation intervention studies	REACTS® medical consultation platform on personal/precofigured iPad; other telecommunication software (Skype, Facetime) used to assess their ability to deliver a similar experience to participants	• Education on medication usage and ice or heat application • 15-min low-impact cardiovascular warm-up: pedaling • Strength: Exercises classified according to difficulty & muscle groups; one intervention per targeted muscle group will be at each session, 2 sets x 10 reps of first exercise of each category with 1-min rest. If unable to complete task, will be reattempted at next session; if able to complete, two more reps asked at the end of last series; if able to perform 22 reps total, progress to more difficult exercise in next session • Global exercises: Squat and plantar flexion standing at every session if tolerated • Joint mobilization & proprioceptive exercises (30 s) assigned based on results of baseline and session evaluations, • Total number of tasks executed for each session will be the same for all participants	Licensed physiotherapists/physiotherapy intern under supervision of physiotherapist	Individual, virtual group or in-person group	In-person group at research centre, telerehabilitation group at home	Supervised sessions 2x/week & unsupervised the other weekdays, for 12 weeks	General health & tolerance to activity monitored at every session; if pain significantly increases, will be met in-person to further assess and adjust treatment	Conncetivity problems forced the use of other mobile telecommunication applications; sometimes no mobile applications provided stable connection and telephone had to be used	Logbook for monitoring adherence rate to programs and medication intake	NR
Gränicher 2020	Preoperative exercise for TKA	Increase the level of PA in ADLs (e.g. walking up and down the stairs) while correcting evasive movements, improve neuromuscular coordination of the joint surrounding muscles and prevent relieving postures during	Ergometer, pedal trainer, treadmill, crosstrainer	• 10-45 min endurance on bicycle ergometer, pedal trainer, treadmill, or crosstrainer (patient choice) with light to moderate exercise intensity (40–70% of maximum heart rate) without pain • Proprioceptive neuromuscular facilitation techniques of quadriceps and hamstring muscles known as the contract-relax-antagonist-contract (CRAC) form and conducted with the assistance of a physiotherapist • Patient education: topics of self-training at home, pain management and coping strategies, pre- and postsurgical procedures, joint-friendly, physiological movement patterns • Individual interventions when indicated: strengthening (10-20% or 30-50% of 1-rep maximum) targeting lower extremities; sensorimotor (3-4 sets of 30-60 s balance exercises on one leg, and lessons on	Physiotherapist	NR	NR	5-9 sessions, 3-4 weeks preoperatively	NR	NR	NR	Two patients unable to complete the nine sessions due to absence (vacation, work); overall exercise compliance was 96.7% regarding (completion of diaries); no dropouts as all patients finished study; no AEs

		these activities		walking with crutches, ADL movement patterns); electromyostimulation training								
Kusumadewi 2020	Prehabilitation exercise using resistance bands	Elastic resistance products & exercise movements to strengthening muscles of the hip, knee, and ankle	Low resistance red Theraband, medium resistance green Theraband	• 5-min warm-up: slow walking • Weeks 1-2 low resistance: squat, knee curl, hip abduction, adduction, flexion, extension, ankle plantarflexion, dorsiflexion (1 set x 10 reps week 1, 2 sets x 10 reps week 2); forward & lateral step-ups (8 steps, stair height 3 inches week 1, 12 steps, stair height 5 inches week 2) • Weeks 3-4 medium resistance: squat, knee curl, hip abduction, adduction, flexion, extension, ankle plantarflexion, dorsiflexion (1 set x 10 reps week 3, 2 sets x 10 reps week 4); forward & lateral step-ups (16 steps, stair height 5 inches week 3, 20 steps, stair height 7 inches week 4) • Cool-down: stretching 2 sets x 20 s, 5-min walking	NR	In-person	In-hospital gymnasium and at home	3x/week, for 4 weeks preoperative	NR	NR	NR	NR
March 2020	KOMPACT (Knee Osteoarthritis Management with Physiotherapy informed by Acceptance and Commitment Therapy)	Behavioural goal setting as explicit inclusions from an ACT perspective, intersecting with physiotherapy practice and guidelines for knee OA management	Patient manual	Four KOMPACT sessions in addition to usual care: • Session 1: 60-min pre-TKA (SMARTER goal setting, prescription 1 lower limb strength exercise and functional goals at 9-10 repetition max, 1 ACT skill taught) • Session 2: 30-min pre-TKA (review SMARTER goal, exercise, progression, ACT skill) • Session 3: 30-min pre-TKA (review) • Session 4: 20-min, post-TKA (review inpatient progress, positive closure, etc.)	Physiotherapist (>10 yr musculoskeletal/orthopaedic experience); complete 16-hour online course 'ACT for Beginners',plus 1-day trial-specific training conducted by a clinical psychologist and experienced physiotherapist	Individual	NR	4 sessions (2 hr 20 min total), beginning within 2 weeks of recruitment, follow-up 3- and 6-weeks after, final during inpatient stay postoperatively	Adjust action plan for SMARTER goal, progression of strength exercises with collaborative approach, teaching different ACT skills/use of ACT metaphor to elicit behaviour change if required	N/A	Intervention fidelity assessed with a priori checklist tailored to KOMPACT, (online supplementary appendix 2, March et al., 2020); treatment sessions recorded and supervising clinical psychologist will listen to ≥10% of sample for supervision and fidelity purposes, physiotherapist will participate in monthly reflection	N/A
Rittharomya 2020	Preoperative Quadriceps	Based on self-efficacy theory:	Logbook to record	• 30-min week 1 session 1: Health information	Principal investigator	NR	Home-based	30-45 min instruction sessions,	NR	NR	Logbook for adherence to quadriceps	NR

	Exercise and Diet Control Program	enactive mastery experience, vicarious experiences, verbal persuasion, physiological and affective states	quadriceps exercise	• 45-min week 1 session 2: Quadriceps training exercise (quadriceps static exercise & leg extension) • Weeks 2-12 monitoring: telephone/LINE application, behavioural strategies				exercises 60-100x/day, 3x/week, for 12 weeks			exercise; monitoring by telephone/LINE application by the PI weekly	
Simpson 2020	Osteoarthritis Preoperative Package for care of Orthotics, Rehabilitation, Topical and oral agent Usage and Nutrition to Improve ouTcomes at a Year (OPPORTUNITY)	Reduction in weight & increased activity, plus analgesia & footwear review preoperatively will improve health-related quality of life following TKA ; followed MRC guidance for complex interventions	Insoles, painkillers, diet resources (Counterweight-Plus program), no equipment needed for exercises	• Behaviour change: goal-setting, self-monitoring, providing feedback, planning, barrier identification, problem-solving, engaging social support, dealing with relapse • Analgesia review: review timing of appropriate topical and orally administered analgesics with the patient • Physical activity: Participants who are unable to perform straight-leg raise or report 'giving way' prescribed tailored home-based exercises to do at home; focus on quadriceps muscle strengthening through graded progression of load and • Weight management program (Counterweight-Plus) Low Energy Liquid Diet (LELD) will be offered to those with BMI >30 kg/m^2. • If not already routinely using shock-absorbing insoles or are deemed not to routinely wear shoes with shock-absorbing soles, will be provided with shock-absorbing insoles • Biweekly face-to-face review sessions to deliver intervention components (e.g., behaviour change component, resupply dietary resource)	Research nurse & members of research team who have been trained accordingly	Home-based with in-person review sessions	Home-based	16 weeks before surgery	Different components of intervention delivered based on whether participants "qualify"; exercise package tailored based on pain symptoms during physical activity and baseline strength	N/A	Biweekly face-to-face review sessions assessing adherence; weekly telephone calls for first 8-12 weeks	N/A
Stone 2020	KneeMD medical device	Improve flexion contracture before TKA	Subject-controlled knee rehabilitation device that helps patients improve range of motion, can be used with both active &	Wear device daily for up to 30 min until surgery; in addition to standard care: preoperative physical therapy and home exercise for at least 4 weeks preoperative, and 2-3 physical therapy visits weekly.	NR	Individual ; home-based	Not stated where knee device administered; home visits for both groups	30 min 3x/day until surgery, for at least 4 weeks preoperative	NR	NR	NR	NR

			passive stretching									
Wang 2020	Otago exercise program (OEP)	Preoperative OEP may provide further benefits to strength and balance; targeting functional exercise on affected limb	Sandbags, personalized exercise calendar	• Warm-up: movement of head, neck, trunk, ankle and body extension; each repeated 5x. • Muscle strength exercises: 1) knee pressing: lay down with a soft pillow under ankle joint and the anterior thigh muscles tighten; extend knee as much as possible to touch the bed for 5-10 seconds, then relax for 5-10 seconds, repeat 30x; 2) straight leg raise exercise: lay on the bed with both legs straight and alternately raise both legs from the bed, stay at the highest position for 10 s, and then gently drop off, repeat 10x, intensity gradually increased; 2) knee extension: seated with a sandbag tied over ankle, lift sandbagged leg off the ground keeping the leg straight, then drop off; 3) knee flexion: standing straight with the sandbag tied over one ankle, flex knee of the sandbagged leg as much as possible and then return. • Balance training: knee flexing, inverted walking with tools, 8-shaped routes walking, sideway walking, standing on tiptoe, walking on tiptoe, one leg standing, etc.	Researchers – unclear	In-person instructions	Home	30-40 min, 3 days/week, for 4 weeks	Individualized exercise plan; physical function assessed to determine exercise intensity and amount	NR	NR	NR
Medina-Garzón 2019	Nursing Intervention to Diminish Preoperative Anxiety	Patient-focused clinical interview to promote changes toward healthier lifestyles	NR	Motivational interview sessions exploring level of anxiety and the triggering factors	Nurse	NR	NR	40 min, three sessions within 6 weeks preoperative	NR	NR	NR	NR
Riddle 2019	Knee Arthroplasty Pain Coping Skills Training (KASTPain)	Pain catastrophizing is a modifiable health indicator associated with poor pain and function outcomes in knee	NR	Coping skills training protocol: Training objective/coping skill training methods (Table 1): • Objective: altering cognitions to change pain catastrophizing; method: cognitive restructuring, self-instructional training • Objective: altering activity patterns to change pain catastrophizing; method: activity-rest cycling, goal setting • Objective: Using Attention Diversion to Change Pain Catastrophizing; method: Relaxation Training, Imagery, Distraction	Local physical therapists with at least 2 years experience treating knee arthroplasty patients; 2-day training session led by clinical	In-person, individual; independently	In-person; Duke University, New York University Medical Center, Virginia Common	Pain coping skills/ arthritis education: 8 x 50-min sessions over ~2-months beginning ~2 weeks preoperative	NR	NR	All sessions audiotaped and assessed to confirm fidelity; clinical psychologists held monthly conference calls; remedial training will be provided for	95/130 (73%) assigned to pain coping received ≥5/8 sessions, an a priori indicator of good adherence; 106/135 (79%)arthritis

		arthroplasty; techniques form cognitive therapy		• Objective: Enhancing Maintenance; method: Relapse Prevention Training • The first session in-person appointment and the remaining sessions occurred via telephone Arthritis education sessions used a presentation-and-discussion format similar to approach used by Lorig et al. Receive information on postoperative course of knee arthroplasty, OA treatment, exercise, joint protection, making future treatment decisions. Co-interventions: Patients are routinely prescribed medications for pain control and are referred for physical therapy following TKA. Data regarding medication and extent of rehabili- tation therapies will be tracked throughout the study period and will be adjusted for, if necessary, in the analyses.	psychologists experienced in pain coping skills training, and received training manual. Arthritis education taught by registered nurses with at least 2 years of experience in OA; one author trained all nurses using a detailed manual		wealth Uni-versity, Wake Forest Universit y, and Southern Illinois Universit y	ly and ending ~6 weeks postoperativ ely			those clinicians who deviate from established protocol	education received ≥5 sessions
Svinøy 2019	Prehabilitat ion for older patients with OA – THA (AktivA)	Guidelines for hip OA suggest exercise and physical activity in combination with patient education to reduce pain and improve function	Exercise machines (see item 4); ActivA training course for providers: www.aktivmed artrose.no.	• Resistance: includes abduction for gluteus medius, squats, balance exercises, loaded knee extension, deadlifts; 1-3 sets x 8-12 reps, at 40%–60% of one rep maximum; load increased for progression • Cardiovascular: includes treadmill, cycling ergometer, walking, stair-climbing, elliptical; perceived exertion of 13-14 on Borg Scale	Physiotherapis ts; trained by 8-hour AktivA course	Individual or group	Home training or self-training at clinic with training program	45-60 min, 3-4x/week for 6-12 weeks	Physiothera pist tailors exercises and progression based on pain levels	N/A	Participant diary for home training adherence; physical therapist records supervised sessions (target ≥80% total planned sessions conducted)	N/A
das Nair 2018	Brief psychologic al intervention , based on cognitive behavioural therapy	Reduction in anxiety and depression preoperativel y may lead to improved postoperative outcomes; core elements outlined by Gatchel et al., Morley, and the Gloucester	Copies of treatment manual available from authors	Psychological intervention sessions based on principles of cognitive behavioural therapy for anxiety, depression, and pain management, tailored to the needs of each participant; includes psychoeducation on relationship between mood and pain, values-based goal-setting, self-management and behavioural activation, relaxation and mindful breathing, cognitive restructuring, and post-surgical planning	One of two psychologists, trained in delivering cognitive behavioural therapy–based interventions, offered the intervention	Individual , in-person	Home or hospital based on participa nt preferenc e	1 hr, 1-2x/week, for up to 18 weeks preoperative ly (up to 10 sessions)	Tailored to needs of each participant – no further detail	NR	Sessions audio-recorded; brief semi-structured feedback interviews; treatment coded as ‘completed’ if terminated by therapist in consultation with participant after all key issues (goals) met, or ‘discontinued’	Participants received 2-8 (mode=3), sessions; 2/25 intervention participants withdrew, 10 discontinued (felt coping they were well, surgery date changed, not able to discuss anxiety); 6 participants

		Pain Management Manual									if it terminated by participants without consultation	completed treatment
Husted 2018	QUADX-1 trial	Efficacy of pre-operative quadriceps strength training on knee-extensor strength before and shortly following TKA	Elastic exercise band, study-specific brochure where instruction notes to the exercise are illustrated and described, supplementary online video	Each exercise session comprises a single-strength training exercise, knee-extension; 2 sets x 12 repetitions at a load corresponding to 12 RM in each set	Physiotherapists specialized in knee OA; trained by primary investigator to ensure standardized exercise instruction and information	In-person instruction and monitoring (municipality setting), and home-based (unsupervised)	Home-based	One of three exercise dosages 1x/day (2, 4, or 6 session/week) for 12 weeks	Personalized to the extent that exercising with an individual absolute resistance in the elastic exercise band corresponding to a relative load of 12 RM	N/A	Adherence objectively quantified using a sensor attached to the exercise band; Exercise quality check-up (booster visit) after 4 & 8 weeks of exercise with the physiotherapist: exercise technique reassessment, optimal length or type of elastic exercise band (12 RM), questions	N/A
Jahic 2018	Home-based exercise program before TKA	In patients undergoing knee replacement, preoperative exercise showed better postoperative function, quadriceps strength and shorter length of stay	NR	Home-based exercises including quadriceps strengthening, flexibility and resistance training	NR	NR	Home-based	3x/day for 6 weeks	NR	NR	NR	NR
Negm 2018	FitJoints	Frailty reduction to improve postoperative outcomes;	Free membership of the YMCA community center to	• Kinesiologist assessment: goal setting, cognitive behavior change strategies • Exercise: Endurance, resistance, balance training minimum 3× week for 45–60 min at	Kinesiologist (exercise, nutrition delivery), pharmacist-	Individual	Home/centre (participant	Exercise minimum 45-60 min, 3x/week; daily protein	Tailored exercise, medication review recommend	N/A	During months 2–10, kinesiologist contacts biweekly	N/A

		exercise based on Canada's Physical Activity Guidelines; medication review based on Beers STOPP/START criteria	participate in the "InMotion pro-gram" if centre-based exercise chosen; exercise bands; Ensure Enlive protein, vitamin D (1000 IU); study-tracking logbook	home and/or YMCA; tailored based on ability and exercise preference (i.e., chair vs standing exercises, functional movements to mimic ADLs) • Nutrition: Vitamin D3 1000 IU/day (1000 IU tablets), unless otherwise prescribed by family physician; 1–2 Ensure Enlive™ protein daily (350 kcal, 20 g protein) advised to take with meal or within 3h of exercise • Medication review: geriatrician reviews the participant medications for any inappropriate medications; mailed/faxed to participant family physicians	trained geriatrician (medication review), nutrition expert (nutrition review); InMotion led by trainers and experienced physiotherapist		preference	supplementation and 1000 IU vitamin D, for 3-10 months	ations, and nutrition		contact (1 monthly visit & 1 interim phone-call) to check on progress, adjust program as needed	
Birch 2017	Physiotherapist-delivered cognitive-behavioral patient education for TKA	Improve understanding of how cognitions and behavior affect pain experience; manual content based on Rolving et al.	Patient handbook with key points and homework, pain diary, and provided with mp3 player with different relaxation and mindfulness exercises and a pain diary	7 CBT sessions with content according to pre-specified manual; content outlined for each session in Table 1	Physiotherapists experience in treating TKA patients & interest in CBT, who complete 3-day training program delivered by 2 psychologists specialized in CBT and pain management	In-person	Hospital setting	45 min, 3 sessions preoperatively, 4 postoperatively	Manual with some flexibility to discuss individual needs and problems in each of the sessions	N/A	NR	N/A
Calatayud 2017	High-intensity preoperative training for TKA	Designed to increase lower limb muscle strength	Bosu Balance Trainer	• 15-min warm-up: dynamic joint movements performed without ballistic movements and dynamic body weight exercises (e.g., 2 sets x 20 rep of step-ups and calf raises at a platform,10 min light-intensity hand or leg ergometry cycling (depending on the perceived pain). • Single warm-up set also performed before each resistance training exercise by using light resistance for 10 reps • Main program: 5 sets x 10 rep for each exercise, 60-s rest between sets; in order: seated leg press, knee extension, leg curl and hip abduction. Intensity based on 10 repetition maximum (10 RM) • 4 sets x 30 s of double leg stance and 4 sets x 15 s of single leg stance on the same unstable device (Bosu® Balance Trainer), starting with the non-affected leg	Experienced physical therapist	Individual, in-person	NR	3x/week (at same time of day, separated by at least 48 hr) for 8 weeks preoperatively	NR	NR	NR	NR

				• 5-min cool-down: light static stretching of hip abductors, flexors and extensors of the knee and ankle plantar flexors								
Tantavisut 2017	400 IU of vitamin E	Evaluate antioxidative and anti-inflammatory effects of vitamin E on oxidative stress in tissue of patients with knee OA	400 IU of vitamin E	Received 400 IU of vitamin E per oral once daily for 2 months	NR	Individual, oral administration	In centre	1x/day for 2 months preoperative	NR	NR	NR	All participants fully adherent to interventions
Alghadir 2016	Preoperative physical therapy	Compared effect of preoperative & postoperative physical therapist vs only postoperative physical therapy on pain & function after TKA	Assistive devices (stick or walker)	Strengthening and mobility exercises, proper techniques of transfers, and gait training with assistive devices (stick or walker)	Physiotherapist	In person instructions	In hospital	30 min sessions, 1x/day; instructed to repeat 2-3x/day for 6 weeks	NR	NR	NR	NR
Cavill 2016	Prehabilitation for THA/TKA	Range of motion & functional outcomes	NR	Circuit program: six separate stations (Table 1). Exercise dosage determined for each participant based on assessment using standardized tools such as the Timed Up and Go (TUG) test (Podsiadlo and Richardson, 1991) and reassessment of pain using a visual analogue scale; home exercise program also provided for each participant, including many of the same exercises done within the group	Physiotherapist	Group in-person, individual at home	Community rehabilitation centre and home-based	1 hr group exercise/education session, then 1hr 2x/week for 3-4 weeks preoperative; continued with home exercise program until surgery if date unknown/postponed	Exercises individually tailored to maximize therapeutic benefit and participant safety; home dosage reviewed at sessions and consistent with dosage completed within the group	NR	NR	NR
Cooke 2016	Pre-operative self-	Assess whether	DVD	• Received DVD at pre-operative session to take home with them, instructed to review within 72 hours and work through the	Research assistant	Individual,	Remote (home)/in-person	20-30 min sessions via DVD;	NR	NR	Self-efficacy and relaxation	6.3%-78.1% engaged in

	efficacy education	pre-operative self-efficacy-based education intervention holds promise on pain, anxiety, self-efficacy and satisfaction with pain management in patients undergoing joint replacement; based on the work of Marks and Allegrante		activities at home four times before admission for surgery. Research assistant called the participants 72 hours after the preoperative session and then again in 2–3 weeks to support participation. • Self-efficacy-based principles: Behaviour modification, improve self-confidence., foster problem solving • Content of DVD: 1) What is self-efficacy, 2) How can I improve my self-efficacy, 3) Setting goals, 4) Obstacles to achieving goals, 5) Strategies for achieving goals, 6) Sharing your goals, 7) Visualise achieving goals, 8) Relaxation techniques (mindfulness exercises, deep breathing, prayer, listening to music, guided imagery)	(registered nurse)	independently	in hospital routine care	unclear duration preoperatively			method utilisation survey asking how frequently participants engaged in these activities	aspects of goal setting and 12.5%-68.8% with practising relaxation strategies.
Hermann 2016	Preoperative progressive explosive-type training program for THA	Activity and function, muscle strength and physical performance	Training machines	• 10-min warm-up followed • Four exercises performed unilaterally on resistance training machines: standing hip extension, and seated knee extension, knee flexion and leg press; executed at moderate to high intensity (3 sets x 8-12 reps, with a load that elicited a maximum number of repetitions corresponding to 8-12 repetition maximum). • Instructed to complete concentric phase of the movement 'as fast as possible', pause briefly, then complete eccentric phase of the movement in approximately 2-3 s	Experienced physiotherapist supervised	Groups (up to 8 people), in-person	Hospital setting	1 hr sessions 2x/week, for 10 weeks	Loading continuously monitored and adjusted when needed; if pain exceeded 'normal' limits, training intensity decreased at next session	NR	Good adherence defined as ≥80% sessions attended/ number of planned sessions	38/40 completed the 10 weeks of training, no withdrawals due to pain or musculoskeletal injury; all patients completed with 80% attendance and 93% average adherence
Jepson 2016	Preoperative occupational therapy to optimise recovery for patients undergoing primary total hip replacemen	Preoperative domiciliary provision of assessment, advice, and appropriate adaptive equipment may enhance activity and	Adaptive equipment; not specified	• Visited by occupational therapist prior to surgery, who delivered intervention package including provision of adaptive equipment required by the participant and education on how equipment should be used. Discussed participant's/carers expectations and anxieties gave explanations about the surgery, hospital stay and postoperative in-patient rehabilitation; and how they planned to recover when they returned home.	Occupational therapist	Individual, in-person	Home visits	1 preoperative visit; unclear duration preoperative	Tailored home recommendations based structured home safety assessment	NR	NR	NR

	t for osteoarthritis (PROOF-THR)	mobility recovery		• Occupational therapist explained how layout of the participant's home might need adaptations to reduce the dislocation risk and falls; structured home safety assessment was performed based on Westmead Home Safety Assessment Form. • All participants received the usual care pathways provided followed by the hospital, including the preoperative multidisciplinary education session								
Mat Eil Ismail 2016	Preoperative physiotherapy	Improve short term functional outcomes	NR	• 10-min hot pack (thermotherapy) • 15-min low-resistance cycling on stationary bike • Ankle circulatory exercise (ankle pumps): 10 repetitions in 4 directions • Isometric quadriceps: Hold for 5 s, 50 reps • Inner range quadriceps: Hold for 5 s, 50 reps • Hamstring stretch: Hold for 10 s, gradually increase to 15 s as tolerated, 10 reps • Straight leg raise: Leg raised to 45º, 20 reps • Heel slides: Hold for 5 s, 20 reps	NR	NR	NR	2x/week for 6 weeks preoperative	NR	NR	NR	NR
Skoffer 2016	Unilateral progressive resistance training	Improving muscle strength before surgery; reducing major strength loss immediately after surgery	Resistance training machines (Cybex, Owatonna, MN)	• 10-min warm-up on stationary bicycle • 6 exercises (leg press, knee extension, knee flexion, hip extension, hip abduction, and hip adduction) were performed unilaterally on standard resistance training machines; only the involved leg trained for to reduce differences in muscle strength between the 2 legs • Training intensity initiated aimed at a load of 12 rep maximum (RM) with progression toward 8 RM throughout the intervention period. 3 sets of each exercise were performed with 2-min rest between • 3 x 30s static stretching of knee extensors, knee flexors, and ankle flexors	Physiotherapists specifically trained in progressive resistance training	Groups of 3 participants, in-person	Hospital setting	1 hr 3x/week for 4 weeks, initiated 5 weeks preoperative	Physiotherapists supervised and ensured that weight load sufficient to allow patients to train to failure in each set	NR	Dropout rate, adherence ([number of completed sessions/number of planned sessions] x 100)	Mean (SD) adherence was 94.0% (8.4%) preoperatively
Huber 2015	Preoperative neuromuscular training (NEMEX-TJ	Principles of neuromuscular and biomechanical training described in neuromuscular exercise program-	Knee school resources: knee joint/lower extremity models, worksheets, photos and videos, handouts,	• Knee school: information on anatomy of the knee joint and adjacent functional structures, recommended activities with prosthesis and postoperative pain management, postoperative rehabilitation phase; peer discussions • 10-min aerobic warm-up on stationary bike • Circuit (4 exercises): stability/postural function, functional alignment, lower-	Specially trained physiotherapist for exercise cycles and knee school	Individual /group	NR	Knee school 1x per week starting 4 weeks before surgery; neuromuscular training	Progression made when an exercise could be performed with 15 reps & 3 cycles with good	NR	Number of training sessions, level of difficulty per session, pain on 0-10 scale before and after each session, and 24	Median number attended sessions was 10 (IQR: 8, 14). 76.2% attended goal of ≥8 sessions. One patient

		total joint replacement; (NEMEX-TJR)	PowerPoint presentations	extremity muscle strength and functional exercises; 10-15 reps for 2-3 cycles with rest between cycles • Progression: varying number, direction and velocity of the movements, increasing load and/or by changing support surface • 10-min cool down				for 4-12 weeks	neuromuscular control and performance (determined by physiotherapist), minimal exertion and control of movement (perceived by patient)		hours after each session	missed 2 sessions due to increased pain, which was deemed a joint-specific AE
Zeng 2015	Preoperative home-based combined Tai Chi and Strength Training	improve balance and aerobic capacity in patients undergoing tha; tai chi forms described in wolf, coogler, & xu, 1997	NR	• 5-min warm-up: relaxed flowing movements, flexibility, balance and self-awareness • 35-min tai chi: 10 simplified tai chi forms including Opening Form, Parting Wild Horse's Mane, Apparent Close Up, wave hand like clouds, Step back and whirl arms on both sides, Grasp the Sparrow's Tail, Brush Knee and Push, Golden Rooster Stands on One Leg, Heel Kick, and Cross Hands (with Closing form); exercises taught in outpatient department (2-3 forms taught per session week 1, full set practiced week 2) • 5 min cool down • Hip muscle strengthening exercises and ROM training might follow, after 1-2 hr rest. Put sandbags on foot, then raising and holding leg with extended knee as hard as possible for 6 s (2 sets x 6–8 reps): for hip flexors in supine position; for hip abductors in side lying; for hip extensors in prone position; and for knee extensors in sitting on a stool. Weight of sandbags estimated 60% of 1RM individually. • ROM: 3-4 sets x 8-12 reps of hip single-joint movement • Training partner (family member) followed patient and performed the exercise at the same speed, monitored patient control/adverse events	Tai chi instructors (licensed physiotherapists); learned from a tai chi master (>5 years of experience)	Individual, in-person	Outpatient setting (weeks 1-2), then home-based (weeks 3-12); recommended to practice in park or outdoors	45-60 min tai chi, 20-30 min strength, at least 5x/week for 12 weeks preoperative	NR	NR	Daily self-report card by patients or their training partners measured compliance; collected when at weekly interviews in outpatient department	Percentage of practice days/total days of home program period (5 days per week)=87.1%; no SAEs

Bergin 2014	Preoperative incentive spirom-etry (IS) education (POISE intervention)	Postoperative pulmonary complica-tions are a leading cause of morbidity and mortality, affecting 25% to 50% of patients;. incentive spirometry (is) hand-held devices are used postoperatively by surgical patients to achieve effective inspiration	Diary, IS device	• Asked to stay for approximately 15 additional minutes after the Joint in Motion (standard care) class • Formal IS education and home use instructions for the IS in the 7-day preoperative period: (1) expand the tube by pulling on both ends at the same time and attach the tube to the tubing port; (2) slide the target to the volume level prescribed; (3) exhale completely and then close your lips tightly around the mouthpiece; (4) inhale slowly, keeping the flow rate guide between the arrows; (5) when you cannot inhale any more, hold your breath for 6 seconds and note the highest level reached at the top of the volume indicator, and try to achieve your prescribed volume; (6) exhale slowly and allow the volume indicator to return to the bottom of the column; (7) repeat Steps 3 to 6 as many times as prescribed; and (8) keep a record of progress on the charts provided • Patients were also instructed to inhale while sitting. Researchers observed the baseline IS volume and reviewed with the patient how to determine if the IS volume was above or below the predictive volume.	Researchers	Individual, in-person, then independently	In-hospital, then at home	7 days preoperative; patients with IS volumes below predicted volume instructed to use IS 10x every 2 hr, patients with IS volumes above predictive volume instructed to use IS 10x every 6 hours while awake	NR	NR	Preoperative daily study diary was to be completed for 7 days preoperative; date, time of use, and the highest volume the top of IS indicator reached	For the 34 not completing the study, 9 had missing spirometry data; Rating of intervention helpfulness Very helpful=25 (50), Helpful=16 (32), Somewhat helpful=1 (2) Not helpful=1 (2), No rating=7 (14)
Brown 2014	Exercise program based on social cognitive theory	Social cognitive theory concepts to encourage exercise behaviour	Prehabilitation training booklet, explaining all 5 components of training program, exercise log	• 5-min warm up: unweighted leg joint movements to increase blood flow to the muscles of the legs, trunk, and arms • 15-min resistance: 8 dynamic muscle strengthening exercises with elastic resistance, including squats, ankle dorsi/plantar, hamstring flexion, bicep curls, triceps; starting 1 set x 10 reps week 1 progressing to 1-2 sets by week 7-8 with moderate fatigue; 2-min rest between sets extensions, chest press, and seated row • 15-min flexibility exercises: 6 exercises including knee extension/flexion, hip flexion/extension, trunk extension/flexion, and shoulder flexion/extension/rotation (2 reps x 20 s each) • 10-min step training: 3 step-training exercises including going up and down a single step forward and then sideways to the left and right • 5 min cool down	Physiotherapy clinic staff	Individual, in-person or independently	Clinic/home	3x/week (1 supervised at clinic, 2 at home) for 8 weeks preoperative	If unable to complete initial training nor progress, an individualized training program developed consistent with their ability level	NR	NR	NR

				• Social cognitive theory principles in Table 3								
Matassi 2014	Preoperative home exercise program for TKA	Improve ROM, functional recovery; exercises based on Feland et al., O'Reilly et al.	Logbook with daily check marks to track exercises	• Received individual explanation of the exercises and performed them once with the primary researcher during the baseline assessment • Flexibility (2 exercises): (1) Quadriceps stretching (30 s x 4 reps, 10 s rest). Sits on chair, holds with one hand the ankle and flexes the knee until the patient reports discomfort; (2) Hamstring stretching. Sits on chair with legs fully extended, bends torso forward until discomfort, and holds (30 s x 4 reps, 10 s rest) • Strength (4 exercises): (3) Isometric quadriceps contraction in full extension held for 5 s. Patient lies supine on a bed with the legs fully extended, with a rolled-up towel under one knee, and contracts the quadriceps by pushing into the floor against the towel; (4) Isotonic hamstring contraction. Patient lies on front or side and bends knee bringing foot towards body; (5) Isotonic quadriceps contraction held in mid-flexion for 5 s. Sits on chair, lifts lower leg to partially extended position and holds; (6) Dynamic stepping exercise, walks up and down one step/chair	Primary researcher	Individual, in-person initial instruction then independently	Home-based	5 days/week for 6 weeks preoperative	NR	NR	Logbooks daily check marks; returned to investigators 1-day preoperative	Completed exercises with a mean of 79.4 % (±23); 1 patient complained of increasing knee pain and had to stop exercises, 1 patient developed ipsilateral adductor tendinitis
van Leeuwen 2014	Preoperative strength training for elderly patients undergoing TKA	Preoperative intensive strength training increase strength and performance before surgery	Dumbbells/plates	• Received additional intensive strength training, consisting of a progressive strength program targeting the lower limbs • 1-leg leg press, 1-leg step up, squat, 1-leg leg extension • Week 1=3 sets x 15 reps, week 2=3 sets x 12 reps, week 3=4 sets x 12 reps, week 4=3 sets x 10 reps, week 5=4 sets x 10 reps, week 6= 4 sets x 8 reps; for each exercise	NR	PT centre/home	Physiotherapy centre	2-3x/week training, plus 2-3x/week home exercises, for 6 weeks preoperative	Weight adjusted to abilities; program modified upon pain/discomfort, but intensity stayed as high as possible	NR	Training logs in which physiotherapists noted alterations of program; if intensity was progressively increased and all exercises completed, the program was considered feasible	All participants in strength training group completed training (12 ± 2 sessions); 8/11 without adaptations and 3 with small adjustments to intensity due to pain
Villadsen 2014	Neuromuscular exercise prior to	Individualised, feasible neuromuscular exercise	Exercise bike	• 10-min aerobic warm-up on stationary exercise bike • Circuits focused on core stability/postural control, postural orientation, lower	Physiotherapist; attended a training session of a	Groups (6-12 participants)	Hospital setting	1 hr 2x/week, for 8 weeks preoperative	Progression made when good movement	NR	Record of number of sessions attended;	RN Intervention group attended

	THA or TKA (NEMEX-TJR exercise program)	program evaluated on basis of self-reported physical function and joint-related pain; program identical Ageberg et al.		extremity muscle strength, functional exercises • Supervising physiotherapist focused on the quality of movement (sensorimotor control), including knee over foot alignment, considered good quality movement	previous cohort				control determined by physiotherapist and minimal exertion determined by patient; pain VAS ≥5/10 indicated reduction in level		attendance at 12 sessions considered good compliance	exercise program 13.1 times on average; 62/84 (74%) had good compliance - From secondary analysis Fernandes 2017
Brown 2012	Prehabilitation for TKA	Knee OA patients who exercise prior to TKA will report higher quality of life 3 months postoperative	Training booklet explaining the 5 aspects of program, based upon previous exercise guidelines for older adults (Topp, Mikesky, Dayhoff, & Holt, 1996); exercise log, elastic resistance band	Warm-up, 10 resistance exercises, six stretching exercises, three step exercises, and cool-down	Project staff at physical therapy clinic	Supervised at clinic + no supervision individually at home	Home/clinic	45 min 3x/week for 8 weeks preoperative	If the participant unable to complete the initial training or progress, an individualized training program was developed consistent with their training ability	NR	Number of repetitions and sets for all tasks of the prehabilitation program was recorded in the exercise log	Mean 16.3 (6.0) exercise sessions; average length of prehabilitation 6.3 (1.5) weeks with compliance rate 89%
Huang 2012	Preoperative home rehabilitation education program before TKA	Simplified, easy-to-learn, and less time-consuming preoperative rehabilitation education program for TKA patients	Educational booklet	• Thigh muscle strength training: straight leg raising, knee setting, ankle pumping, and hip abduction with resistance; 3 sets x 20 reps for each suggested • Educational content: protocol for hospitalization and discharge, post-TKA rehabilitation, safe transferring technique, device-using guide for crutches and canes, fall prevention information • One week prior to admission, participants received phone call from physiotherapist in for questions about home rehabilitation program or educational booklet	Experienced physiotherapist	Initial instructions in-person, at home exercises	Physical medicine and rehabilitation department/home	40 min instruction session, then 2-4 weeks preoperative home exercises	NR	NR	NR	NR
McKay 2012	Prehabilitation exercise training program on quadriceps	Simple and easy-to-implement prehabilitation exercise	Treadmills, ergometers, rowing ergometers,	• 10-min aerobic warm-up (participant's choice of using a treadmill, cycling ergometer, rowing ergometer, or recumbent stepper)	NR	In-person, unclear if in groups/individual	Research facility private exercise space	3x weekly, for 6 weeks	Progressed exercises based on tolerance	NR	NR	NR

	strength for TKA (lower body experimental program)	training program on quadriceps strength for patients under-going TKA.	recumbent steppers	• Circuit of bilateral lower body exercises (standing calf raise, seated leg press, leg curl, knee extension); 2 sets x 8 reps each. Calf raises were performed with body weight only. Remaining exercises began at 60% of 1 repetition maximum and increasing gradually by increments of 1-2 kg per week as tolerated								
Oosting 2012	Preoperative home-based physical therapy	Improve functional health of frail older adults undergoing THA; principles of functional task exercise developed by de Vreede et al.; Dutch guidelines for OA	Pedometer with 7-day memory to monitor walking activity	• Aim to walk 30min/day in graded manner, functional activities included walking, climbing stairs, sit and rise from a chair • Intensity and number of reps of exercises progressively increased; functional activities were made more challenging by combining physical tasks or performing physical and mental tasks • In home-based program trained corresponding to 55% to 75% of their maximal heart rate or perceived exertion 11-13 on the Borg scale, instructed to train with help of friends or relatives • If experiencing symptoms/pain after training, physical therapy and relaxation exercises were given as recommended in the Dutch guideline for OA	NR	Individual, in-person/independent	Home-based	Supervised 30 min 2x/week for 3-6 weeks; plus 4x/week at home	Training tailored to patient and their home environment	NR	Diary of AEs and symptoms	Diary completed fully by 6 patients, partially by 5. All showed good adherence to homework exercises; pedometer showed good adherence (patients used daily), and physical activity (number of steps) was consistent with the distance walked recorded in the diary of 9 patients
Soni 2012	Acupuncture and physiotherapy	Exercise protocol and Western medical style acupuncture based on approach in previous studies	Theraband, gym ball, wobble board	• Supervised exercise circuit: static quadriceps contractions, inner range quadriceps contractions, straight leg raises, sit to stands, stair climbing, calf stretches, Theraband-resisted knee extensions, wobble board balance training, knee flexion/extension sitting on a gym ball, free standing peddle revolutions. • Western medical style acupuncture: needles (1 inch, 0.25 gauge) inserted, 'de qi' sensation achieved where possible, left in situ for 20 min	Physiotherapist; completed the Acupuncture Association for Chartered Physiotherapists foundation course and is experienced in musculoskeletal acupuncture	Groups (6-10 participants)	NR	1x/week weekly sessions for 4 weeks, followed by biweekly sessions for 4 weeks, then monthly sessions until surgery	NR	Protocol adapted – points used were SP9 & SP10, ST34 & ST36, LI3, GB34 and LI8 (Figure 1)	NR	NR
Tungtrongjit 2012	Preoperative	Preoperative quadriceps strength is	NR	Sitting on a chair and bending knee and hip joints to 90°, stretch leg up to the maximum extension and hold for ≤6 seconds then return	NR	Individual, remote – telephone	Home-based	3x/day (morning, afternoon,	NR	NR	NR	NR

	quadriceps exercise	predictor of functional performance 1 year postoperative		to 90°flexion position. All these were counted one rep. After finishing, pause for 20 seconds. Repeat same exercise 10 times. Instructed by telephone every week before surgery				evening) for 3 weeks preoperative				
Bitterli 2011	Pre-Surgical Sensorimotor Training for THA	Minimal intervention strategy; exercises to promote awareness of position and movement of the hip joint & musculature	NR	6 daily exercises not requiring use of training aids (Figure 2). Each exercise should be performed twice daily with 10 repetitions or until pain, without any progression	NR	NR	Home	2x/day for 2-6 weeks after 2 verbal and written instruction sessions	NR	NR	Training and any problems encountered recorded by each participant in a training logbook	NR
Gstoettner 2011	Preoperative proprioceptive training programme	Proprioceptive deficiencies due to OA and arthroplasty often reported; proprioceptive training leads to an economisation of movements and supports energy-saving movement patterns	Written instructions for daily home training (Appendix A of Gstoettner et al., 2011); Airex mat (height 1.5 cm), balance pad (height 6 cm; both by Alcan Airex AG, 5643 Sins, Switzerland)	• 5-10 min warm-up: heel, toe and fast-paced walking • 5 stretching exercises of gastrocnemius, quadriceps, biceps, gluteal muscles, and the adductor muscles of both legs, each 3 x 20 s. • Performed barefoot on different mats, depending on the patients' abilities: Patients with balance problems started training on hard floor, then on Airex mat) and, if possible, on Airex balance pad. Placed one hand on a wall or other support, if necessary. Exercises repeated with eyes closed if capable of performing without any problems • Exercise 1 – slide step forward/backward: Start with a double leg stance with knee joints flexed to ~70°, shift weight slowly to non-TKA leg until weight fully supported on it. Slowly slide the other foot forward without lifting leg, then backward. Go back to starting position with a double leg stance with knee joints flexed to about 70°. Then change sides and repeat for the other leg. • Exercise 2 – Step forward/backward: Start with a double leg stance with knee joints flexed to ~70°. Shift weight slowly to non-TKA leg until weight fully supported. Begin the forward step by flexing hip and raising knee up to waist height (thigh is parallel to the ground), knee flexed to ~90°. Bring foot forward to a short step, first	Physical therapist	NR	NR	45 min, 1x/week for 6 weeks preoperative	NR	NR	NR	NR

				contacting the floor with heel, then performing a rolling motion to full contact with all toes. Then backward: first contact with the toes, rolling motion to full contact with the heel. Repeat this forward and backward action 10–15 times while gradually increasing the speed and ROM of the movement. Sustain a relaxed posture, with upper body upright and your gaze directed ahead. Then change sides and repeat for the other leg. • Exercise 3: single leg stance. Start with a double leg stance with knee joints flexed to ~70°. Shift weight slowly to non-TKA leg with weight-bearing leg lightly flexed at the knee, hip, and ankle, until standing with weight fully supported on it. Flex hip and raise knee up to waist height (thigh is parallel to ground), with knee flexed to ~90°. Keep position for at least 10 s. Then step down to the starting position, repeat for the other side • Exercise 4: squats. Start with a double leg stance with knee joints flexed to ~70°. Shift weight slowly to non-TKA leg with weight-bearing leg lightly flexed at the knee, hip, and ankle, until standing with your weight fully supported on it. Flex hip and raise knee and step approximately 30 cm to the side. Stand with weight fully supported on both legs and keep the position for at least 10 s. Then step back to the starting position, repeat with sides changed								
Swank 2011	Resistance band, flexibility and step exercise program	Improved leg strength and ability to perform functional tasks	Exercise bands	Progression in following exercises for 2 -week intervals across 8 weeks: warm up squats, leg extension, leg curl, hip abduction, hip adduction, hip flexion, hip extension, foot plantar flexion, foot dorsiflexion, step ups-forward/lateral both sides, cool down (sets and reps in Table 1)	NR	NR	Clinic, home	3x/week for 4-8 weeks preoperative	NR	NR	NR	Subject training did not indicate strict adherence to exercise progression
Hoogeboom 2010	Short (3–6 weeks) tailor-made, therapeutic exercise programme was	Preoperative functioning, postoperative recovery in frail elderly	Pedometer, bicycle ergometer, leg press	• Four phases of supervised sessions: 5-min walk to warm up; lower extremity leg-press (sets of 10–20) through full possible ROM (concentric and eccentric), 20-30 min aerobic capacity training on bicycle ergometer; specific tailor-made training integrating functional physical activities into daily living	Physiotherapists	Individual, in-person supervised, plus individually at home	Outpatient physiotherapy department/home	60 min 2x/week for 3-6 weeks preoperative	Fourth phase of program was tailor-made training for functional	NR	Progressed training parameters gradually, let patients include spouse/family in exercises, implemented	None of the exercisers dropped out, high adherence rate, no unexpected SAEs, all

	compared with usual care			• Intensity set to 13–14 (moderate to high) on 15-point rated perceived exertion scale except for the warm-up. If an exercise was rated 'somewhat hard' (12 on rated perceived exertion scale), increased the weight carried, number of repetitions and/or the distance walked • If necessary, manipulative tractions used to reduce discomfort					activities in daily living		feedback about intensity of and attitude towards the exercise	participants very satisfied
Walls 2010	NMES training	In knee OA, NMES can increase quadriceps strength and improve functional performance, has been found to be as effective as exercise therapy	Portable, battery powered, garment-based stimulator (KneeHAB II, Bio-Medical Research, Galway, Ireland), hydrogrel electrodes (Axelgaard, Fallbrook, CA)	• Received instruction on application of the device to thigh of affected limb and usage of the stimulator according to manufacturer guidelines, written instruction on device controls and NMES training program schedule. • Sessions performed in the sitting position with the knee flexed to 60°, the foot flat on the floor, and toes against a wall to permit isometric muscle contraction • Four hydrogel electrodes secured to inside of garment placed over vastus medialis and vastus lateralis proximally and distally. The surface areas of the four electrodes are: 194 cm^2; 83 cm^2; 74 cm^2; 66 cm^2 • Encouraged to increase the stimulation intensity to their maximum tolerated level (pain threshold) during each session	NR	Individual, autonomous	Home-based	20 min/day on alternate days for 6 weeks preoperative	NR	NR	Logbook to record usage; unknown to the patients the stimulator also recorded usage	99% compliance; Some subjects had a stimulator recorded compliance >100% (may have spent additional time familiarising themselves with the device or trained for more than prescribed)
Aoki 2009	Home stretching exercise	Home-based stretching exercise to improve ROM and gait	Calendar	Two exercises: knee flexion assisted by hand while sitting on floor and knee flexion assisted by hand (or by the opposite leg if difficult to reach with the hand) in prone position (Figure 1). Keep knee flexed as much as possible for 30 seconds and complete a minimum of 10 reps at least once a day	NR	Individual	Home-based	1x/day until surgery for ~80 days	NR	NR	NR	The percentage of days for which the participants performed the exercises during the study period was 93.1 ± 4.3% in the stretching group
Gill 2009	Land-based versus pool-based exercise for people awaiting joint replacement surgery of	Determine whether 2 different exercise-based interventions, together with education and a home	Pool-based: noodle or cuff float; land-based stationary exercise bike	• The initial class for both groups was a 60-minute education session: pathogenesis of advanced OA and disability and the principles of healthy exercise • Exercises completed at a moderate intensity (12 -14 Borg Rating of Perceived Exertion Scale). • Land-based program: 5-10 min of forward, sideways, and backward walking; 20 min	Physiotherapist	Groups (4-6 participants), in-person	Land-based in physiotherapy gym, pool-based in hydrothe	1 hr 2x/week, for 6 weeks	NR	NR	Throughout the investigation, participants kept a logbook of compliance; targets not specified	Average of 10.5 and 9.8 of the 12 classes attended by land-based and pool-based groups, respectively;

	the hip or knee	environment assessment, might improve preoperative status of those awaiting joint replacement surgery, and whether one form of exercise better tolerated than another		pedaling a stationary exercise bike; resistance exercises (table 4); calf, hamstrings, and quadriceps stretches (2 sets x 30 s). • Pool-based program: walking and active range of movement exercises (table 5); calf, hamstring, and quadriceps stretches (2 sets x 30 s). Noodle or cuff float was placed below foot or attached to moving leg. Subjects who required assistance for balance held onto kick boards or rail at pool side • All participants were asked to complete 30 minutes of exercise at home, 3x/week, including walking, riding a stationary bike, or performing exercises similar to those completed in the supervised classes. After 6-week intervention, encouraged to continue to exercise at home until follow-up • All participants received home visit and environmental assessment from an occupational therapist			rapy center					land-based and pool-based groups reported mean of 3.8 and 3.7 sessions of home exercise each week (30-40 min). Apart from transient soreness, no AEs due to intervention
Topp 2009	Preoperative prehabilitation exercise intervention on knee pain, functional ability, and quadriceps strength	Training before TKA may have positive effects on postoperative knee pain, functional ability, and quadriceps strength	Therabands (Hygienic Corporation, Akron, OH)	• 5-min warm-up: light walking. • 9 lower body resistance exercises: squats, hip flexion and extension, hip abduction and adduction, ankle plantar flexion and dorsiflexion, knee extension and flexion; incorporated various intensity levels of Therabands • Forward and lateral step training exercises: up and down a standard 8-inch step • Cool-down: light static stretching including gluteus, hip, hamstring, calf, torso, upper back, lower back, and triceps, then 5 minutes of light walking	Research personnel (supervised 1 of 3 weekly sessions)	NR	Home-based (2x/week); in-person location NR (1x/week)	3x/week (1 supervised, 2 at home); variable total number of sessions as duration of time available before the subject underwent TKA varied by surgeon's availability	NR	NR	Subjects documented compliance using an exercise log	NR
Evgeniadis 2008	Preoperative therapeutic exercise before TKA	Strengthen trunk and upper extremities using elastic Therabands preoperatively	Therabands	• Each exercise technique presented via photos and demonstration of the whole program • Three phases: warm-up, main program and cool-down. • Strengthening exercises from the sitting position aiming to reinforce muscles of the upper back-shoulder, humeral bicep and triceps, deltoid, rectum abdominals and femoral flexors.; 1-3 sets x 10–14 reps; 2-3 min rest between sets	Physical therapist and orthopaedist	NR	NR	3x/week on alternate days for 3 weeks preoperative	Resistance level depended on participant status	NR	NR	NR

				• Resistance chosen based on patient's ability to perform 1 set x 8 reps with modest fatigue; progress depended on patient's ability to perform 15 reps comfortably on last set								
Ferrara 2008	Preoperative physical therapy for THA	Exercise protocol was adapted from previous studies about patients with OA	NR	• Small groups (maximum three patients) for 40 min, then individually for 20 min • Strength and flexibility: leg stretching, particularly of the hamstrings, hip adductor muscles and hip flexor muscles, and strengthening exercises of the hip abductor muscles and femoral quadriceps; 3–4 sets x 8–12 reps of single-joint movement and strengthening exercises • Cardiovascular: 10-15 min recumbent stationary bicycle at low/moderate intensity • Exercises for postural realignment of the spine, shoulders, elbows, wrists, hands, hips, knee and ankles. Received advice on the movements that should be avoided, preventing the dislocation of prostheses, the use of devices (crutches, elevated toilet seats, elevated beds and forceps to help in dressing and undressing), correct posture, lifting and carrying, washing and bathing	Physical therapist	Group (3 participants)/individual	NR	60 min 5x/week, for 1 month preoperative	NR	NR	NR	NR
Sandell 2008	Multidisciplinary assessment and intervention for patients awaiting THA	Improve quality of life	Equipment/mobility aids (not specified); Exercise instructions handout	Explanation of surgery, assessing gait, appropriateness of mobility aids, details of relevant exercises to strengthen hip joint, home assessment for equipment, postoperative advice, pain management (analgesic history and advice for taking medication/non-pharmacological methods); exercises and other procedures not further specified	Orthopaedic nurse specialist, physiotherapist, occupational therapist, nurse specialist acute pain	Individual, in-person	Home (OT visit)/clinic (visit with other team members)	Average 3 visits by OT; exercise dosage/duration unclear	Multidisciplinary intervention tailored to individuals	NR	NR	NR
Vukomanovic 2008	Short-term preoperative physical therapy and education for THA	Effects of educative preoperative programs on patients' ability to perform basic ADLs upon discharge	Brochure	• Education: informed about the operation, caution measures and rehabilitation after THA arthroplasty through conversation with the physiatrist and a brochure • Physical therapy: instructed by a physiotherapist to perform exercises and basic activities from the postoperative rehabilitation program, such as bed mobility, getting out and in bed, standing and walking with crutches, use of toilet, sitting on chair, walking up and down stairs with aids	Physiotherapist, physiatrist	NR	NR	1 appointment with physiatrist, 2 practical classes with physiotherapist; duration unclear	NR	NR	NR	NR

Williamson 2007	Acupuncture, physiotherapy (supervised exercise) for patients awaiting knee replacement	Acupuncture and exercise therapy effective in the treatment of OA knee pain, but effect of acupuncture on postoperative recovery has not been studied; recent recommendations for the medical management of knee OA include combining non-drug therapies	Needles (1 inch, 0.25 gauge), Theraband, wobble board, gym ball	• Acupunture: needles inserted and 'de chi' achieved where possible, and left in situ for 20 min. The acupuncture points used were those most used in previous reported research studies in the field (Fig. 1). Up to 3 additional needles used in trigger or traditional points at the physiotherapist's discretion • Exercise: circuit devised and supervised by the same physiotherapist who provided acupuncture. The exercises were: static quadriceps contractions; inner range quadriceps contractions; straight leg raises; sit to stands, stair climbing; calf stretches; TheraBand resisted knee extensions; wobble board balance training; knee flexion/extension sitting on gym ball, freestanding peddle revolutions	Senior physiotherapist experienced in musculoskeletal acupuncture	Group (6-10 participants), in-person	National Health Service outpatient setting	Acupuncture: 1x/week for 6 weeks; physiotherapy 1 hr 1x/week, for 6 weeks	NR	NR	NR	No AEs due to treatment beyond minor bruising and bleeding in the acupuncture group (no concern or discomfort for the patient)
Nuñez 2006	Therapeutic education and functional readaptation	Evaluate the effect of a program of therapeutic education and functional re-adaptation (based on social learning and self-management) on health-related quality of life in patients diagnosed with OA waiting for TKR	Written information on session content	• Content centered on consequences of the disease on daily life, included principles of economy/energy conservation and joint protection; evaluation and control of pain (rest and positioning, ice and heat, necessary length of application) and treatments recommended for the management of knee OA; demonstration and use of assistive devices and tables of physical exercises with no burden on the lower limbs • Knee exercises to maintain and improve strength of muscles acting around the knee, the knee ROM and locomotor function; increase up to maximum of 2 sets/day x 30 reps • General exercises to mobilize the joints and strengthen musculature of body; 1x/day x 10 reps • Exercises taught in the group sessions. Patients were instructed to practice the exercises at home in the week previous to the second group session, in which all patients carried out the complete table of exercises, supervised by the educator.	Trained health educator	Groups (10-12 participants accompanied by relative/family)/individual, in-person/independently	Home/ location of group sessions not described	30 min 2x/week (week 1 & at 3 months), 90 min 1x/week (weeks 3 & 4) for 3 months preoperative; all sessions in morning	Dosage of NSAIDs varied according to individual patient needs; exercises tailored depending on pain levels	NR	NR	Combination of individual and group visits could have improved adherence, as patients may have received reinforcement from both the therapist and from fellow patients

				Follow-ups were performed in the individual visits • Both groups of patients received 3-4 g/day of paracetamol alone or 2 g/day of paracetamol combined with 2400 mg/day of ibuprofen or other NSAIDs								
Rooks 2006	Short preoperative exercise intervention	Cardio-vascular, strength-training, and flexibility exercise on pre- and postoperative function, pain, and muscle; protocol adapted from previous studies of persons with osteoarthritis and fibromyalgia	Pool, stationary bicycle, elliptical, Life Fitness machines	• Weeks 1-3: 1–2 sets x 8 –12 reps of single-joint movements while standing in chest-deep, 93°F water; pool exercises focused on single planar motion of cervical spine, shoulders, elbows, wrists, hands, hips, knees, and ankles. • Weeks 4-6: Total body fitness program of cardiovascular, strength, & flexibility training; recumbent stationary bicycle/elliptical for 10 min (moderate intensity); strength training activities performed isotonically including seated row, chest press, leg press movements using resistance machines; biceps curl and triceps kickback exercises using hand weights; and movements for the shoulders and abdomen using bodyweight (2 sets x 8 –12 reps each). End session flexibility exercises of hip, knee, and ankle flexors and extensors and hip adductors (2 sets x 20s)	Physical therapist	In-person	Community fitness facility	30-60 min 3x/week for 6 weeks preoperative	Tailored to each person's fitness level and comfort with performing the movements	NR	NR	Adherence to the exercise intervention was high; participants attended an average of 16 (89%) of 18 class sessions
Mitchell 2005	Preoperative home physiotherapy for TKA	Senior hospital and community physiotherapists designed intervention with reference to a literature review and current practice	NR	Pre-operative physiotherapy, based on an initial assessment, typically included pain relief, techniques to increase knee flexion and extension, gait re-education and home/functional adaptations.	Four community physiotherapists; half a day observing inpatient TKA physiotherapy and visiting outpatient knee classes, plus two 1-hour in-house training sessions	Individual	Home-based	Minimum 3 preoperative visits starting within 8 weeks of joining TKA waiting list	NR	NR	NR	Mean of 2.8 pre-operative sessions; 64.9% satisfaction with physiotherapy in home group compared to 47.4% in hospital group
Beaupre 2004	Preoperative exercise and education program	Improve knee mobility and strength, pain using simple	NR	Simple strengthening exercises with progressive resistance added to patient tolerance (Appendix of Beaupre et al., 2004)); warmup and cool-down to prevent injury, minimize swelling and pain post-exercise	NR	In-person (community physio clinic)	Community physical therapy clinic	3x/week for 4 weeks (total 12 sessions)	NR	NR	NR	All but one subject completed the 12 sessions prior to

		exercises similar to those postoperatively										surgery, based on logbooks
Berge 2004	Pain management program	Behaviour change for exercise, joint protection, & pacing activity; addressing unrealistic fears contributing to disability, cognitive methods to deal with frustrations of limited activity and flexibility; relaxation	Intervention not manualised; 'details available from the authors on request'	Described in Table 1 - exercise; problem solving; aids to daily living; relaxation; goal setting and planning; joint protection; cognitive methods for thoughts and feelings associated w/ pain; foot care; beds and sleep; complementary therapies; etc.	Clinical psychologist, occupational therapist, physiotherapist, with experience in running chronic pain PMPs; had not previously run PMP for hip OA but it was tailored for THA patients	Groups of 9-10	NR	1-2x/week (mornings) for 6 weeks, totaling 21.5 hrs	NR	NR	NR	NR
Gocen 2004	Preoperative physiotherapy and education THA	designed to strengthen the muscles of the upper and lower limbs and to improve range of motion of the hip,	NR	Straight leg raising, stretching of hamstring and hip flexors and strengthening of upper extremity exercises (3x/day, 10 reps), plus education programme including advice on movements that should be avoided, use of devices (such as crutches, elevated toilet seats, elevated beds and forceps to help dressing and undressing), posture, lifting and carrying, washing and bathing.	Physiotherapist supervision	NR	NR	3x/day for 8 weeks preoperative	NR	NR	NR	NR
Crowe 2003	Individually tailored rehabilitation for clients who were undergoing THA/TKA	Preoperative rehabilitation would require fewer days to achieve discharge criteria, and have a shorter actual length of stay.	Preoperative education video (50-min), booklet; information on length of stay, discharge criteria, respite care and diet; small adaptive equipment provided as required (e.g., long reachers,	• Some received dietitian counseling (weight loss, protein intake), pharmacy (for those with complex medications) and social work input (including financial assistance to enable home alterations or equipment rental) • Individualized counseling from an occupational therapist about assistive devices (bathe, dress and care for themselves), and suggestions for minor home alterations to optimize function and independence post-operatively (followed by home assessment and planning if applicable).	OT, PT, nurse	Individual, in-person; varied - single session OT and/or PT, outpatient PT or OT, home care OT or PT, day hospital	Clinic, hospital, in-home	NR	Assessed by an occupational therapist, physiotherapist or nurse and scheduled into aspects of the program meeting their needs	NR	NR	NR

			sock-application aids, elastic shoelaces, special cushions)	• Physical conditioning program at out-patient physiotherapy clinic or in-home visits available for subjects which focused on improving strength and endurance (especially in non-arthroplasty joints)								
Møller 2002	Preoperative smoking intervention	Smoking intervention from 6–8 weeks before surgery could reduce frequency of postoperative complications	NR	• Weekly meeting with project nurse. At the first meeting a Fagerstöm test completed to estimate the magnitude and profile of nicotine dependence. A personalised nicotine substitution schedule was devised in accordance with the test results and patient's preference. • Patients strongly encouraged to stop smoking completely, but also had option to reduce tobacco consumption by ≥50%. Smoking status monitored by carbon monoxide in expired air. • Nicotine substitution products provided without charge • At all subsequent meetings, tobacco consumption recorded, given advice about smoking cessation or reduction; benefits and side-effects, managing immediate withdrawal symptoms, keeping weight gain to a minimum, and general issues related to smoking intervention or hospitalisation	Project nurse trained in smoking cessation techniques	Individual, in-person	NR	1x/week, for 6–8 weeks preoperative	Personalized nicotine schedule – not described further	NR	NR	Intervention group: 36 stopped smoking, 14 reduced, 6 smoked; control group: 48 smoked, 4 stopped smoking
Wang 2002	Perioperative exercise program	Determine if perioperative exercise programs are well tolerated by elderly patients and if customized program achieves earlier recovery of normal ambulatory function after THA	Ankle weights, dumbbells, stationary bikes, resistive training machines	• Clinic sessions: hydrotherapy, stationary bike riding, resistive training machines for strength in thigh abduction, thigh flexion and extension, leg flexion and extension, ankle plantar flexion; resistance exercises designed to improve strength at slow movement velocities. • Subjects determined intensity of exercise sessions. Resistance initially set at a level that the subject could move through a pain-free range for 10 reps. Once managed 3 sets x 10 reps without exacerbating joint pain, the weight was increased by 5-kg increments. • Home exercises consisted of further muscle strengthening using ankle weights, dumbbells, and a series of flexibility exercises	NR	Individual (home); unclear group/individual clinic sessions	Clinic/home	1 hr 4x/week (2 clinic-based, 2 home-based) for 8 weeks preoperative	Customized to level of pain, age, and general physical ability	NR	NR	97.3% of pre- and postoperative sessions attended; majority (n=13) of exercise group continued program to postoperative week 24; no training injuries during program
Haslam 2001	Acupuncture vs exercise and advice	Acupuncture increasingly popular	Viva' sterile disposable acupuncture needles	• Acupuncture (6 sessions): 10 min first session, with the patient side-lying with affected hip uppermost. Acupuncture points	Study author	Individual, in-person	In-hospital physiotherapy	Acupuncture: 1x/week, 6-week period (10 min 1st	NR	NR	NR	NR

	for symptomatic treatment of OA of the hip	in the symptomatic treatment of OA; hypothesized no difference between acupuncture and advice and exercises	(0.25mm diameter, 25mm length), longer needles were used at GB30 (0.25mm diameter, 40mm length) (Helio Medical Supplies Inc, Santa Clara, CA 95050, USA)	used were: GB29, GB30, GB34, GB43, ST44, LI4 bilaterally, and 4 'ah shi' points around the greater trochanter, in a north, south, east, west formation. Most points chosen were on the Gall Bladder meridian passing over the lateral and posterior hip. Needle manually stimulated for ~10 s halfway through treatment. Subsequent sessions lasted 25min, with manual stimulation of each needle, for ~10 seconds, every 5 min • Exercise and advice (3 sessions): The first session involved giving each patient an advice sheet on OA & set of 5 exercises, and on self-help. Exercises demonstrated then practiced by patient. 2 subsequent review sessions at 3-week intervals to confirm exercises performed properly & progression)			departmen t	session, sessions 2-6 25 min); exercise 30 min x 3 sessions over 6-week period. All sessions at same time of day				
Tillu 2001	Unilateral versus bilateral acupunctur e on knee function in advanced OA of the knee	Acupuncture beneficial in relieving pain in knee OA; hypothesized no difference between bilateral and unilateral acupuncture for OA treatment	Needles	Unilateral group received acupuncture to the most symptomatic knee, bilateral group to both both knees. Sterile disposable one-inch needles were inserted at four local points and one distal point. The four local points around the knee were Spleen 9 (Yinlinquan, SP9), Spleen 10 (Xuehai, SP10), Stomach 34 (Liangqui, ST34) and Stomach 36 (Zusanli, ST36). The distal point used was Large Intestine 4 (Hegu, LI4) on the 1st ipsilateral web space. All needles inserted deeply in a standard manner and manually stimulated 4x during 15 min of treatment	Trained acupuncturist with 10 years of experience	Individual , in-person	NR	15 min, 6 treatments at weekly intervals	NR	NR	NR	44 participants completed treatment and attended reassessment at 2 months; no major side effects reported except 3 patients with minor bruising at insertion sites
D'Lima 1996	Experiment al physical therapy/exp erimental cardiovascu lar	Improve upper and lower extremities and knee ROM/impro ve fitness and maintain heart rate	Physical therapy: weights as tolerated, cardiovascular exercise: Cybex Aerobic Ergometer & Cybex Upper Body Ergometer (Cybex, Ronkonkoma, NY)	• Physical therapy group: initial stretching of calf, hamstring, and quadriceps muscles; isometric and isotonic strengthening exercises of the triceps surae, quadriceps, hamstrings, hip flexors, hip extensors, hip abductors, shoulder flexors, shoulder abductors, and triceps brachii; number of repetitions increased by 1 every third day until goal reached • Cardiovascular group: Twelve sessions emphasized arm ergometry and cycle ergometry, and included light stretching, muscle toning, and aerobic activity; 6 sessions aquatic exercises	Physiotherapis t (physical therapy group); exercise physiologist (cardiovascula r group)	Physical therapy: individual , in-person; cardiovas cular: individual , in-person, unclear if aquatic in groups/in dividual	NR	45 min 3x/week (total 18 sessions)	NR	NR	Physical therapy: graphed exercise program to record reps; exercises reviewed with physical therapist at each visit	NR

Christensen 1992	Acupuncture treatment of severe knee osteoarthrosis	Acupuncture for pain relief in patients undergoing TKA	NR	Skin was cleansed with an alcoholic swab and needles inserted 10-15 mm into classical Chinese acupuncture points (Figure 1); five needles around the knee and one needle in ipsilateral hand. Needles manually stimulated during 20 min of treatment.	NR	NR	NR	20 min 2x/week during weeks 1-3.	NR	NR	NR	NR

Abbreviations: AAOS=American Academy of Orthopaedic Surgeons, AAHKS=Annual Meeting of the American Association of Hip and Knee Surgeons, ACSM=American College of Sports Medicine, ACT=Acceptance and Commitment Therapy, ADL=Activity of daily living, AE=Adverse event, CBT=Cognitive-behavioural therapy, HIIT=High-intensity interval training, IS=Incentive spirometry, NMES=Neuromuscular electrical stimulation, NR=Not reported, OA=Osteoarthritis, OT=Occupational therapist, PT=Physiotherapist, RA=Research assistant, ROM=Range of motion, RM=Repetition maximum, RPE=Rating of Perceived Exertion, SAE=Serious adverse event, THA=Total hip arthroplasty, TJA=Total joint arthroplasty, TKA=Total knee arthroplasty

Table 3. Adherence to TIDieR items

Author, year	TIDieR Items												Overall Score	TIDieR Rating†
	Item 1: Name	Item 2: Why (rationale)	Item 3: What (materials)	Item 4: What (procedures)	Item 5: Who provided	Item 6: How (mode of delivery)	Item 7: Where (location)	Item 8: When and how much (dose)	Item 9: Tailoring	Item 10: Modifications*	Item 11: How well (planned adherence/fidelity)	Item 12: How well (actual adherence/fidelity)*		
Gränicher 2024	1	1	1	1	0.5	1	1	1	1	0	1	1	10.5	Good
Roxburgh 2024	1	1	1	0.5	0	0.5	0	1	0	0	0	1	6	Moderate
Briguglio 2023	1	1	1	1	0	1	0	1	0	0	1	0	7	Moderate
Guida 2023	1	1	1	1	0.5	1	1	1	1	N/A	0.5	N/A	9	Good
Khalid 2023	1	1	1	1	1	1	1	1	0.5	N/A	1	N/A	9.5	Good
Sun 2023	1	1	0.5	1	0.5	1	0.5	1	0	0	0	0	6.5	Moderate
Zhang 2023	1	1	1	1	1	1	1	0.5	0	N/A	0	N/A	7.5	Moderate
Franz 2022	1	1	0	1	0	0	0	1	1	0	0	0	5	Poor
Nguyen 2022	1	1	0.5	1	1	1	1	1	0	0	1	1	9.5	Good
Pacheco-Brousseau 2022	1	1	0	1	0.5	1	1	1	1	1	0	0	8.5	Moderate
Risso 2022	1	1	1	1	0	1	0	1	1	0	0	0	7	Moderate
Terradas-Monllor 2022	1	1	1	1	0.5	1	1	1	0.5	0	1	0	9	Good
An 2021	1	1	1	1	0.5	1	1	1	0.5	0	0	0	8	Moderate
Domínguez-Navarro 2021	1	1	0	1	0	0	1	1	0	0	0	1	6	Moderate

Kim 2021	1	1	1	1	0.5	0.5	1	1	1	0	1	0	9	Good
Liljensoe 2021	1	1	1	1	0.5	1	1	1	0	0	0	0	7.5	Moderate
Miller 2021	1	1	1	1	0.5	1	1	1	0	N/A	1	N/A	8.5	Moderate
Şavkin 2021	1	1	1	1	0	1	1	1	0	0	0.5	0	7.5	Moderate
Aunger 2020	1	1	1	1	1	1	1	1	1	1	1	1	12	Good
Blasco 2020	1	1	0.5	1	1	1	1	1	0.5	0	1	0.5	9.5	Good
Doiron-Cadrin 2020	1	1	1	1	0.5	1	1	1	1	1	1	0	10.5	Good
Gränicher 2020	1	1	1	1	0.5	0	0	1	0	0	0	1	6.5	Moderate
Kusumadewi 2020	1	1	1	1	0	1	1	1	0	0	0	0	7	Moderate
March 2020	1	1	0.5	1	1	1	0	1	1	N/A	1	N/A	8.5	Moderate
Rittharomya 2020	1	1	1	1	0.5	0	1	1	1	1	1	0	9.5	Good
Simpson 2020	1	1	1	1	1	1	1	0.5	0.5	N/A	1	N/A	9	Good
Stone 2020	1	1	1	1	0	1	0.5	1	0	0	0	0	6.5	Moderate
Wang 2020	1	1	0.5	1	0	1	1	1	0.5	0	0	0	7	Moderate
Medina-Garzón 2019	1	1	0	0.5	0.5	0	0	1	0	0	0	0	4	Poor
Riddle 2019	1	1	0	1	1	1	0.5	1	0	0	1	1	8.5	Moderate
Svinøy 2019	1	1	1	1	1	1	1	1	1	N/A	1	N/A	10	Good
das Nair 2018	1	1	0.5	1	1	1	1	1	0.5	0	1	1	10	Good
Husted 2018	1	1	1	1	1	1	1	1	1	N/A	1	N/A	10	Good

Jahic 2018	1	1	0	0.5	0	0	1	0.5	0	0	0	0	4	Poor
Negm 2018	1	1	1	1	0.5	1	1	1	1	N/A	1	N/A	9.5	Good
Birch 2017	1	1	1	1	1	1	1	1	0.5	N/A	0	N/A	8.5	Moderate
Calatayud 2017	1	1	1	1	0.5	1	0	1	0	0	0	0	6.5	Moderate
Tantavisut 2017	1	1	1	1	0	1	1	1	0	0	0	1	8	Moderate
Alghadir 2016	1	1	1	1	0.5	1	1	1	0	0	0	0	7.5	Moderate
Cavill 2016	1	1	0	1	0.5	1	1	1	1	0	0	0	7.5	Moderate
Cooke 2016	1	1	1	1	0.5	1	1	0.5	0	0	1	1	9	Good
Hermann 2016	1	1	0.5	1	0.5	1	1	1	1	0	1	1	10	Good
Jepson 2016	1	1	0.5	1	0.5	1	1	1	1	0	0	0	8	Moderate
Mat Eil Ismail 2016	1	1	0	1	0	0	0	1	0	0	0	0	4	Poor
Skoffer 2016	1	1	1	1	1	1	1	1	0.5	0	1	1	10.5	Good
Huber 2015	1	1	1	1	1	1	0	1	1	0	1	1	10	Good
Zeng 2015	1	1	0	1	1	1	1	1	0	0	1	1	9	Good
Bergin 2014	1	1	1	1	0.5	1	1	1	0	0	1	0.5	9	Good
Brown 2014	1	1	1	1	0.5	1	1	1	1	0	0	0	8.5	Moderate
Matassi 2014	1	1	1	1	0.5	0	1	1	0	0	1	1	8.5	Moderate
van Leeuwen 2014	1	1	1	1	0	1	1	1	0.5	0	1	1	9.5	Good
Villadsen 2014	1	1	1	1	1	1	0.5	1	1	0	1	1	10.5	Good

Brown 2012	1	1	1	1	0.5	1	1	1	1	0	1	1	10.5	Good
Huang 2012	1	1	1	1	0.5	1	1	0.5	0	0	0	0	7	Moderate
McKay 2012	1	1	1	1	0	0.5	1	0.5	0.5	0	0	0	6.5	Moderate
Oosting 2012	1	1	1	0.5	0	1	1	1	1	0	1	1	9.5	Good
Soni 2012	1	1	1	1	1	1	0	1	0	0.5	0	0	7.5	Moderate
Tungtrongjit 2012	1	1	0	1	0	1	1	1	0	0	0	0	6	Moderate
Bitterli 2011	1	1	0	1	0	0	1	0.5	0	0	0.5	0	5	Poor
Gstoettner 2011	1	1	1	1	0.5	0	0	1	0	0	0	0	5.5	Poor
Swank 2011	1	1	1	1	0	0	0.5	1	0	0	0	0.5	6	Moderate
Hoogeboom 2010	1	1	1	1	0.5	1	1	1	1	0	0.5	0.5	9.5	Good
Walls 2010	1	1	1	0.5	0	1	1	1	0	0	1	1	8.5	Moderate
Aoki 2009	1	1	1	1	0	0.5	1	1	0	0	0	1	7.5	Moderate
Gill 2009	1	1	1	1	0.5	1	1	1	0	0	0.5	1	9	Good
Topp 2009	1	1	1	1	1	0	0.5	1	0	0	0.5	0	7	Moderate
Evgeniadis 2008	1	1	1	0.5	0.5	0	0	1	1	0	0	0	6	Moderate
Ferrara 2008	1	1	0	1	0.5	1	0	1	0	0	0	0	5.5	Poor
Sandell 2008	1	1	0.5	0.5	1	1	1	0.5	1	0	0	0	7.5	Moderate
Vukomanovic 2008	1	1	0.5	0.5	0.5	0	0	0.5	0	0	0	0	4	Poor
Williamson 2007	1	1	1	0.5	0.5	1	1	1	0	0	0	0	7	Moderate

Nuñez 2006	1	1	0.5	0.5	0.5	1	0.5	1	0.5	0	0	0.5	7	Moderate
Rooks 2006	1	1	1	1	0.5	1	1	1	0.5	0	0	1	9	Good
Mitchell 2005	1	1	0	0.5	1	1	1	0.5	0	0	0	1	7	Moderate
Beaupre 2004	1	1	0	1	0	1	1	1	0	0	0	1	7	Moderate
Berge 2004	1	1	0	1	1	1	0	1	0	0	0	0	6	Moderate
Gocen 2004	1	1	0	0.5	0.5	0	0	1	0	0	0	0	4	Poor
Crowe 2003	1	1	1	0.5	0.5	1	1	0	1	0	0	0	7	Moderate
Møller 2002	1	1	0	1	0.5	1	0	0.5	0.5	0	0	0.5	6	Moderate
Wang 2002	1	1	1	1	0	0.5	1	1	1	0	0	1	8.5	Moderate
Haslam 2001	1	1	1	1	0.5	1	1	1	0	0	0	0	7.5	Moderate
Tillu 2001	1	1	1	1	0.5	1	0	1	0	0	0	0.5	7	Moderate
D'Lima 1996	1	1	1	1	0.5	1	0	1	0	0	1	0	7.5	Good
Christensen 1992	1	1	0	1	0	0	0	1	0	0	0	0	4	Poor
Proportion of studies reporting item (score=1)	84/84 (100%)	84/84 (100%)	55/84 (65%)	71/84 (85%)	21/84 (25%)	63/84 (75%)	56/84 (67%)	72/84 (86%)	26/84 (31%)	4/74 (5%)	31/84 (37%)	26/74 (35%)	–	–

*Items 10 and 12 not applicable to randomized controlled trial protocols
†Overall scores ≥9=good reporting quality, 6-8=moderate reporting quality, <6=poor reporting quality

Appendix A. PRISMA 2020 Statement

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Pg. 19
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Pg. 20
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pg. 22
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Pg. 22
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Pg. 23
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Pg. 24
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix B
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Pg. 24
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Pg. 24
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Pg. 24
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Pg. 24
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Pg. 26
Effect	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or	N/A

Section and Topic	Item #	Checklist item	Location where item is reported
measures		presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	N/A
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Pg. 25-26
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Pg. 24
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Pg. 26
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Pg. 29
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Appendix D
Study characteristics	17	Cite each included study and present its characteristics.	Pg. 26/Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Pg. 32/Appendix C
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A

Section and Topic	Item #	Checklist item	Location where item is reported
syntheses	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pg. 40
	23b	Discuss any limitations of the evidence included in the review.	Pg. 40
	23c	Discuss any limitations of the review processes used.	Pg. 40
	23d	Discuss implications of the results for practice, policy, and future research.	Pg. 40
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Pg. 23
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Pg. 23
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Pg. 44
Competing interests	26	Declare any competing interests of review authors.	Pg. 44
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Pg. 43

Appendix B. Search Strategy

Database: Ovid MEDLINE(R) ALL <1946 to May 2, 2024>
Search Strategy:

1 arthroplasty, replacement, hip/ or arthroplasty, replacement, knee.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word]
2 total hip arthroplast*.mp.
3 total hip replacement*.mp.
4 total knee replacement*.mp.
5 total knee arthroplast*.mp.
6 1 or 2 or 3 or 4 or 5
7 Preoperative Exercise/
8 prehab*.mp.
9 ((preop* or pre-op* or pre surg* or pre-surg* or presurg* or prior to or before) adj2 (medic* or drug* or exercis* or phys* or rehab* or nutrition* or diet* or multi*)).mp.
10 7 or 8 or 9
11 6 and 10

Database: Embase <1974 to 2024 May 02>
Search Strategy:

1 hip replacement.mp. or exp hip replacement/
2 knee replacement.mp. or exp total knee replacement/ or exp knee arthroplasty/ or exp knee replacement/
3 total hip arthroplast*.mp.
4 total hip replacement*.mp.
5 total knee replacement*.mp.
6 total knee arthroplast*.mp.
7 1 or 2 or 3 or 4 or 5 or 6
8 exp preoperative exercise/
9 prehab*.mp.
10 ((preop* or pre-op* or pre surg* or pre-surg* or presurg* or prior to or before) adj2 (medic* or drug* or exercis* or phys* or rehab* or nutrition* or diet* or multi*)).mp.
11 8 or 9 or 10
12 7 and 11

Database: EBM Reviews - Cochrane Central Register of Controlled Trials <May 2024>
Search Strategy:

1 total hip arthroplast*.mp.
2 total hip replacement*.mp.
3 total knee replacement*.mp.
4 total knee arthroplast*.mp.
5 total joint replacement*.mp.
6 2 or 3 or 4 or 5
7 prehab*.mp.
8 ((preop* or pre-op* or pre surg* or presurg*) adj2 (med* or exercis* or rehab* or nutrition*)).mp. (1672)
9 7 or 8
10 6 and 9

Database: Google Scholar
Search Strategy:
"prehabilitation total hip knee joint arthroplasty replacement"
Screened first 300 results sorted by relevance

Appendix C. Risk of Bias Traffic Plot Figure

Appendix D. Excluded Studies

1. Pre-Operative Exercise Therapy and Patient Education Before Total Knee Replacement. Pre-operative Exercise Therapy and Patient Education Before Total Knee Replacement - Effect on Subjective Knee Function, Patient Satisfaction and Enablement. 2024;

2. Pua YH, Yeo SJ, Clark RA, Tan BY, Haines T, Bettger JP, et al. Cost and outcomes of Hospital-based Usual cAre versus Tele-monitor self-directed Rehabilitation (HUATR) in patients with total knee arthroplasty: A randomized, controlled, non-inferiority trial. Osteoarthritis and cartilage. 2024;32(5):601–11.

3. Gagniere M., Abdoul H., Ollivier C., Rannou F., Nguyen C. INFLUENCE OF ADHERENCE TO PREHABILITATION BEFORE TOTAL KNEE REPLACEMENT FOR KNEE OSTEOARTHRITIS ON POST-OPERATIVE FUNCTIONAL INDEPENDENCE: SECONDARY ANALYSES OF A RANDOMIZED CONTROLLED TRIAL (EDEX). Osteoarthritis and Cartilage. 2024;32(Supplement 1):S558–9.

4. Wang Q, Ma T, Wang L, Zhao C, Kang P. Efficacy of Adding Acetaminophen to Preemptive Multimodal Analgesia in Total Knee Arthroplasty: A Double-blinded Randomized Study. Orthopaedic surgery. 2023;15(9):2283–90.

5. Tonnesen H, Raffing R, Lauridsen SV, Lauritzen JB, Elholm AMH, Jensen HS, et al. Two novel prehabilitation apps to help patients stop smoking and risky drinking prior to hip and knee arthroplasty. International orthopaedics. 2023;47(11):2645–53.

6. Minshull C., Simmons S., Rimmer Y., Malek I., Brownlow M. Effects of strength focussed, multidisciplinary online prehabilitation on pain and function in long waiter (>52 weeks) knee arthroplasty patients; the joint approach programme. Osteoarthritis and Cartilage. 2023;31(5):712.

7. Hashizaki T, Nishimura Y, Ogawa T, Ohno C, Kouda K, Umemoto Y, et al. Effectiveness of a 3-Week Rehabilitation Program Combining Muscle Strengthening and Endurance Exercises Prior to Total Knee Arthroplasty: A Non-Randomized Controlled Trial. Journal of clinical medicine. 2023;12(4).

8. Du D, Li H, Xu Y, Zheng T, Xu X, Wang J, et al. Study on the Effect of Pain Programmed Care Based on the Concept of Prehabilitation on the Recovery of Joint Function and WHOQOL-BREF Score in Elderly Patients after Total Hip Arthroplasty. Alternative therapies in health and medicine. 2023;29(8):618–23.

9. Contillo A., Kostyun R., Grady-Benson J., Rodriguez N. Peri-Operative Protein Intake Assessment in Total Knee and Hip Arthroplasty Patients - A Study Protocol. Current Developments in Nutrition. 2023;7(Supplement 1):101715.

10. Choo NN, Bourke A, Wong BKM. Evaluation of a tailored pathway for frail and pre frail older people awaiting elective hip or knee arthroplasty. Perioperative Care and Operating Room Management. 2023;33:100340.

11. Zheng Y, Huang Z, Dai L, Liu Y, Chen Y, Zhang W, et al. The Effect of Preoperative Rehabilitation Training on the Early Recovery of Joint Function after Artificial Total Knee Arthroplasty and Its Effect Evaluation. Journal of healthcare engineering. 2022;2022(101528166):3860991.

12. Vasileiadis D, Drosos G, Charitoudis G, Dontas IA, Vlamis J. The Efficacy of High-Intensity Preoperative Physiotherapy Training on Postoperative Outcomes in Greek Patients Undergoing Total Knee Arthroplasty: A Quasi-Experimental Study. Cureus. 2022;14(3):e23191.

13. Temporiti F, Ruspi A, De Leo D, Ugolini A, Grappiolo G, Avanzini P, et al. Action Observation and Motor Imagery administered the day before surgery enhance functional recovery in patients after total hip arthroplasty: A randomized controlled trial. Clinical Rehabilitation. 2022;36(12):1613–22.

14. Roxburgh BH. Optimisation of cardiorespiratory fitness prior to total joint arthroplasty. 2022.

15. Ho CJ, Chen YT, Wu HL, Huang HT, Lin SY. The Effects of a Patient-Specific Integrated Education Program on Pain, Perioperative Anxiety, and Functional Recovery following Total Knee Replacement. Journal of personalized medicine. 2022;12(5).

16. He Y, Tang X, Ning N, Chen J, Li P, Kang P. Effects of Preoperative Oral Electrolyte-Carbohydrate Nutrition Supplement on Postoperative Outcomes in Elderly Patients Receiving Total Knee Arthroplasty: A Prospective Randomized Controlled Trial. Orthopaedic surgery. 2022;14(10):2535–44.

17. Drost JM, Cook CB, Spangehl MJ, Probst NE, Mi L, Trentman TL. A Plant-Based Dietary Intervention for Preoperative Glucose Optimization in Diabetic Patients Undergoing Total Joint Arthroplasty. American journal of lifestyle medicine. 2022;16(1):150–4.

18. Cooper D.M., Bhuskute N., Walsh G. Exploring the Impact and Acceptance of Wearable Sensor Technology for Pre- and Postoperative Rehabilitation in Knee

Replacement Patients: A U.K.-Based Pilot Study. JBJS Open Access. 2022;7(2):e21.00154.

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