**Appendix A. Key Questions from full AHRQ Comparative Effectiveness Review**

Note that Key Questions (KQ) 2 and 4 are addressed in the companion articles.

**KQ 1:** What are the effects, comparative effects, and harms of (preoperative) prehabilitation services (and specific components) for patients with osteoarthritis undergoing elective, unilateral total knee replacement surgery on patient-reported outcomes, performance-based outcomes, and healthcare utilization?

**KQ 2:** What are the effects, comparative effects, and harms of (postoperative) rehabilitation services (and specific components) for patients with osteoarthritis undergoing elective, unilateral total knee replacement surgery on patient-reported outcomes, performance-based outcomes, and healthcare utilization?

**KQ 3:** What are the effects, comparative effects, and harms of (preoperative) prehabilitation services (and specific components) for patients with osteoarthritis undergoing elective, unilateral total hip replacement surgery on patient-reported outcomes, performance-based outcomes, and healthcare utilization?

**KQ 4:** What are the effects, comparative effects, and harms of (postoperative) rehabilitation services (and specific components) for patients with osteoarthritis undergoing elective, unilateral total hip replacement surgery on patient-reported outcomes, performance-based outcomes, and healthcare utilization?

**For all KQs:**

**Subquestion a:** Do the effects, comparative effects, and harms vary by patient factors, such as age, sex, race/ethnicity, socioeconomic status, body mass index, and comorbidities?

**Subquestion b:** Do the effects, comparative effects, and harms vary by surgical factors, such as surgical procedure, type of implant, perioperative protocol, type of hospital, and length of hospital stay?

**Subquestion c:** Do the effects, comparative effects, and harms vary by setting of active structured physical activity programs?

**Contextual Question**

Contextual Question: What are the major direct and indirect cost factors for the various aspects of rehabilitation and prehabilitation around major joint replacement surgery, including such factors as personnel, setting overhead, materials, and training?

**Appendix C. Methods**

**Literature Search Strategies**

Note that the full search strategy included searches for research questions about prehabilitation and rehabilitation for total knee arthroplasty and total hip arthroplasty. These can be found in Appendix A of the full report (see article for reference).

All searches restricted to January 2005 to May 3, 2021 (final search date, updated from full report search on April 16, 2020)

**Medline (via PubMed)**

((arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*) OR "Arthroplasty, Replacement, Hip"[Mesh] OR "Arthroplasty, Replacement, Knee"[Mesh] OR (("Arthroplasty"[Mesh] or arthroplasty or replacement) and (knee or hip)))

AND

((pre-hab\* or prehab\*) OR "Arthroplasty, Replacement, Knee/rehabilitation"[Mesh] OR "Arthroplasty, Replacement, Hip/rehabilitation"[Mesh] OR ((presurg\* or preoperativ\* or pre-surg\* or pre-operativ\* or early or home) and (rehab or rehabilitate or rehabilitation or re-hab\* or "Rehabilitation"[Mesh] or "Physical Therapy Modalities"[Mesh] or “physical therapy” or physiotherapy\*)) OR ("Preoperative Care/methods"[Mesh] OR "Preoperative Care/rehabilitation"[Mesh] ) OR ((before or prior to) and (arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*) and (rehab or rehabilitate or rehabilitation or re-hab\* or intervention\* or recovery)) OR ((“Preoperative Care”[MESH] OR “Preoperative Period”[MESH]) and (rehab or rehabilitate or rehabilitation or re-hab\* or "Rehabilitation"[Mesh] or "Physical Therapy Modalities"[Mesh] or “physical therapy” or physiotherapy\*)) OR (“Postoperative Period”[Mesh] and (rehab or rehabilitate or rehabilitation or re-hab\*)) OR ((postsurg\* or post-surg\* or postoperativ\* or post-operativ\*) AND (rehab or rehabilitate or rehabilitation or re-hab\* or "Rehabilitation"[Mesh] or "Physical Therapy Modalities"[Mesh] or “physical therapy” or physiotherapy\*)) OR ((after or post) AND (arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*) AND (rehab or rehabilitate or rehabilitation or re-hab\* or "Rehabilitation"[Mesh] or "Physical Therapy Modalities"[Mesh] or “physical therapy” or physiotherapy\*)))

AND

("Cohort Studies"[Mesh] OR cohort OR "Clinical Trial" [Publication Type] OR (follow-up or followup) OR longitudinal OR "Placebos"[Mesh] OR placebo\* OR "Research Design"[Mesh] OR "Evaluation Study" [Publication Type] OR "Comparative Study" [Publication Type] OR ((comparative or Intervention) AND study) OR pretest\* OR posttest\* OR prepost\* OR “before and after” OR interrupted time\* OR time serie\* OR intervention\* OR ((quasi-experiment\* OR quasiexperiment\* OR quasi or experimental) and (method or study or trial or design\*)) OR “real world” OR “real-world” OR "Case-Control Studies"[Mesh] OR (case and control) OR "Random Allocation"[Mesh] OR "Clinical Trial" [Publication Type] OR "Double-Blind Method"[Mesh] OR "Single-Blind Method"[Mesh] OR random\* OR "Placebos"[Mesh] OR placebo OR ((clinical OR controlled) and trial\*) OR ((singl\* or doubl\* or trebl\* or tripl\*) and (blind\* or mask\*)) OR rct OR crossover OR cross-over OR cross-over OR RCT OR "Randomized Controlled Trial" [Publication Type] OR systematic[sb] OR meta-analysis[pt] OR meta-analysis as topic[mh] OR meta-analysis[mh] OR meta analy\* OR metanaly\* OR metaanaly\* OR met analy\* OR (systematic AND (review\* OR overview\*)) OR "Review Literature as Topic"[Mesh] OR cochrane[tiab] OR embase[tiab] OR (psychlit[tiab] or psyclit[tiab]) OR (psychinfo[tiab] or psycinfo[tiab]) OR (cinahl[tiab] OR cinhal[tiab] OR “cumulative index to nursing and allied health”) OR science citation index[tiab] OR ibids[tiab] OR “international bibliographic information on dietary supplements” OR cancerlit[tiab] OR reference list\*[tiab] OR bibliograph\*[tiab] OR hand-search\*[tiab] OR relevant journals[tiab] OR manual search\*[tiab] OR ((selection OR inclusion OR exclusion) AND criteria[tiab]) OR data extraction[tiab] OR relevant journals OR "Systematic Review" [Publication Type])

NOT

(“address”[pt] or “autobiography”[pt] or “bibliography”[pt] or “biography”[pt] or “case reports”[pt] or “comment”[pt] or “congress”[pt] or “dictionary”[pt] or “directory”[pt] or “festschrift”[pt] or “historical article”[pt] or “interview”[pt] or “lecture”[pt] or “legal case”[pt] or “legislation”[pt] or “news”[pt] or “newspaper article”[pt] or “patient education handout”[pt] or “periodical index”[pt] or "comment on" or ("Animals"[Mesh] NOT "Humans"[Mesh]) OR rats[tw] or rat[tw] or cow[tw] or cows[tw] or chicken\*[tw] or horse[tw] or horses[tw] or mice[tw] or mouse[tw] or bovine[tw] or sheep[tw] or ovine[tw] or murinae[tw] or cats[tw] or cat[tw] or dog[tw] or dogs[tw] or rodent[tw] )

**Embase**

#5 #3 AND #4 AND ([article]/lim OR [article in press]/lim) AND [2005-2020]/py

#4 'pre hab\*' OR prehab\* OR ((presurg\* OR preoperativ\* OR 'pre surg\*' OR 'pre operativ\*' OR early OR home) AND (rehab OR rehabilitate OR rehabilitation OR 're hab\*' OR 'physical therapy' OR physiotherapy\*)) OR ((before OR prior) AND to AND ((((((arthroplast\* OR hip) AND replacement\* OR knee) AND replacement\* OR joint) AND replacement\* OR total) AND hip OR total) AND knee OR total) AND joint\* AND (rehab OR rehabilitate OR rehabilitation OR 're hab\*' OR intervention\* OR recovery)) OR ((postsurg\* OR 'post surg\*' OR postoperativ\* OR 'post operativ\*') AND (rehab OR rehabilitate OR rehabilitation OR 're hab\*' OR 'physical therapy' OR physiotherapy\*)) OR ((after OR post) AND ((((((arthroplast\* OR hip) AND replacement\* OR knee) AND replacement\* OR joint) AND replacement\* OR total) AND hip OR total) AND knee OR total) AND joint\* AND (rehab OR rehabilitate OR rehabilitation OR 're hab\*' OR 'physical therapy' OR physiotherapy\*))

#3 #1 OR #2

#2 (hip OR knee) AND replacement

#1 'arthropathy'/exp OR 'arthropathy' AND (knee OR hip)

**Cochrane**

#1 MeSH descriptor: [Arthroplasty, Replacement, Hip] explode all trees

#2 MeSH descriptor: [Arthroplasty, Replacement, Knee] explode all trees

#3 (arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*)

#4 ((arthroplasty or replacement) and (knee or hip))

#5 #1 OR #2 OR #3 OR #4

#6 (pre-hab\* or prehab\* OR ((presurg\* or preoperativ\* or pre-surg\* or pre-operativ\* or early or home) and (rehab or rehabilitate or rehabilitation or re-hab\* or “physical therapy” or physiotherapy\*)) OR ((before or prior to) and (arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*) and (rehab or rehabilitate or rehabilitation or re-hab\* or intervention\* or recovery)) OR ((postsurg\* or post-surg\* or postoperativ\* or post-operativ\*) AND (rehab or rehabilitate or rehabilitation or re-hab\* or “physical therapy” or physiotherapy\*)) OR ((after or post) AND (arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*) AND (rehab or rehabilitate or rehabilitation or re-hab\* or “physical therapy” or physiotherapy\*)))

#7 #5 AND #6

**CINAHL**

(arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\* or ((arthroplasty or replacement) and (knee or hip)))

AND

(pre-hab\* or prehab\* or ((presurg\* or preoperativ\* or pre-surg\* or pre-operativ\* or early or home) and (rehab or rehabilitate or rehabilitation or re-hab\* or “physical therapy” or physiotherapy\*)) or ((before or prior to) and (arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*) and (rehab or rehabilitate or rehabilitation or re-hab\* or intervention\* or recovery)) or ((postsurg\* or post-surg\* or postoperativ\* or post-operativ\*) and (rehab or rehabilitate or rehabilitation or re-hab\* or “physical therapy” or physiotherapy\*)) OR ((after or post) AND (arthroplast\* or hip replacement\* or knee replacement\* or joint replacement\* or total hip or total knee or total joint\*) AND (rehab or rehabilitate or rehabilitation or re-hab\* or “physical therapy” or physiotherapy\*)))

**Inclusion/Exclusion Criteria**

Population(s)

* Adults (≥18 years old) undergoing (or planning to undergo) total hip or knee replacement surgery
  + for primary osteoarthritis
  + elective (nonemergent) surgery
  + primary surgery (not revision)
  + unilateral TJR
* Exclude: Studies where >10% of patients underwent total knee or hip replacement surgery:
  + for partial joint replacement
  + for causes other than primary osteoarthritis (e.g., cancer, trauma, rheumatoid arthritis)
  + for emergency surgery
  + for revision joint replacement
  + bilateral TJR (simultaneous in both joints)
* N.B. Studies that reported stratified or subgroup analyses of the population of interest were included if they meet the other eligibility criteria (e.g., if they included unilateral and bilateral surgeries but reported data specific to unilateral)
* Did not exclude based on prior surgeries to other joints (including contralateral hip or knee)

**Intervention(s):**

* Active, structured physical activity or activities designed to attain measurable goals of reducing impairments and improving movement-related function as defined by the International Classification of Functioning, Disability and Health (ICF)
  + Any movement-related physical goal including improvements beyond the basal (or baseline) state in: mobility and stability of joint function (including flexibility and range of motion), movement control, power and tone of muscles (including strength), gait, endurance; along with the related goal of reducing pain.
  + Interventions need to be sufficiently described to be replicable by a therapist or other professional. The exception to this was rehabilitation interventions delivered in different settings (inpatient vs. outpatient), which we included even if there was not sufficient detail about their (p)rehabilitation interventions (and noted such in our coding).
  + Single or multiple components. For multicomponent interventions, the goals of the intervention criteria refer to the overall intervention, not necessarily to each individual component. We categorized the content of the rehabilitation interventions according to a categorization scheme based on ongoing research by Oatis and Franklin to develop a taxonomy defining the components of physical therapy after TKR.1 The taxonomy comprehensively lists specific rehabilitation content that are hierarchically linked to larger rehabilitation goals. The larger component goals include:
    - Strengthening exercise
    - Aerobic exercise
    - Flexibility exercise
    - Balance-motor/learning-agility exercise
    - Task specific training
    - Patient education
  + We used the taxonomy to code both the subcategory content and larger category goals (e.g., intervention content of squats would be coded for the subcategory of “squats” hierarchically linked to the goal of “strengthening”).
  + *Exclude:* Continuous passive motion (CPM) was not included as there is strong evidence, summarized in an existing systematic review,2 that that component is ineffective.
  + The intervention had to have been delivered, supervised, and/or monitored by a healthcare professional or other trained individual (e.g., physical therapist, physical therapy assistant, nurse trained in rehabilitation, health educator with training in exercise delivery or rehabilitation, other healthcare professional trained in rehabilitation)
    - Peer-led (or patient-led) interventions were eligible if monitored by a professional or other trained individual
    - The physical therapist (or other trained individual) had to have been involved in patient engagement and assessment of progress, and provided ongoing feedback to the patient throughout the course of intervention
      * This interaction could have been direct (e.g., in-person therapy) or remote (e.g., via app, Web, or telephone)
      * Remote therapy had to have included active monitoring by a physical therapist (or other trained individual), although the (p)rehabilitation therapy could have been guided completely by the app
  + The patient needed to be actively involved or engaged in at least part of the intervention (and not be only a passive recipient of the intervention)
* Interventions evaluating the combined benefit an intervention defined above with an adjunctive modality were also included.   
  Adjunctive modalities are either passively applied to patients and/or do not (on their own) have the direct goals of reducing impairments or improving movement-related function but are used to help other components achieve these goals. Examples of therapies that were considered adjunctive modalities if combined with an intervention meeting criterion above included:
  + Neuromuscular electrical stimulation (NMES)
  + Transcutaneous electrical nerve stimulation (TENS)
  + Manual therapy (e.g., therapeutic massage, passive range of motion)
  + Biofeedback devices
  + Cryotherapy (or other thermal therapies)
  + Dry needling
  + Mindfulness, stress/anxiety-reduction interventions
  + Complementary and alternative therapies (*excluding* ingested, inhaled, or transcutaneous treatments)
  + Modalities had to have been sufficiently described to be replicable by a therapist or other professional
* *Exclude*: Interventions that were not active, structured physical activities delivered by a healthcare professional or other trained individual, including devices not designed to be used primarily during active therapy; for example:
  + Splinting, bracing, taping
  + One-time distribution of information
  + Assistive devices (e.g., crutches vs. canes or walkers)
* *Exclude*: Interventions (as a whole) without specific goals (e.g., unsupervised swimming, walking, cycling, hiking).
* *Exclude*: Interventions (as a whole) without active engagement of the healthcare professional (e.g., only set-up and removal of intervention without monitoring, or healthcare professional engagement only to measure pre- and post-intervention outcome measures).
* *Exclude*: Surgical or hospital process-improvement interventions (e.g., early mobilizations, enhanced recovery after surgery [ERAS], care managers, pre-anesthesia protocols)
* Exclude: Pharmaceutical (or over-the-counter) treatments (although, allowed as part of an overall intervention)

**Comparator(s):**

* No active, structured physical activity, as defined above
  + Allow “usual care” only if the intervention arm includes well-defined components or adjunctive modalities plus the same “usual care”
* Other active structured physical activity (or set of activities)
* Other adjunctive modality
* Different duration (or intensity) of intervention
* Different providers
* Different setting
* *Exclude*: no comparison (or comparison with only pre-intervention state)

**Outcomes:** (\* denotes important/priority outcomes that were included in Strength of Evidence tables)

* Patient-reported outcomes
  + Activities of daily living\*
  + Patient satisfaction with care\*
  + Quality of life (QoL)\*
  + Pain
  + Injury related to arthroplasty (e.g., fall)
  + Time lost from work
  + Measures that combined these outcome domains (e.g., Hip disability/Knee injury and osteoarthritis outcome score [HOOS/KOOS])
* Performance-based outcomes
  + Mobility of joint function (e.g., knee range of motion)\*
  + Power and tone of muscle (e.g., strength)\*
  + Joint stability
  + Endurance
  + Gait
  + Balance
  + Measures that combined these domains (e.g., timed-up-and-go [TUG], stair climb test)
* Healthcare utilization
  + Hospital- or surgical clinic-based procedures postoperatively (e.g., need for manipulation under anesthesia)\*
  + Hospital readmission
  + Postoperative care (excluding physical therapy services)
* Harms
  + Injury related to therapy intervention\*
  + Other harms related to therapy intervention

**Modifiers/Subgroups of interest:**

* Patient factors:
  + Demographics (age, sex, race/ethnicity, education, region)
  + Body mass index
  + Comorbidities, including mental health and other joint comorbidities
  + Socioeconomic status, insurance status
  + Prior arthroplasty of contralateral joint
  + Preoperative symptoms/status
    - Severity of preoperative symptoms, including pain, impaired function, restricted movement, and physical activity
    - Frailty (and related assessments of preoperative function)
  + Narcotic use
  + Caregiver support (outside of (p)rehabilitation)
* Surgical factors:
  + Surgical procedure
  + Perioperative protocols (e.g., enhanced recovery after surgery)
  + Type of implant
  + Setting of surgery
    - Type of hospital (e.g., community, referral/teaching, or urban/suburban/rural)
* Setting factors:
  + Setting of intervention (e.g., inpatient, outpatient center, rehabilitation center, home)
  + Was considered as a modifier only regarding the same intervention provided in different settings

**Timing:**

* Study publication date >2005
* ≥50% of surgeries occurred after 2005
* Outcomes
  + Patient-reported and performance-based outcomes[[1]](#footnote-1)
    - ≥3 months postoperative for KQ 1 and 2 (TKA)
    - ≥6 months postoperative for KQ 3 and 4 (THA)
  + Healthcare utilization outcomes
    - Perioperative for KQ 1 and 3 (prehabilitation)
    - ≤3 months
    - For prehabilitation, starting at the initiation of intervention
  + Harms: duration of (p)rehabilitation intervention

**Setting:**

* Any setting, including:
  + Acute inpatient (postoperative)
  + Other inpatient facility (e.g., skilled nursing facility)
  + Physical therapy/rehabilitation facility (outpatient)
  + Home
  + Gym or other community center
  + Other

**Design:**

* RCTs, N>20 per group
* NRCS, N>20 per group, with or without adjustment for confounders
  + Prospective or retrospective (as long as there was a clear, specific intervention)
  + Parallel or series comparisons (i.e., “pre-post” studies that evaluate different cohorts of patients receiving vs. not receiving an intervention before and after a change in available (p)rehabilitation services)
* Cost-effectiveness (and related) analyses (for relevant QoL data, as available)
* *Exclude*: noncomparative (single group) studies (i.e., where all received the same intervention and there is no comparison intervention)
* *Exclude*: crossover studies (where the same individual receives more than one intervention in series)
* *Exclude*: case reports or series; case-control studies

Additional Criteria for KQs 1 and 3 (Prehabilitation)

**Population:**

* Patients in whom the decision has been made to have a joint replacement surgery
* *Exclude*: Patients who are trying to avoid or delay surgery

**Interventions:**

* Delivered within 3 months prior to surgery
* *Exclude*: Preoperative interventions designed to reduce symptoms or prevent or delay surgery; i.e., interventions not designed to be prehabilitation for planned surgery

**Outcomes (in addition to those listed above for all KQs):**

* Healthcare utilization
  + Length of stay (postoperative)\*
  + Posthospital disposition (e.g., to home, outpatient, skilled nursing facility, “subacute” rehabilitation, “acute” inpatient rehabilitation)\*
  + Length of (postoperative) rehabilitation needed
* Harms
  + Perioperative surgical complications

Additional Criteria for KQs 2 and 4 (Postoperative rehabilitation)

**Interventions:**

* Delivered within 6 months following surgery

**Potential Modifiers:**

* Length of hospital stay

**Coding the Rehabilitation Interventions**

**Guiding Principles and Assumptions**

* We assumed that some studies may describe interventions vaguely, that is, by the goal of the intervention (e.g., strengthening exercises) rather than the specific content components being delivered to achieve that goal (e.g., squats to promote muscle strength).
* We understood that some specific components of (p)rehabilitation interventions may target multiple (p)rehabilitation goals (e.g., step downs may have the goal of improving strength and balance).
* We assumed that the effects of interventions as defined by their i) goals and ii) specific content components are of interest to decision-makers to understand impact of (p)rehabilitation interventions from different categorization perspectives and given the limitations of varying reporting detail.
* We assumed that identifying the gaps in describing (p)rehabilitation interventions according to both their i) goals and ii) specific content components is of interest to decision-makers to identify areas for improving the design and reporting of primary studies
* We assumed that refining linkage of i) goals and ii) specific content components is of interest to decision-makers to improve intervention design and professional practice (e.g., understand what specific components are most/least frequently used to achieve certain goals and lead to most/least change in outcomes).

**Coding Process and Taxonomy**

We used Oatis/Franklin’s hierarchical taxonomy1 to code both the intervention goal and specific content components, as feasible. The adapted taxonomy included 147 specific components.

We coded interventions:

* Per large categories largely defined by the goal/aim of the intervention (n=6 components)
  + Strengthening
  + Aerobic
  + Flexibility
  + Balance-motor/Learning-agility
  + Task specific training
  + Patient education (see note below)
    - Note that while we coded patient education, the intervention (as a whole) had to meet the criteria of an active, structured rehabilitation program. Thus, patient education alone would not be eligible.
* Per smaller sub-categories nested within the large categories (that are not all distinct and may target multiple goals/aims) (n=129 specific content components)
  + Strengthening (n=63 components)
  + Aerobic (n=9 components)
  + Flexibility (n=17 components)
  + Balance-motor/Learning-agility (n=17 components)
  + Task specific training (n=17 components)
  + Patient education (n=6 components)
* Each study was independently coded by two investigators, one with expertise in rehabilitation interventions (LMT, DP) and the other with expertise in multicomponent interventions (KJK)
* Each investigator reviewed the content of the intervention and:
  + Sought to match the content to a **specific content** component*(i.e., subcategories)*. Where a match could be made, the investigator inserted a code ‘1’ to indicate its presence in cell (otherwise ‘0’ to indicate absence).
  + Subsequently sought to match the **specific content** component to the higher category intervention **goal**. Determination of the goal of the **specific content** component was based on the hierarchical taxonomy and interpretation of how the component was used (e.g., description of the parameters used to implement it) and other contextualizing details of the text.
    - The latter was especially important for specific content components capable of addressing multiple goals (e.g., ‘step down’ can address “strengthening” and “balance-motor learning-agility”).
  + Inserted article text used to justify any specific content component or goal codes in the cell for the larger goal category and indicated what specific content component the text was meant to justify.
    - Descriptive content was used to justify coding where discrepancies arose and provided qualitative text for further consideration of the taxonomy.
* One investigator compared codes, raised disagreements, prepared for consensus meeting (KJK).
* Both investigators (KJK and LMT or KJK and DP) met to discuss and come to consensus, revising coding rules as necessary.
* Where conflicts remained, a third reviewer (LMT or DP depending on who was the primary coder) was engaged in group discussion until consensus was achieved.

**Additional General Principles**

The following principles were used to guide intervention coding:

1. The intervention of at least one arm of each included study needed to be sufficiently described to be replicable by a therapist or other professional.
   1. Studies defining interventions as “rehabilitation” without further detail were excluded.
   2. Studies defining interventions based on rehabilitation goals only (e.g., “strengthening exercises”) were included and coded according to the goal, but not regarding the specific content component for which there was no information
2. We coded the rehabilitation i) goals and ii) specific content components of all study arms, regardless of arm label (e.g., control, “treatment as usual”) if rehabilitation content and goals met the descriptions above.

**Adjunctive Modalities and Intervention Modifiers**

In addition to coding primary intervention components (by goals and specific content components, above), we coded the presence of the following 18 **adjunctive modalities**:

* Modalities
  + Cold
  + Heat
  + Compression for edema
  + E-stim for pain (TENS)
  + E-stim for strength (NMES)
  + Other modalities for pain
  + Ultrasound
* Manual therapy (e.g., therapeutic massage, passive range of motion)
  + Contract-relax for knee flexion/extension ROM
  + Hold-relax for knee flexion/extension ROM
  + Massage for edema control
  + Massage for scar mobility
  + Massage/myofascial techniques for soft tissue
  + Mobilizations – Tibiofemeral
  + Mobilizations - Patellar
* Biofeedback devices
* Dry needling
* Mindfulness, stress/anxiety-reduction interventions
* Complementary and alternative therapies (*excluding* ingested or inhaled treatments)

**Intervention modifiers**:

* *Progression.* Study states that progression was a part of the intervention (Code 1=yes; 0=no).
* *Appropriate progression*. Progression deemed appropriate based on parameters defined (Code 1=present; 0=absent).
* *Personnel.* The intervention must be delivered, supervised, and/or monitored by a healthcare professional or other trained individual. Peer-led (or patient-led) interventions are eligible if monitored by a professional or other trained individual. The physical/healthcare professional (or other trained individual) must be involved in patient engagement and assessment of progress, and must provide ongoing feedback to the patient throughout the course of intervention
* *Mode of delivery.* The interaction with the healthcare professional or other trained individual may be direct (e.g., in-person therapy) or remote (e.g., via app, Web, or telephone). Remote therapy must include active monitoring by a physical therapist (or other trained individual), although the (p)rehabilitation therapy may be guided completely by the app.
* *Setting of intervention.* Physical location in which the intervention was delivered (may overlap slightly with mode of delivery). Select all that apply
  + Acute inpatient (postoperative)
  + Other inpatient facility (e.g., skilled nursing facility)
  + Physical therapy/rehabilitation facility (outpatient)
  + Home
  + Gym or other community center
  + Other (specify)
  + Not reported

**Specific Coding Elements**

* MJR\_id (number=unique ID for study as created by MJR review)
* source (text= file pdf name used and additional sources other than primary paper).
* Exclude (category=yes/no/maybe). If no or maybe, give reason in note
* Exclude\_note (text =specific text describing why intervention is/is not well specified)

Labels:

* arm\_name (text=specific label for arm as written in article; each study arm extracted into a unique row)
* Ix\_well\_specified (binary 0=no; 1=yes; is the intervention as a whole well specified?)
  + Code YES if: Intervention is sufficiently described to be replicable by a therapist or other professional in practice
  + Code NO if: Intervention is generally not well specified
* Ix\_well\_specified\_note (text =specific text describing why intervention is/is not well specified)

**Intervention i) Goal and ii) Specific Content**

**For each arm evaluated in the study, determine:**

**1. Strengthening** (binary 0=no; 1=yes)

Code YES (to strengthening goal) if intervention describes

* + Strengthening exercise generally
  + One or more of the specific content components below and coder interprets that component supports the strengthening goal (also code YES to the specific content binary 0=no; 1=yes)

- If position unclear code 1 (position unclear) for all relevant codes

1.1 Bridges One-legged (supine hip extension)

1.2 BridgesTwo-legged (supine hip extension)

1.3 Calf press (one-leg)

1.4 Calf press (two-legs)

1.5 Clamshells

1.6 Core strengthening

1.7 Deadlifts

1.8 Gluteal Sets

1.9 Heel raises – bilateral

1.10 Heel raises – unilateral

1.11 Hip abduction in sidelying

1.12 Hip abduction in standing

1.13 Hip abduction in supine

1.14 Hip adduction in sidelying

1.15 Hip adduction in standing

1.16 Hip adduction in supine

1.17 Hip extension in sidelying

1.18 Hip extension in prone

1.19 Hip extension in standing

1.20 Hip flexion in sidelying

1.21 Hip flexion in sitting

1.22 Hip flexion in standing

1.23 Hip flexion in supine

1.24 Hip hikes in standing

1.25 Hip hikes in supine

1.26 Hip rotation external (lateral)

1.27 Hip rotation internal (medial)

1.28 Knee extension machine (one-leg)

1.29 Knee extension machine (two-legs)

1.30 Knee extension AAROM in sitting or supine (short- or long arc quad)

1.31 Knee extension in sitting or supine (long arc quad)

1.32 Knee extension in sitting or supine (short arc quad)

1.33 Knee flexion machine (Hamstring curl) one knee

1.34 Knee flexion machine (Hamstring curl) two knees

1.35 Knee flexion in prone

1.36 Knee flexion in sitting or supine

1.37 Knee flexion in standing

1.38 Leg Press (one leg)

1.39 Leg Press (two legs)

1.40 Leg Press (side lying)

1.41 Lunges

1.42 Lunges to side (lateral lunge)

1.43 Quad sets

1.44 Quadruped arm lift

1.45 Quadruped leg lift

1.46 Quadruped arm and leg lift

1.47 Single Leg Stance (SLS)

1.48 Sit-to-stand

1.49 Squats

1.50 Squats (one leg)

1.51 Standing TKE (terminal knee extension)

1.52 Step down

1.53 Step down laterally

1.54 Step lateral

1.55 Step up – forward

1.56 Step up – lateral

1.57 Stool scoots

1.58 Straight leg raise (SLR)

1.59 Toe raises

1.60 Upper extremity strengthening

1.61 Wall slides

1.62 Wall slides - Lateral (hip AB and ADductors)

1.63 Open chain ankle dorsiflexion/plantar flexion/inversion/eversion (added from original taxonomy)

Code NO if:

* + No mention of strengthening exercise goal generally
  + No mention of specific content components interpreted as seeking to improve the strengthening goal

Strengthening note (text=text to support goal and specific content codes)

**2. Aerobic** (binary 0=no; 1=yes)

Code YES (to aerobic endurance goal) if intervention describes

* + Aerobic exercise generally
  + One or more of the specific content components below and coder interprets that component supports the aerobic endurance goal (also code YES to the specific content binary 0=no; 1=yes

2.1 Aquatics (water aerobics, water walking)

2.2 Bike (Endurance)

2.3 Elliptical machine

2.4 Jogging in place or overland

2.5 Rowing machine

2.6 Step-ups

2.7 Stepper (upright or sitting)

2.8 Treadmill walking

2.9 Walking

Code NO if:

- No mention of aerobic exercise goal generally

- No mention of specific content components interpreted as seeking to improve the aerobic endurance goal

Aerobic note (text =text to support goal and specific content codes)

**3. Flexibility** (binary 0=no; 1=yes)

Code YES (to flexibility goal) if intervention describes

- Flexibility exercise generally

- One or more of the specific content components below and coder interprets that component supports the flexibility goal (also code YES to the specific content binary 0=no; 1=yes)

- If position unclear code 1 (position unclear) for all relevant codes

3.1 Ankle pumps

3.2 Bike (ROM)

3.3 Calf stretch with knee bent

3.4 Calf stretch with knee straight

3.5 Hamstring stretch in any position

3.6 Heel slides

3.7 Hip extensor stretch (knee to chest)

3.8 Hip flexor stretch

3.9 Iliotibial band (ITB) stretch in any position

3.10 Knee extension AROM

3.11 Knee extension PROM in supine

3.12 Knee extension PROM in prone

3.13 Knee flexion AROM

3.14 Knee flexion PROM in sitting or supine

3.15 Knee flexion AROM in any position (rectus femoris stretch)

3.16 Knee flexion PROM in prone (rectus femoris stretch)

3.17 Standing terminal knee extension

Code NO if:

- No mention of flexibility exercise goal generally

- No mention of specific content components interpreted as seeking to improve the flexibility goal

Flexibility note (text =text to support goal and specific content codes)

**4. Balance-Motor Learning-Agility (BMLA)** (binary 0=no; 1=yes)

Code YES (to a BMLA goal) if intervention describes

- BMLA exercise generally

- One or more of the specific content components below and coder interprets that component supports the BMLA goal (also code YES to the specific content binary 0=no; 1=yes)

4.1 Balance in kneeling

4.2 Balance in quadruped

4.3 Balance on unstable surface

4.4 Balance with perturbations

4.5 Ladder drills

4.6 Marching

4.7 Quadruped

4.8 Single leg stance

4.9 Standing weight shifts

4.10 Stepping multiple directions (grapevine)

4.11 Step down

4.12 Step down laterally

4.13 Step lateral (side step)

4.14 Step up – forward

4.15 Step up – lateral

4.16 Tandem standing

4.17 Tandem walking

Code NO if:

- No mention of BMLA goal generally

- No mention of specific content components interpreted as seeking to improve the a BMLA goal

Balance-Motor Learning-Agility note (text =text to support goal and specific content codes)

**5. Task specific training** (binary 0=no; 1=yes)

Code YES (to task specific training goal) if intervention describes

- Task specific training generally

- One or more of the specific content components below and coder interprets that component supports the task specific training goal (also code YES to the specific content binary 0=no; 1=yes)

5.1 Car transfers

5.2 Deadlifts

5.3 Floor-to-sit or Floor-to-stand

5.4 Gait backwards

5.5 Gait downhill

5.6 Gait on uneven surfaces

5.7 Gait sideways

5.8 Gait training

5.9 Gait uphill

5.10 Gait with perturbations

5.11 Gait with resistance

5.12 Obstacle training

5.13 Sit-to-stand training

5.14 Sports specific training

5.15 Stair training

5.16 Treadmill gait

5.17 Treadmill gait (retro)

Code NO if:

- No mention of task specific training goal generally

- No mention of specific content components interpreted as seeking to improve the task specific training goal

Task specific training note (text =text to support goal and specific content codes)

**6. Patient education** (binary 0=no; 1=yes)

Code YES (to patient education goal) if intervention describes

- Patient education generally

- One or more of the specific content components below and coder interprets that component supports the patient education goal (also code YES to the specific content binary 0=no; 1=yes)

6.1 ADLs

6.2 Home exercise program (HEP)

6.3 Life-style change

6.4 Pain management

6.5 Self-management

6.6 Wound care management

Code NO if:

- No mention of patient education goal generally

- No mention of specific content components interpreted as seeking to improve the flexibility goal

Patient education note (text=text to support goal and specific content codes)

**7. Adjunctive modalities** (Binary 0=no; 1=yes)

Code YES (to each adjunctive modality as relevant) if intervention describes the presence of any of the following adjunctive modalities

- Modalities

7.1 Cold

7.2 Heat

7.3 Compression for edema

7.4 E-stim for pain (TENS)

7.5 E-stim for strength (NMES)

7.6 Other modalities for pain

7.7 Ultrasound

7.8 Manual therapy (e.g., therapeutic massage, passive range of motion)

7.9 Contract-relax for knee flexion/extension ROM

7.10 Hold-relax for knee flexion/extension ROM

7.11 Massage for edema control

7.12 Massage for scar mobility

7.13 Massage/myofascial techniques for soft tissue

7.14 Mobilizations – Tibiofemeral

7.15 Mobilizations – Patellar

7.16 Biofeedback devices

7.17 Dry needling

7.18 Mindfulness, stress/anxiety-reduction interventions

7.10 Complementary and alternative therapies (excluding ingested or inhaled treatments)

Code NO if:

- No mention of using adjunctive modality(ies)

**For each arm evaluated in the study, determine:**

**Effect modifiers**

**Progression** (binary 0=no; 1=yes)

Code YES if:

* Study states that progression was a part of the intervention (Code 1=yes; 0=no). May be progression by time and/or patient response.

Code NO if:

* The intervention does not mentioned progression of the intervention.

**Progression\_appropriate** (binary 0=no; 1=yes)

Code YES if:

* The progression program is deemed appropriate based on parameters defined.

Code NO if:

* The progression program is not deemed appropriate based on parameters defined.

Code Unclear if:

* Not enough information to determine Yes or No.

**Progression\_ note** (text=specific description of the details of progression)

**Personnel** (categories)

Indicate personnel who delivered the intervention from the following.

Select all that apply.

* Physical therapist
* Nurse
* Educator
* Peer
* Athletic trainer
* Exercise physiologist
* None (unsupervised)
* Other

**Personnel\_note** (text=specific description of the details of the personnel delivering the intervention)

**Mode\_of\_delivery** (categories)

Indicate mode of how the intervention was delivered.

Select all that apply.

* In-person therapy
* Remote via app
* Remote via web
* Remote via telephone
* Self-guided (unsupervised)

**Mode\_of\_delivery\_note** (text=specific description of the details of how the intervention was delivered)

**Setting** (categories)

Select a prespecified category of where the intervention was delivered.

Select all that apply.

* Acute inpatient (postoperative)
* Other inpatient facility (e.g., skilled nursing facility)
* Physical therapy/rehabilitation facility (outpatient)
* Home
* Gym or other community center
* Other (specify)
* Not reported

**Setting\_note** (text=specific description of where the intervention was delivered)

**Additional intervention comments**

Use to note content of interventions that you think may be relevant/we may want to be aware of but are not of sufficient information, or cross the threshold to warrant coding (e.g., provided supplemental information, esp. in control group, but not really sufficient to count as patient education)

**Concerns/queries**

Use to note other potential methodological concerns separate from the intervention

**Grading the Strength of the Body of Evidence**

We graded the SoE for key outcomes as per the Agency for Healthcare Research and Quality (AHRQ) Methods Guide.3, 4 For each SoE assessment, we considered the number of studies, the study limitations (i.e., risk of bias and overall methodological quality), the directness of the evidence to the KQs, the consistency of study results, the precision of any estimates of effect, the likelihood of reporting bias, other limitations, and the overall findings across studies.

We interpreted **directness** based on the proximity of the outcome to the clinical outcome of interest (i.e., intermediate) and whether the outcome was assessed among the individuals of interest vs. proxy. For example, a patient-reported outcome of function or a performance-based outcome of strength would both be considered direct.

We interpreted **precision** based on the confidence intervals of the individual studies. This is considered appropriate in the GRADE methods “if a meta-analysis is infeasible or inappropriate, reviewers may consider the narrowness of the range of CIs or the significant level of p-values in the individual studies in the evidence base”.4

Based on these assessments, we assigned a SoE rating as being either high, moderate, low, or insufficient to estimate an effect.4 Outcomes with highly imprecise estimates, highly inconsistent findings across studies, or with data from only one study, were deemed to have “insufficient evidence” to allow a conclusion. This overall approach is consistent with the definition of Very Low-quality evidence per GRADE defined as “any estimate of effect is very uncertain”.5

**References for Appendix C**

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3. Berkman ND, Lohr KN, Ansari M, et al. AHRQ Methods for Effective Health Care

Grading the Strength of a Body of Evidence When Assessing Health Care Interventions for the Effective Health Care Program of the Agency for Healthcare Research and Quality: An Update. Methods Guide for Effectiveness and Comparative Effectiveness Reviews. Rockville (MD): Agency for Healthcare Research and Quality (US); 2008.

4. Berkman ND, Lohr KN, Ansari MT, et al. Grading the strength of a body of evidence when assessing health care interventions: an EPC update. J Clin Epidemiol. 2015 Nov;68(11):1312-24. doi: 10.1016/j.jclinepi.2014.11.023. PMID: 25721570.

5. Atkins D, Best D, Briss PA, et al. Grading quality of evidence and strength of recommendations. Bmj. 2004 Jun 19;328(7454):1490. doi: 10.1136/bmj.328.7454.1490. PMID: 15205295.

**Appendix D. Literature Flow Diagram**



Abbreviations: CPG = clinical practice guideline, D = (study) design, I = (study) intervention, KQ = Key Question, MJR = major joint replacement, NRCS = nonrandomized comparative study, O = (study) outcomes, P = (study) population, SEAD = supplemental evidence and data (request), SR = systematic review, T = (outcome) timing, THA = total hip arthroplasty, TKA = total knee arthroplasty.

\* 1 study included for both KQs 1 and 2, 1 study included for both KQs 1 and 3, 2 studies included for both KQs 2 and 4.

**Appendix E. Design details and arm characteristics for prehabilitation for total knee arthroplasty**

| **StudyA, Year,**  **PMID,**  **Country** | **Funding Source** | **Risk of Bias** | **Eligibility Criteria** | **InterventionB** | **N, Enrolled** | **Mean Age, Years (SD)** | **Female, %** | **Mean BMIC (SD)** | **Prior Contralateral Arthroplasty** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017, 26768606, Spain | Non-industry | Moderate | INCLUSION: >60 yo, diagnosed with advanced idiopathic knee OA and scheduled for unilateral TKA. EXCLUSION: Pain in the contralateral limb (defined as maximum pain of 4 of 10 during daily activities), hip or knee joint replacement in the previous year, any medical condition in which exercise was contraindicated, presence of any disease that affected functional performance. | High intensity preoperative training  Comp: S-F-B  AdjMod: -  Set: O | 25 | 66.8 (4.8) | 72% | 32.3 (4.2) | NR |
| No data | No data | No data | Control  Comp: NR  AdjMod: NR  Set: NR | 25 | 66.7 (3.1) | 76% | 31.2 (3.8) | NR |
| Huang, 2012, 22480863, Taiwan | NR | High | INCLUSION: Scheduled to undergo unilateral, primary TKA for advanced OA, the ability to follow rehabilitation program and an interval of 4 weeks between enrolment and surgery. EXCLUSION: Inflammatory arthritis (e.g., RA or psoriatic arthritis), any medical condition in which a moderate level of exercise was contraindicated (e.g., heart failure or hypertension). | Preoperative rehabilitation education program  Comp: S-F-E  AdjMod: -  Set: O, H | 126 | 69.8 (7.2) | 70% | 27.1 (4.0) | NR |
| No data | No data | No data | Conventional care  Comp: -  AdjMod: -  Set: - | 117 | 70.5 (7.4) | 74% | 27.2 (4.5) | NR |
| Huber, 2015, 25925404, Switzerland | Non-industry | High | INCLUSION: 55-90 yo, living at home, on waitlist for primary TKR, sufficient time prior to surgery to take (minimum 8 sessions of the training program. EXCLUSION: Revision surgery, history of inflammatory arthritis, cognitive impairments, absence before or after surgery, inability to walk at least 3 meters with or without a walking aid. | Neuromuscular training program (NEMEX-TJR) & knee school  Comp: S-A-F-B-T-E  AdjMod: -  Set: O | 22 | 68.8 (8.0) | 50% | 30.8 (4.9) | NR |
| No data | No data | No data | Knee school  Comp: E  AdjMod: -  Set: O | 23 | 71.9 (8.1) | 44% | 29.9 (5.5) | NR |
| Matassi, 2014, 23271039, Belgium | NR | Moderate | INCLUSION: 18-90 yo, non-inflammatory OA, scheduled primary unilateral TKA, moderate to severe pain in the affected knee. EXCLUSION: BMI > 35, physical activity needs less than moderate, previous hip or knee replacement surgery in the last 6 months, failed total or unicondylar knee replacement of the affected knee or high tibial osteotomy of the affected knee, active local infection or systemic infection, physical, emotional or neurological conditions that would compromise the patients compliance with the preoperative home exercise regime, postoperative rehabilitation and follow-up, grade three collateral ligament insufficiency, knee flexion less than 80, fixed flexion deformity greater then 20, varus or valgus align- ment greater than 10 unless correctable to under 10, immunosuppressive disorder, immunosuppressive therapy or auto-immune diseases including inflammatory arthritis, intra-articular steroid infiltration in the affected knee within 6 weeks of the baseline assessment, recent fracture (3 months) of upper or lower extremity, inability to understand the study (dementia, language problem), physiotherapy for the affected knee during the preceding 6 months. | Preoperative home exercise program  Comp: S-F-E  AdjMod: -  Set: H | 61 | 66 (7.2) | 54% | 29 (4.3) | NR |
| No data | No data | No data | Control  Comp: -  AdjMod: -  Set: - | 61 | 67 (7.7) | 43% | 28 (3.7) | NR |
| Mat Eil Ismail, 2016, 26996450, Malaysia | NR | High | INCLUSION: > 45 yr, lived within a convenient distance of the physiotherapy facility, had been diagnosed with unilateral or bilateral primary knee OA; and underwent unilateral TKA at HUSM. EXCLUSION: Systemic inflammatory arthritis; degenerative joint diseases involving the hip or ankle joint or spine; medical comorbidities with an inability to tolerate a moderate level of physical exertion; premorbid knee joint stiffness; history of cardiovascular accident; and cognitive, psychological or language impairment. | Prehabilitation  Comp: S-F  AdjMod: Heat  Set: NR | 24 | 62.4 (NR) | 92% | NR | NR |
| No data | No data | No data | No prehabilitation  Comp: -  AdjMod: -  Set: - | 26 | 64.3 (NR) | 81% | NR | NR |
| Mitchell, 2005, 15869558, UK | Non-industry | High | INCLUSION: primary unilateral TKA for OA. EXCLUSION: revision TKA, bilateral and unicondylar knee replacements, TKA for trauma, onset of serious comorbidity or terminal illness since patient placed on the waiting list, contralateral knee replacement within the preceding 12 months. | Home pre-operative and post-operative rehabilitation  Comp: F-T-E  AdjMod: Massage  Set: H | 57 | 70.0 (7.2) | 63% | NR | 16% |
| No data | No data | No data | Hospital outpatient post-operative rehabilitation  Comp: F-T  AdjMod: TENS, NMES  Set: O | 58 | 70.6 (8.2) | 53% | NR | 26% |
| Skoffer, 2016, 26713665, Denmark | Non-industry | Moderate | INCLUSION: >18 yo, scheduled for primary unilateral TKA, were radiographically and clinically diagnosed with OA, residents in the Aarhus municipality, able to transport themselves to training. EXCLUSION: Heart disease or uncontrolled hypertension, neuromuscular or neurodegenerative conditions, unable to comprehend the protocol instructions | Preoperative progressive resistance training  Comp: S-F  AdjMod: -  Set: O | 30 | 70.7 (7.3) | 63% | 30.0; Range (22.6, 42.5) | 10% |
| No data | No data | No data | Standard care preoperatively  Comp: -  AdjMod: -  Set: - | 29 | 70.1 (6.4) | 59% | 31.8; Range (24.3, 42.2) | 14% |
| Soeters, 2018, 29529614, USA | NR | Moderate | INCLUSION: 18-85 yo, scheduled for unilateral THA or TKA, able to independently ambulate a half a block or more with or without an assistive device, able to independently perform nonreciprocal stairs with or without assistive devices, and planned to be discharged home after surgery. EXCLUSION: Patients who did not undergo scheduled surgery, underwent a procedure other than primary TJA, or were discharged to inpatient rehabilitation centers | Preoperative physical therapy education (PreopPTEd)  Comp: T-E  AdjMod: -  Set: NR | 32 | 61 (9); Range (37-98)D | 44% | 29 (6); Range (19-46) | NR |
| No data | No data | No data | No preoperative physical therapy education  Comp: -  AdjMod: -  Set: - | 31 | 62 (8); Range (45-85) | 29% | 29 (6); Range (17-48) | NR |
| Soni, 2012, 22914302, UK | Non-industry | Moderate | INCLUSION: Listed for knee arthroplasty due to OA who had unilateral or bilateral knee pain lasting more than 3 months. EXCLUSION: Anticoagulants or diagnosed as having a bleeding diathesis, needle-phobic, allergic to metal, experiencing any skin disease around the knee, within 3 months of receiving an intra-articular steroid injection, experiencing back or hip pain, diagnosed as having RA, within 12 months of receiving acupuncture or physiotherapy | Acupuncture & exercise  Comp: S-F-B-T  AdjMod: Acupuncture  Set: O | 28 | 66.9 (9.8) | 54% | 31.4 (4.2) | NR |
| No data | No data | No data | Exercise & advice leaflet  Comp: -  AdjMod: -  Set: - | 28 | 70.0 (7.9) | 46% | 31.1 (4.9) | NR |
| Topp, 2009, 19695525, USA | Non-industry & Industry | High | INCLUSION: > 50 yo, scheduled for a unilateral TKA, and did not meet standard exclusion criteria for engaging in moderate intensity exercise. EXCLUSION: NR | Prehabilitation exercises  Comp: S-F-T  AdjMod: -  Set: O, H | 26 | 64.1 (7.1) | 27% | 32.2 (5.9) | NR |
| No data | No data | No data | Usual care  Comp: -  AdjMod: -  Set: - | 28 | 63.5 (6.7) | 36% | 32.0 (6.1) | NR |
| Valtonen, 2015, CN-01126383, Finland | NR | High | INCLUSION: Scheduled for unilateral TKA EXCLUSION: NR | Aquatic training  Comp: S  AdjMod: -  Set: Aquatic center | 31 | NR | NR | NR | NR |
| No data | No data | No data | Control  Comp: -  AdjMod:-  Set: - | 24 | NR | NR | NR | NR |
| Villadsen, 2014, 23661494, Denmark | Non-industry and Industry | Moderate | INCLUSION: >18 years, scheduled for primary unilateral THA or TKA due to severe symptomatic OA. EXCLUSION: current or previous fractures in or adjacent to the joint, inflammatory arthritis and comorbidity (e.g., severe heart disease and neurological deficits) contraindicating exercise and testing, scheduled for bilateral TJA | Neuromuscular exercise (NEMEX-TJR) & standard education package  Comp: S-A-F-B-T  AdjMod: -  Set: O | 41 | 67.1 (8.8) | 61% | 30.8 (4.9) | NR |
| No data | No data | No data | Standard education package  Comp: -  AdjMod: -  Set: - | 40 | 65.1 (9.0) | 60% | 33.4 (5.8) | NR |
| Williamson, 2007, 17604311, UK | Non-industry | Moderate | INCLUSION: knee arthroplasty due to OA; with unilateral or bilateral knee pain lasting > 3 months. EXCLUSION: taking anticoagulants; within 2 months after receiving an intra-articular steroid injection; experiencing back pain associated with referred leg pain; suffering from ipsilateral OA of the hip; suffering psoriasis or other skin disease in the region of the knee; suffering from RA; received acupuncture or physiotherapy treatment in the previous year. | Acupuncture  Comp: -  AdjMod: Acupuncture  Set: O | 60 | 72.4 (7.7) | 55% | 30.9 (6.0) | NR |
| No data | No data | No data | Physiotherapy (supervised exercise)  Comp: S-F-B-T  AdjMod:-  Set: O | 60 | 70.0 (8.8) | 52% | 32.8 (5.7) | NR |
| No data | No data | No data | Control  Comp: -  AdjMod: -  Set: - | 61 | 69.6 (10) | 54% | 32.7 (6.4) | NR |

Abbreviations: BMI = H = home, NA = not applicable, NMES = neuromuscular electrical stimulation, NR=not reported, O = outpatient physiotherapy center, OA = osteoarthritis, PMID = PubMed identifier, RA = rheumatoid arthritis, SD = standard deviation, SD = standard deviation, TENS = transcutaneous electrical nerve stimulation, THA = total hip arthroplasty, TJA = total joint arthroplasty, TKA = total knee arthroplasty, yo = years old

A All randomized controlled trials, except as footnoted. There were no non-randomized comparative studies in Key Question 1.

B Including Components (Comp); Adjunctive modalities (AdjMod); and Setting (Set).

Components: A = aerobic exercise, B= Balance-motor/Learning-agility exercise, E = patient education, F = flexibility exercise, S = strengthening exercise, T = task-specific training.

C kg/m2

D Reported age, gender, BMI data for total joint replacement population (TKA and THA) combined

**Appendix F. Prehabilitation component details for total knee arthroplasty**

| **Study, Year, PMID, Country** | **Intended Comparison** | **Arm** | **Components (Specific Exercises/Strategies)** | **Progression (Appropriate?)** | **Personnel** | **Mode of Delivery** | **Setting** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017, 26768606, Spain | High intensity preoperative training vs control group [undescribed] | High intensity preoperative training | **1. Strength**  1.9 Heel raises – bilateral (calf raises)  1.11 Hip abduction in sidelying (position unclear)A  1.12 Hip abduction in standing (position unclear)  1.13 Hip abduction in supine (position unclear)  1.31 Knee extension in sitting or supine (long arc quad) (position unclear)  1.32 Knee extension in sitting or supine (short arc quad) (position unclear)  1.35 Knee flexion in prone (position unclear)  1.36 Knee flexion in sitting or supine (position unclear)  1.37 Knee flexion in standing(position unclear)  1.38 Leg press (one leg) (one or two legs unclear)  1.39 Leg press (two legs) (one or two legs unclear)  1.47 Single leg stance  1.55 Step up – forward  **3. Flexibility**  3.2 Bike (ROM)  3.3 Calf stretch with knee bent (soleus) (unclear bent or straight)  3.4 Calf stretch with knee straight (gastric) (unclear bent or straight)  3.9 Iliotibial band stretch in any position  3.15 Knee flexion AROM in any position (rectus femoris stretch)  3.16 Knee flexion PROM in prone (rectus femoris stretch)  **4. Balance-Motor Learning-Agility**  4.3 Balance on unstable surface | Y (Y) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Control | NR  [No description provided] | NR | NR | NR | NR |
| Huang, 2012, 22480863, Taiwan | Preoperative rehabilitation education program vs. No preoperative rehabilitation education program (conventional care) | Preoperative rehabilitation education program | **1. Strength (goal)**  1.11 Hip abduction in sidelying (position unclear)  1.12 Hip abduction in standing (position unclear)  1.13 Hip abduction in supine (position unclear)  1.43 Quad sets  1.58 Straight leg raise  **3. Flexibility**  3.1 Ankle pumps  **6. Patient education**  6.1 ADLs  6.2 Home exercise program | N (NA) | Physical therapist; None (unsupervised) | In-person; Self-guided (unsupervised); Remote via telephone | Physical therapy/rehabilitation facility (outpatient); Home |
| No data | Conventional pre-TKA care | NA  [No prehab or education; usual activities and exercise not prohibited] | NA | NA | NA | NA |
| Huber, 2015, 25925404, Switzerland | Neuromuscular training program (NEMEX-TJR) & knee school (education) vs. Knee school (education) | Neuromuscular training program (NEMEX-TJR) & knee school (education) | **1. Strength**  1.6 Core strengthening  1.12 Hip abduction in standing  1.15 Hip adduction in standing  1.31 Knee extension in sitting or supine (long arc quad)  1.36 Knee flexion in sitting or supine  1.41 Lunges  1.42 Lunges to side (lateral lunge)  **2. Aerobic**  2.2 Bike (endurance)  **3. Flexibility**  [specific exercises not defined]  **4. Balance-Motor Learning-Agility**  4.4 Balance with perturbations  4.11 Step down  4.14 Step up – forward  **5. Task specific training**  5.4 Gait backwards  5.8 Gait training  5.13 Sit-to-stand training  5.15 Stair training  **6. Patient education**  6.4 Pain management | Y (Y) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Knee school (education) | **6. Patient education**  6.4 Pain management | N (NA) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| Matassi, 2014, 23271039, Belgium | Preoperative home exercise program vs. usual activity | Preoperative home exercise program | **1. Strength**  1.31 Knee extension in sitting or supine (long arc quad)  1.35 Knee flexion in prone  1.43 Quad sets  1.52 Step down  1.55 Step up – forward  **3. Flexibility**  3.5 Hamstring stretch in any position  3.15 Knee flexion AROM in any position (rectus femoris stretch)  **6. Patient education**  6.2 Home exercise program | N (NA) | None (unsupervised) | Self-guided (unsupervised) | Home |
| No data | Control | NA  [Instructed to continue usual activities until surgery] | NA | NA | NA | NA |
| Mat Eil Ismail, 2016, 26996450, Malaysia | Preoperative physiotherapy vs. No preoperative physiotherapy | Prehabilitation | **1. Strength**  1.31 Knee extension in sitting or supine (long arc quad)  1.32 Knee extension in sitting or supine (short arc quad)  1.43 Quad sets  1.58 Straight leg raises  **3. Flexibility**  3.1 Ankle pumps  3.2 Bike (ROM)  3.5 Hamstring stretch in any position  3.6 Heel slides  **7. Adjunctive modality**  7.2 Heat | N (NA) | NR | NR | NR |
| No data | No prehabiltation | **NA**  [No additional care preoperative; same postoperative as the intervention group] | N (NA) | NA | NA | NA |
| Mitchell, 2005, 15869558, UK | Pre- and post-operative  physiotherapy at home vs. hospital outpatient post-operative  physiotherapy | Home pre-operative and post-operative rehabilitation | **3. Flexibility**  3.10 Knee extension AROM (unclear)  3.11 Knee extension PROM in supine (unclear)  3.12 Knee extension PROM in prone (unclear)  3.13 Knee flexion AROM (unclear)  3.14 Knee flexion PROM in sitting or supine (unclear)  3.15 Knee flexion AROM in any position (rectus femoris stretch) (unclear)  3.16 Knee flexion PROM in prone (rectus femoris stretch) (unclear)  **5. Task specific training**  5.8 Gait training  **6. Patient education**  6.1 ADLs  6.4 Pain management  **7. Adjunctive modality**  7.12 Massage/myofascial techniques for soft tissue | N (NA) | Physical therapist | In-person | Home |
| No data | Hospital outpatient post-operative rehabilitation | **3. Flexibility**  3.10 Knee extension AROM (unclear)  3.11 Knee extension PROM in supine (unclear)  3.12 Knee extension PROM in prone (unclear)  3.13 Knee flexion AROM (unclear)  3.14 Knee flexion PROM in sitting or supine (unclear)  3.15 Knee flexion AROM in any position (rectus femoris stretch) (unclear)  3.16 Knee flexion PROM in prone (rectus femoris stretch) (unclear)  **5. Task specific training**  5.8 Gait training  **7. Adjunctive modality**  7.4 E-stim for pain (TENS)  7.5 E-stim for strength (NMES) | N (NA) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| Skoffer, 2016, 26713665, Denmark | Preoperative and postoperative progressive resistance  training vs. postoperative progressive resistance  trainingB | Preoperative progressive resistance training | **1. Strength**  1.11 Hip abduction in sidelying (position unclear)  1.12 Hip abduction in standing (position unclear)  1.13 Hip abduction in supine (position unclear)  1.14 Hip adduction in sidelying (position unclear)  1.15 Hip adduction in standing (position unclear)  1.16 Hip adduction in supine (position unclear)  1.17 Hip extension in sidelying (position unclear)  1.18 Hip extension in prone (position unclear)  1.19 Hip extension in standing (position unclear)  1.28 Knee extension machine (one-leg)  1.33 Knee flexion machine (Hamstring curl) one knee  1.38 Leg press (one leg)  **3. Flexibility**  3.2 Bike (ROM)  3.10 Knee extension AROM (unclear)  3.11 Knee extension PROM in supine (unclear)  3.12 Knee extension PROM in prone (unclear)  3.13 Knee flexion AROM (unclear)  3.14 Knee flexion PROM in sitting or supine (unclear)  3.15 Knee flexion AROM in any position (rectus femoris stretch) (unclear)  3.16 Knee flexion PROM in prone (rectus femoris stretch) (unclear) | Y (N) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Standard care preoperatively | NA  [No training preoperatively; same postoperative progressive resistance training as intervention group] | NA | NA | NA | NA |
| Soeters, 2018, 29529614, USA | One-on-one preoperative physical therapy education and microsite vs. no preoperative physical therapy education | Preoperative physical therapy education (PreopPTEd) | **5. Task specific training**  5.1 Transfers  5.13 Sit-to-stand training  5.15 Stair training  **6. Patient education**  6.1 ADLs |  | Physical therapist | In-person | NR (Unclear if home or outpatient) |
| No data | No preoperative physical therapy education | NA  [One preoperative group education class (usual care at the institution); postoperatively received the same physical therapy as the intervention group] | NA | NA | NA | NA |
| Soni, 2012, 22914302, UK | Combined acupuncture and physiotherapy vs. standard care | Acupuncture & exercise | **1. Strength**  1.32 Knee extension in sitting or supine (short arc quad)  1.36 Knee flexion in sitting or supine  1.43 Quad sets  1.48 Sit-to-stand  1.58 Straight leg raise  **3. Flexibility**  3.2 Bike (ROM)  3.3 Calf stretch with knee bent (soleus) (unclear knee bent or straight)  3.4 Calf stretch with knee straight (gastric) (unclear knee bent or straight)  **4. Balance-Motor Learning-Agility**  4.3 Balance on unstable surface  **5. Task specific training**  5.15 Stair training  **7. Adjunctive modality**  7.16 Dry needling (acupuncture) | N (NA) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Exercise & advice leaflet | NA  [Exercise and advice leaflet designed by the physiotherapy, orthopedic, and rheumatology departments] | N (NA) | NA | NA | NA |
| Topp, 2009, 19695525, USA | Prehabilitation vs. usual care | Prehabilitation exercise | **1. Strength**  1.11 Hip abduction in sidelying (position unclear)  1.12 Hip abduction in standing (position unclear)  1.13 Hip abduction in supine (position unclear)  1.14 Hip adduction in sidelying (position unclear)  1.15 Hip adduction in standing (position unclear)  1.16 Hip adduction in supine (position unclear)  1.17 Hip extension in sidelying (position unclear)  1.18 Hip extension in prone (position unclear)  1.19 Hip extension in standing (position unclear)  1.20 Hip flexion in sidelying (position unclear)  1.21 Hip flexion in sitting (position unclear)  1.22 Hip flexion in standing (position unclear)  1.31 Knee extension in sitting or supine (long arc quad) (long or short arc unclear)  1.32 Knee extension in sitting or supine (short arc quad) (long or short arc unclear)  1.35 Knee flexion in prone (position unclear)  1.36 Knee flexion in sitting or supine (position unclear)  1.37 Knee flexion in standing (position unclear)  1.49 Squats  1.52 Step down  1.53 Step down laterally  1.55 Step up – forward  1.56 Step up – lateral  1.63 Open chain ankle dorsiflexion/plantar flexion/inversion/eversion  **3. Flexibility**  3.3 Calf stretch with knee bent (soleus) (unclear knees bent or straight)  3.4 Calf stretch with knee straight (gastric) (unclear knees bent or straight)  3.7 Hip extensor stretch (knee to chest) (unclear)  3.8 Hip flexor stretch (iliopsoas) (unclear)  **5. Task specific training**  [specific exercises not defined] | N (NA) | Other (research personnel); None (unsupervised) | In-person; Self-guided (unsupervised) | Physical therapy/rehabilitation facility (outpatient); Home |
| No data | Usual care | NA  [Continue normal activities until the TKA] | N (NA) | NA | NA | NA |
| Valtonen, 2015, CN-01126383, Finland | Preoperative progressive aquatic resistance training vs. Usual care  [Abstract only] | Aquatic training | **1. Strength**  [specific exercises not defined] | Y (N) | NR | In-person | Other (aquatic center) |
| No data | Control | NA  [Continued life as normal] | NA | NA | NA | NA |
| Villadsen, 2014, 23661494, Denmark | Preoperative neuromuscular exercise program plus standard education vs. standard education alone | Neuromuscular exercise (NEMEX-TJR) & standard education package | **1. Strength**  1.2 Bridges Two-legged (supine hip extension)  1.6 Core strengthening  1.12 Hip abduction in standing  1.15 Hip adduction in standing  1.31 Knee extension in sitting or supine (long arc quad)  1.36 Knee flexion in sitting or supine  1.41 Lunges  1.42 Lunges to side (lateral lunge)  1.52 Step down  1.55 Step up – forward  **2. Aerobic**  2.2 Bike (Endurance)  **3. Flexibility**  3.2 Bike (ROM)  **4. Balance-Motor Learning-Agility**  [specific exercises not defined]  **5. Task specific training**  5.4 Gait backwards  5.8 Gait training  5.13 Sit-to-stand training | Y(Y) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Standard education package | NA  [No limitations regarding exercise habits or seeking other treatment] | NA | NA | NA | NA |
| Williamson, 2007, 17604311, UK | Preoperative acupuncture vs. preoperative physiotherapy (supervised exercise) vs. standard care | Acupuncture | **7. Adjunctive modality**  7.16 Dry needling (acupuncture) | N (NA) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Physiotherapy (supervised exercise) | **1. Strength**  1.30 Knee extension AAROM in sitting or supine (short- or long arc quad) (long or short unclear)  1.31 Knee extension in sitting or supine (long arc quad) (long or short unclear)  1.43 Quad sets  1.48 Sit-to-stand  1.58 Straight leg raise  **3. Flexibility**  3.2 Bike (ROM)  3.3 Calf stretch with knee bent (soleus) (unclear knees bent or straight)  3.4 Calf stretch with knee straight (gastric) (unclear knees bent or straight)  **4. Balance-Motor Learning-Agility**  4.3 Balance on unstable surface  **5. Task specific training**  5.15 Stair training | N (NA) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Control | NA  [Exercise and advice leaflet] | N (NA) | None (unsupervised) | None (unsupervised) | Home |

Abbreviations: AAROM = assisted active range of motion, ADL = activities of daily living, AROM = active range of motion, NA = not applicable, NMES = neuromuscular electrical stimulation NR = not reported, PROM = passive range of motion, ROM = range of motion, TENS = transcutaneous electrical nerve stimulation, TKA = total knee arthroplasty.

A Where position was not specified, all positions were coded with a comment of ‘position unclear’

B Only preoperative exercises were coded

Appendix G. Risk of bias assessment for randomized controlled trials evaluating prehabilitaiton for total knee arthroplasty

Table 1. Prehabilitation for total knee arthroplasty

| **Study, Year, PMID** | **Random** | **Allocation** | **Blinding, Participants** | **Blinding, Providers** | **Blinding, Outcome, Obj / Subj** | **Dropout** | **Reporting Bias** | **Other** | **Population** | **Intervention** | **Outcomes** | **Overall RoB** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017, 26768606 | Low | Low | High | High | Unsure | Low | Low | Low | No | No | No | Moderate |
| Huang, 2012, 22480863 | Unsure | Unsure | High | High | Low | Low | Low | Low | No | No | No | High |
| Huber, 2015, 25925404 | Low | Low | High | High | Low | Low | High | HighA | No | No | No | High |
| Matassi, 2014, 23271039 | Low | Unsure | High | High | Low | Low | Low | Low | No | No | No | Moderate |
| Mat Eli Ismail, 2016, 26996450 | High | Unsure | High | High | High | Low | Low | Low | No | No | No | High |
| Mitchell, 2005, 15869558 | Low | High | High | High | Unsure | Low | Low | Low | No | No | No | High |
| Skoffer, 2016, 26713665 | Low | Low | High | High | Low | Low | Low | HighB | No | No | No | Moderate |
| Soeters, 2018, 29529614 | Low | Low | High | Low | Low | Low | Low | Low | No | No | No | Moderate |
| Soni, 2012, 22914302 | Low | Low | High | High | Low | Low | Low | Low | No | No | No | Moderate |
| Topp, 2009, 19695525 | Unsure | Unsure | High | Low | Unsure | Low | Low | Low | No | No | No | High |
| Valtonen, 2015, No PMID | Unsure | Unsure | Low | Low | Unsure | Unsure | Unsure | Low | No | Yes | Yes | High |
| Villadsen, 2014, 23661494 | Low | Low | High | High | Low | High | Low | Low | No | No | No | High |
| Williamson, 2007, 17604311 | Low | Low | High | Low | Low | Low | Low | Low | No | No | No | Moderate |

PMID = Obj = objective, PubMed Identifier, Subj = subjective.

From the Cochrane Risk of Bias Tool (each item rated as Low, High, Unsure, or N/A). Ratings are color coded for emphasis only.

* Random: Random sequence generation (selection bias): Selection bias (biased allocation to interventions) due to inadequate generation of a randomized sequence;
* Allocation: Allocation concealment (selection bias): Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment;
* Blinding of participants (performance bias): Performance bias due to knowledge of the allocated interventions by participants during the study;
* Blinding of personnel/care providers (performance bias): Performance bias due to knowledge of the allocated interventions by personnel/care providers during the study;
* Blinding of outcome assessor (detection bias): Detection bias due to knowledge of the allocated interventions by outcome assessors;
* Dropout: Incomplete outcome data (attrition bias): Attrition bias due to amount, nature or handling of incomplete outcome data;
* Reporting Bias: Selective outcome reporting (outcome reporting bias): Bias arising from outcomes being selectively reported based on the direction and/or strength of the results;
* Other Bias: Bias due to problems not covered elsewhere in the table.

From the National Heart, Lung, and Blood Institute (NHLBI) Quality Assessment Tool (each item rated as No, Yes, or Unsure)

* Population: Eligibility criteria not prespecified and clearly described: potentially related to selection bias;
* Intervention: Intervention not clearly described and delivered consistently: potentially related to performance bias
* Outcomes: Outcomes not prespecified, clearly defined, valid, reliable, and assessed consistently: potentially related to detection bias.

Overall risk of bias assessed as **HIGH**, **MODERATE**, or **LOW.**

AThe study failed to recruit the sample size planned (n=45 recruited vs. n=80 planned)

B The study failed to recruit the sample size planned (n=59 recruited vs. n=79 planned)

**Appendix H. Design details and arm characteristics for prehabilitation for total hip arthroplasty**

| **StudyA, Year,**  **PMID,**  **Country** | **Funding Source** | **Overall RoB** | **Eligibility Criteria** | **InterventionB** | **N, Enrolled** | **Mean Age, Years (SD)** | **Female, %** | **Mean BMIC (SD)** | **Prior Contralateral Arthroplasty** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bitterli, 2011, 21630176, Switzerland | NR | Moderate | INCLUSION: Unilateral arthrosis or femoral head necrosis, first and unilateral THA. EXCLUSION: Previous surgery on the affected joint, who had been fitted with hip, knee or ankle joint prostheses, for whom a double-sided TKA had been planned, surgery < 3 weeks, able to follow the training program for < 15 days, suffering from neurological complaints. | Pre-operative home exercise sensorimotor training program  Comp: S-E  AdjMod: -  Set: H | 41 | 65.4 (10.8) Range (37, 85) | 46% | 27.6 (3.6) Range (20, 40) | NR |
| No data | No data | No data | Control  Comp: -  AdjMod: -  Set: - | 39 | 68.4 (9.7) Range (40, 86) | 31% | 27.1 (3.6)  Range (18, 36) | NR |
| Holsgaard-Larsen, 2020, 32376477, Denmark | NR | Moderate | INCLUSION: >50 yo, scheduled THA due to primary OA. Minimum participation in 80% of training (no more than 2 sequential skipped sessions. EXCLUSION: Uremia, cancer, systemic treatment with glucocorticoid >3mo in the last 5 yrs with a daily dose >5mg. Fracture of the hip (ipsi or contralateral). Other fracture of the lower extremities within the last year. Other condition with reduced function. | Preoperative progressive resistance training  Comp: S  AdjMod: -  Set: O | 40 | 70.0 (7.7) | 27% | 28.2 (5.3) | NR |
| No data | No data | No data | Control  Comp: -  AdjMod: -  Set: - | 40 | 70.8 (7.5) | 25% | 27.4 (3.8) | NR |
| Pour, 2007, 17768187, USA | Industry | High | INCLUSION: 18-75 yo, diagnosis of OA. EXCLUSION: BMI >30 kg/m2, cognitive impairment or severe psychiatric illness that would preclude participation in the protocol-mandated procedures. | Accelerated rehabilitation  Comp: T  AdjMod: -  Set: O | 46 | 60.4(NR)\* | 48% | 25.5 (NR)\* | NR |
| No data | No data | No data | Standard rehabilitation  Comp: -  AdjMod: -  Set: - | 48 | 61.1(NR)D | 50% | 26.4(NR)d | NR |
| Rooks, 2006, 17013852, USA | NR | Moderate | INCLUSION: Unilateral, primary THA, advanced OA, interval of 8-12 weeks between enrolment and surgery. EXCLUSION: Inflammatory arthritis (i.e., RA, systemic lupus erythematosus), Parkinsons disease, or any medical condition in which a moderate level of exercise was contraindicated (i.e., uncontrolled diabetes or hypertension), bilateral joint replacement or an extended out-of-town vacation during the 6 wks prior to surgery. | Preoperative exercise  Comp: S-A-F  AdjMod: -  Set: Gym or other community center | 32 | 65 (11) | 63% | 28.4 (5.3) | NR |
| No data | No data | No data | Preoperative education  Comp: -  AdjMod: -  Set: - | 31 | 59 (7) | 52% | 30.3 (9.1) | NR |
| Soeters, 2018, 29529614, USA | NR | Moderate | INCLUSION: 18-85yo, scheduled unilateral TJA (THA or TKA), able to independently ambulate a half a block or more with or without an assistive device, able to independently perform nonreciprocal stairs with or without assistive devices, and planned to be discharged home after surgery. EXCLUSION: Patients who did not undergo scheduled surgery, underwent a procedure other than primary TJA, or were discharged to inpatient rehabilitation centers. | Preoperative physical therapy (PreopPTEd)  Comp: T-E  AdjMod: -  Set: NR | 31 | 61 (9); Range (37-98)E | 44% | 29 (6); Range (19-46) | NR |
| No data | No data | No data | No preoperative physical therapy education  Comp: -  AdjMod: -  Set: - | 32 | 62 (8); Range (45-85) | 29% | 29 (6); Range (17-48) | NR |
| Vukomanović, 2008, 18499950, Serbia | NR | High | INCLUSION: <70yo, primary and secondary OA, ability to walk up and down stairs, no need for using crutches while walking, no experience in walking with crutches (because of opposite hip arthroplasty or some other reasons), no coexisting morbidity such as a history of severe cardiovascular, respiratory, neuromuscular, rheumatic disease or mental confusion. EXCLUSION: intraoperative (femoral or acetabular fracture), postoperative complications (postoperative disorientation, anemia, circulatory collapse, orthostatic hypotension, chest pain, sustained hypertension, deep venous thrombosis, pulmonary embolism, hip dislocation) which compromised or delayed the beginning of physical therapy after the operation | Short-term preoperative physical therapy and education  Comp: T-E  AdjMod: -  Set: NR | 23 | 60.1 (11.0); Range (30-70) | 70% | NR | NR |
| No data | No data | No data | Control  Comp: -  AdjMod: -  Set: - | 22 | 56.2 (18.5); Range (19-70) | 80% | NR | NR |

Abbreviations: BMI = H = home, NA = not applicable, NMES = neuromuscular electrical stimulation, NR=not reported, O = outpatient physiotherapy center, OA = osteoarthritis, PMID = PubMed identifier, RA = rheumatoid arthritis, RoB = risk of bias, SD = standard deviation, SD = standard deviation, TENS = transcutaneous electrical nerve stimulation, THA = total hip arthroplasty, TJA = total joint arthroplasty, TKA = total knee arthroplasty, yo = years old.

Components: A = aerobic exercise, B= Balance-motor/Learning-agility exercise, E = patient education, F = flexibility exercise, S = strengthening exercise, T = task-specific training.

A All randomized controlled trials, except as footnoted

B Including Components (Comp)); Adjunctive modalities (AdjMod); and Setting (Set)

C kg/m2

D Calculated

E Reported age, gender, BMI data for total joint replacement population (TKA and THA) combined

**Appendix I. Prehabilitation component details for total hip arthroplasty**

| **Study, Year, PMID** | **Intended Comparison** | **Arm** | **Components (Specific Exercises/Strategies)** | **Progression (Appropriate?)** | **Personnel** | **Mode of Delivery** | **Setting** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Bitterli, 2011, 21630176, Switzerland | Pre-operative sensorimotor training vs. no therapy | Pre-operative home exercise sensorimotor training program | **1. Strength**  1.2 Bridges two-legged (supine hip extension)  1.8 Gluteal Sets  1.12 Hip abduction in standing  1.13 Hip abduction in supine  1.36 Knee flexion in sitting or supine  1.43 Quad sets  1.49 Squats  **6. Patient education**  6.2 Home exercise program | N (NA) | NR (who delivered the instruction for the home exercise program); None (unsupervised) | In-person; Self-guided (unsupervised) | Home |
| No data | Control | NA  [No therapy] | NA | NA | NA | NA |
| Holsgaard-Larsen, 2020, 32376477, Denmark | Preoperative explosive type progressive resistance training vs. care as usual | Preoperative progressive resistance training | **1. Strength**  1.19 Hip extension in standing  1.28 Knee extension machine (one-leg)  1.33 Knee flexion machine (Hamstring curl) one knee  1.38 Leg press (one leg) | Y (Y) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Control | NA  [Care as usual including no formal exercise] | NA | NA | NA | NA |
| Pour, 2007, 17768187, USA | Accelerated preoperative protocol vs. standard preoperative protocol | Accelerated rehabilitation | **5. Task specific training**  5.8 Gait training | N (NA) | Physical therapist | In-person | Physical therapy/rehabilitation facility (outpatient) |
| No data | Standard rehabilitation | NA  [No preoperative rehabilitation; standard pre-operative appointment to discuss procedure and post-operative rehabilitation expectations] | NA | NA | NA | NA |
| Rooks, 2006, 17013852, USA | Short preoperative rehabilitation intervention vs. Education intervention | Preoperative exercise | **1. Strength**  1.6 Core strengthening  1.38 Leg Press (one leg)  1.39 Leg Press (two legs)  1.60 Upper extremity strengthening  **2. Aerobic**  2.2 Bike (Endurance)  2.3 Elliptical machine  **3. Flexibility**  3.1 Ankle pumps  3.3 Calf stretch with knee bent (soleus)  3.4 Calf stretch with knee straight (gastroc)  3.7 Hip extensor stretch (knee to chest)  3.8 Hip flexor stretch (iliopsoas)  3.10 Knee extension AROM (unclear)  3.11 Knee extension PROM in supine (unclear)  3.12 Knee extension PROM in prone (unclear)  3.13 Knee flexion AROM (unclear)  3.14 Knee flexion PROM in sitting or supine (unclear)  3.15 Knee flexion AROM in any position (rectus femoris stretch) (unclear)  3.16 Knee flexion PROM in prone (rectus femoris stretch) (unclear) | Y (N) | Physical therapist | In-person | Gym or other community center |
| No data | Preoperative education | NA  [handout about home modifications and preparation for surgery and hospital stay, no advice on exercise; attention control] | NA | NA | NA | NA |
| Soeters, 2018, 29529614, USA | One-time preoperative physical therapy education session with practice plus microsite vs. no preoperative physical therapy education | Preoperative physical therapy education (PreopPTEd) | **5. Task specific training**  5.1 Transfers  5.13 Sit-to-stand training  5.15 Stair training  **6. Patient education**  6.1 ADLs | NR | Physical therapist | In-person | NR (Unclear if home or outpatient) |
| No data | No preoperative physical therapy education | NA  [One group education class regarding surgery specific information] | NA | NA | NA | NA |
| Vukomanović, 2008, 18499950, Serbia | Preoperative physical therapy and education vs. no physical therapy or education | Short-term preoperative physical therapy and education | **5. Task specific training**  5.1 Transfers  5.8 Gait training  5.13 Sit-to-stand training  5.15 Stair training  **6. Patient education**  6.1 ADLs  6.2 Home exercise program | N (NA) | Physical therapist | In-person | NR |
| No data | Control | [No additional care] | NA | NA | NA | NA |

Abbreviations: ADL = activities of daily living, AROM = active range of motion, NA = not applicable, NMES = neuromuscular electrical stimulation, NR = not reported, PROM = passive range of motion, ROM = range of motion, TENS = transcutaneous electrical nerve stimulation.

Appendix J. Risk of bias assessment for randomized controlled trials evaluating prehabilitaiton for total hip arthroplasty

| **Study, Year, PMID** | **Random** | **Allocation** | **Blinding, Participants** | **Blinding, Providers** | **Blinding, Outcome,**  **Obj / Subj** | **Dropout** | **Reporting Bias** | **Other** | **Population** | **Intervention** | **Outcomes** | **Overall** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bitterli, 2011, 21630176 | Low | Low | High | Low | Low | Low | High | Low | No | No | No | Moderate |
| Holsgaard-Larsen, 2020, 32376477 | Low | Low | High | High | High | Low | Low | Low | No | No | No | Moderate |
| Pour, 2007, 17768187 | Unsure | Unsure | High | High | Low | Low | Low | Low | No | No | No | High |
| Rooks, 2006, 17013852 | Low | Unsure | High | Low | Unsure | Low | Low | Low | No | No | No | Moderate |
| Soeters, 2018, 29529614 | Low | Low | High | Low | Low | Low | Low | Low | No | No | No | Moderate |
| Vukomanović, 2008, 18499950 | Unsure | Unsure | High | High | Unsure | Low | Low | Low | No | No | No | High |

PMID = Obj = objective, PubMed Identifier, Subj = subjective.

From the Cochrane Risk of Bias Tool (each item rated as Low, High, Unsure, or N/A). Ratings are color coded for emphasis only.

* Random: Random sequence generation (selection bias): Selection bias (biased allocation to interventions) due to inadequate generation of a randomized sequence;
* Allocation: Allocation concealment (selection bias): Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment;
* Blinding of participants (performance bias): Performance bias due to knowledge of the allocated interventions by participants during the study;
* Blinding of personnel/care providers (performance bias): Performance bias due to knowledge of the allocated interventions by personnel/care providers during the study;
* Blinding of outcome assessor (detection bias): Detection bias due to knowledge of the allocated interventions by outcome assessors;
* Dropout: Incomplete outcome data (attrition bias): Attrition bias due to amount, nature or handling of incomplete outcome data;
* Reporting Bias: Selective outcome reporting (outcome reporting bias): Bias arising from outcomes being selectively reported based on the direction and/or strength of the results;
* Other Bias: Bias due to problems not covered elsewhere in the table.

From the National Heart, Lung, and Blood Institute (NHLBI) Quality Assessment Tool (each item rated as No, Yes, or Unsure)

* Population: Eligibility criteria prespecified and clearly described: potentially related to selection bias;
* Intervention: Intervention clearly described and delivered consistently: potentially related to performance bias;
* Outcomes: Outcomes prespecified, clearly defined, valid, reliable, and assessed consistently: potentially related to detection bias.

Overall risk of bias assessed as **HIGH**, **MODERATE**, or **LOW.**

**Appendix K. Outcome data**

Body Structure and Function Outcomes – Prehabilitation for Total Knee Arthroplasty

**Symptoms**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017, 26768606, Spain | WOMAC: Stiffness (0-8) | Moderate | 3 mo | 22 | 2.2 (95% CI 2.0,2.5) | 22 | 3.2 (95% CI 2.9,3.4) | **–0.9 (–1.3, –0.6)** | **<0.05** |
| Huber, 2015,  25925404, Switzerland | KOOS: Symptoms (0-100) | High | 3 mo | 21 | NR | 20 | NR | 4.6 (–5.0, 14.2) | NR |
| Mitchell, 2005, 15869558, UK | WOMAC: Stiffness (0-8) | High | 3 mo | 57 | 3.5 (1.4) | 57 | 3.6 (2.1) | Adj MD –0.2 (–0.9, 0.4) | 0.496 |
| Skoffer, 2016,  26713665, Denmark | KOOS: Symptoms (0-100) | Moderate | 3 mo | 29 | 72.8 (16.4) | 21 | 71.9 (11.4) | 0.9 (–4.6, 6.4)B | NR |
| Villadsen, 2014,  23661494, Denmark | KOOS: Symptoms (0-100) | Moderate | 3 mo | 84 | NR | 81 | NR | –6.0 (–13.4,1.5) | 0.12 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: Adj MD = adjusted mean difference CI = confidence interval, KOOS = Knee injury and osteoarthritis outcome score, mo = month, NR = not reported, PMID = PubMed identifier, Prehab = prehabilitation, RoB = risk of bias, SD = standard deviation, SF-36 = 36-Item Short Form survey, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index

A Time from surgery

B Calculated

**Pain**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017,  26768606,  Spain | VAS (0-10) | Moderate | 3 mo | 22 | 1.4 (95% CI 1.1,1.7) | 22 | 2.9 (95% CI 2.5,3.2) | **–1.5 (–1.9, –1.1)** | **<0.05** |
| WOMAC: Pain (0-20) | Moderate | 3 mo | 22 | 2.9 (95% CI 2.5,3.3) | 22 | 3.8 (95% CI 3.4,4.2) | **-0.9 (–1.5, –0.14)** | **<0.05** |
| Huber, 2015,  25925404,  Switzerland | EQ-5D: Pain/discomfort (1-3) | High | 3 mo | 21 | NR | 20 | NR | −0.0 (−0.5, 0.3) | NR |
| EQ-5D: Pain/discomfort (1-3) | High | 12 mo | 21 | NR | 20 | NR | −0.1 (−0.4, 0.3) | NR |
| KOOS: Pain (0-100) | High | 3 mo | 21 | NR | 20 | NR | –3.3 (–13.5, 6.8) | NR |
| EQ-5D (VAS) (0-100) | High | 3 mo | 21 | NR | 20 | NR | 1.2 (–8.4, 10.8) | NR |
| KOOS: Pain (0-100) | High | 12 mo | 21 | NR | 20 | NR | 2.3 (-8.5,13.0) | NR |
| SF-36: Bodily pain (0-100) | High | 3 mo | 21 | NR | 20 | NR | −3.4 (−15.5, 8.7) | NR |
| SF-36: Bodily pain (0-100) | High | 12 mo | 21 | NR | 20 | NR | 4.9 (−7.8, 17.7) | NR |
| Mitchell, 2005, 15869558, UK | SF-36: Bodily pain (0-100) | High | 3 mo | 57 | 46.6 (20.6) | 57 | 48.5 (26.8) | Adj MD –3.4 (–12.0, 5.2) | 0.432 |
| WOMAC: Pain (0-20) | High | 3 mo | 57 | 6.8 (3.7) | 57 | 6.9 (4.3) | Adj MD –0.5 (–2.0, 1.0) | 0.530 |
| Skoffer, 2016,  26713665,  Denmark | VAS: Current pain (0-10) | High | 3 mo | 29 | 1.0 (1.7) | 21 | 1.1 (1.3) | –0.1 (–0.7, 0.5**)**B | NR |
| VAS: Average painC (0-10) | High | 3 mo | 29 | 1.4 (1.6) | 21 | 1.5 (1.1) | –0.1 (–0.6, 0.4**)**B | NR |
| VAS: Worst painC (0-10) | High | 3 mo | 29 | 2.6 (2.6) | 21 | 2.4 (1.9) | 0.2 (–0.7, 1.1**)**B | NR |
| KOOS: Pain (0-100) | High | 3 mo | 29 | 78.1 (16.3) | 21 | 79.9 (14.2) | –1.8 (–7.8, 4.2**)**B | NR |
| Soni, 2012,  22914302, UK | VAS (0-10) | Moderate | 3 mo | 28 | 3.9 (3) | 28 | 4.7 (2.8) | –0.8 (–2.6, 1.1) | NR |
| Topp, 2009,  19695525, USA | VAS: Ascend stairs (0-10) | High | 3 mo | 26 | 1.33 (0.31) | 28 | 1.26 (0.30) | 0.07 (-0.09, 0.23**)**B | NR |
| VAS: Descend stairs (0-10) | High | 3 mo | 26 | 1.42 (0.37) | 28 | 1.45 (0.35) | -0.03 (-0.22, 0.16**)**B | NR |
| VAS: Sit-to-stand (0-10)D | High | 3 mo | 26 | 1.62 (0.29) | 28 | 1.06 (0.28) | 0.56 (0.41, 0.71**)**B | NR |
| VAS: 6-min walk (0-10) | High | 3 mo | 26 | 1.53 (0.34) | 28 | 1.38 (0.33) | 0.15 (-0.03, 0.33**)**B | NR |
| Valtonen, 2015,  CN-01126383,  Finland | VAS (0-10) | High | 3 mo | 31 | NR | 24 | NR | **–58%** | **0.001** |
| Villadsen, 2014,  23661494,  Denmark | KOOS: Pain (0-100) | Moderate | 3 mo | 84 | NR | 81 | NR | –5.5 (–13.0, 2.9) | 0.1556 |
| EQ-5D (VAS) (0-100) | Moderate | 3 mo | 84 | NR | 81 | NR | 2.8 (–4.8, 10.4) | 0.4684 |
| Williamson, 2007,  17604311, UK | VAS (0-10) | High | 3 mo | 23 | 3.86 (2.59) | 19E | 3.95 (2.59) | –0.09 (–1.71,1.53) | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: Adj MD = adjusted mean difference, CI = confidence interval, EQ-5D = EuroQol-5 dimensions, KOOS = Knee injury and osteoarthritis outcome score, min = minute, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, SF-36 = 36-item short form health survey, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, VAS = visual analog scale.

A Time from surgery

B Calculated

C During the past 14 days

D Repetitions in 30 seconds

E Control arm sample size is uncertain from study report. Study was retained despite potential sample size of control being less than 20

**Range of motion**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size**  **(95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud,2017, 26768606,  Spain | Active Knee ROM: Extension (deg)B | Moderate | 3 mo | 22 | 8.2 (95% CI 7.2,9.3) | 22 | 13.9 (95% CI 12.8,14.9) | **–5.6 (–6.9, -4.3)** | **<0.05** |
| Active Knee ROM: Flexion (deg) | Moderate | 3 mo | 22 | 101.2 (95% CI 97.8,104.7) | 22 | 96.4 (95% CI 92.9,99.9) | **4.8 (0.2, 9.5)** | **<0.05** |
| Huber, 2015,  25925404,  Switzerland | Knee ROM (active/passive unspecified): Extension (deg) | High | 3 mo | 21 | NR | 20 | NR | 1.4 (–1.8. 4.5) | NR |
| Knee ROM (active/passive unspecified): Flexion (deg) | High | 3 mo | 21 | NR | 20 | NR | –3.9 (–10.2, 2.4) | NR |
| Matassi, 2014,  23271039,  Belgium | Knee ROM (active/passive unspecified): Extension (deg) | Moderate | 12 mo | 61 | 1.00 (NR) | 61 | 0.68 (NR) | **NR** | **0.032** |
| Active Knee ROM: Flexion (deg) | Moderate | 12 mo | 61 | 118.3 (NR) | 61 | 118.7 (NR) | NR | ns |
| Passive Knee ROM: Flexion (deg) | Moderate | 12 mo | 61 | 120.5 (NR) | 61 | 120.4 (NR) | NR | ns |
| Skoffer, 2016,  26713665,  Denmark | Active Knee ROM: Extension (deg) | Moderate | 3 mo | 29 | 3.3 (2.8) | 21 | 4.3 (2.4) | -1.00 (-2.45, 0.45) | 0.089 |
| Passive Knee ROM: Extension (deg) | Moderate | 3 mo | 29 | 1.2 (2.3) | 21 | 1.7 (2.4) | –0.5 (–1.4, 0.4)C | 0.207 |
| Active Knee ROM: Flexion (deg) | Moderate | 3 mo | 29 | 113.0 (14.8) | 21 | 112.5 (7.81) | 0.5 (-5.84, 6.84) | 0.995 |
| Passive Knee ROM: Flexion (deg) | Moderate | 3 mo | 29 | 118.7 (15.7) | 21 | 118.3 (8.0) | 0.4 (-4.6, 5.4)C | 0.678 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, deg = degree, mo = month, N= number, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, ROM = range of motion, SD = standard deviation.

A Time from surgery

B Measured with goniometer

C Calculated

**Strength**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size**  **(95% CI)** | **Reported p-Value** |
| Calatayud, 2017,  26768606,  Spain | Strength: Isometric knee extension (kg)B | Moderate | 3 mo | 22 | 22.8 (95% CI 19.7,25.9) | 22 | 14.3 (95% CI 11.1,17.5) | **8.5 (4.8,12.1)** | **<0.05** |
| Strength: Isometric knee flexion (kg) | Moderate | 3 mo | 22 | 9.4 (95% CI 8.8,9.9) | 22 | 4.4 (95% CI 3.8,5.0) | **5.0 (4.3, 5.7)** | **<0.05** |
| Huber, 2015,  25925404,  Switzerland | Strength: Isometric knee extension (N)C | High | 3 mo | 21 | NR | 20 | NR | –3.5 (–52.7, 45.6) | NR |
| Strength: Isometric knee flexion (N) | High | 3 mo | 21 | NR | 20 | NR | –12.7 (–36.2, 10.8) | NR |
| Strength: Knee-bending/30sD | High | 3 mo | 21 | NR | 20 | NR | –3.3 (–7.4, 0.8) | NR |
| Skoffer, 2016,  26713665,  Denmark | Strength: Isometric peak knee extension (Nm/kg)B | Moderate | 3 mo | 29 | 1.0 (0.3) | 21 | 0.8 (0.3) | **0.2 (0.1, 0.3)**E | **<0.001** |
| Strength: Isokinetic peak knee extension (Nm/kg) | Moderate | 3 mo | 29 | 0.9 (0.3) | 21 | 0.7 (0.2) | **0.2 (0.06, 0.34)**E | **0.002** |
| Strength: Isometric peak knee flexion (Nm/kg) | Moderate | 3 mo | 29 | 0.7 (0.3) | 21 | 0.6 (0.2) | **0.1 (0.001, 0.2)**E | **0.042** |
| Strength: Isokinetic peak knee flexion (Nm/kg) | Moderate | 3 mo | 29 | 0.5 (0.2) | 21 | 0.4 (0.2) | **0.1 (-0.01, 0.21)**E | **0.002** |
| Topp, 2009,  19695525,  USA | Strength: Knee peak extension (Nm/kg) B | High | 3 mo | 26 | 62.27 (SE=4.81) | 28 | 60.23 (SE=5.00) | 2.04 (-11.56, 15.64)E | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, kg = kilogram, N = Newton, Nm/kg = torque normalized to body weight, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, s = second, SD = standard deviation, SE = standard error.

A Time from surgery

B Measured with a dynamometer

C Measured with a hand-held pull gauge

D Measure rapid alternation between concentric and eccentric function, maximum number of knee-bending in 30 seconds (higher is better function)

E Calculated

**Energy and vigor**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size**  **(95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Huber, 2015,  25925404,  Switzerland | SF-36: Vitality (0-100) | High | 3 mo | 21 | NR | 20 | NR | −8.3 (−20.0, 3.3) | NR |
| Mitchell, 2005, 15869558, UK | SF-36: Vitality (0-100) | High | 3 mo | 57 | 50.7 (19.5) | 57 | 48.2 (23.7) | 3.4 (–3.5, 10.3) | 0.330 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SF-36 = 36-Item short form survey, SD = standard deviation.

A Time from surgery

**Emotional functioning**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size**  **(95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Huber, 2015,  25925404,  Switzerland | SF-36: Emotional role functioning (0-100) | High | 3 mo | 21 | NR | 20 | NR | −10.2 (−34.0, 13.5) | NR |
| SF-36: Social functioning (0-100) | High | 3 mo | 21 | NR | 20 | NR | −1.6 (–13.7, 10.5) | NR |
| SF-36: Mental health (0-100) | High | 3 mo | 21 | NR | 20 | NR | −3.0 (−12.2, 6.1) | NR |
| Mitchell, 2005, 15869558, UK | SF-36: Emotional role functioning (0-100) | High | 3 mo | 57 | 48.0 (46.7) | 57 | 45.6 (44.8) | Adj MD 4.1 (–10.9, 19.0)B | 0.592 |
| SF-36: Social functioning (0-100) | High | 3 mo | 57 | 64.1 (26.6) | 57 | 60.8 (33.1) | Adj MD 6.7 (–3.4, 16.7) | 0.193 |
| SF-36: Mental health (0-100) | High | 3 mo | 57 | 68.0 (20.4) | 57 | 71.2 (20.0) | Adj MD –2.9 (-9.3, 3.5) | 0.368 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: Adj = adjusted, CI = confidence interval, MD = mean difference, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, SF-36 = 36-Item short form survey.

A Time from surgery

B Regression coefficient represents the effect on post-operative quality of life due to the presence of intervention after adjusting for pre-operative quality of life and pre-operative waiting time

Body Structure and Function Outcomes – Prehabilitation for Total Hip Arthroplasty

**Symptoms**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Holsgaard-Larsen, 2020, 32376477, Denmark | HOOS: Symptoms (0-100) | Moderate | 12 mos | 40 | NR | 40 | NR | NMD 4.9 (-12.7,2.8) | 0.21 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, mo = month, NMD = net mean difference, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, HOOS = Hip disability and osteoarthritis outcome

A Time from surgery

**Pain**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Holsgaard-Larsen, 2020, 32376477, Denmark | HOOS: Pain (0-100) | Moderate | 12 mos | 40 | NR | 40 | NR | NMD 0.5 (-6.7,7.7) | 0.89 |
| Rooks, 2006, 17013852, USA | SF-36: bodily pain (0, 100) | Moderate | 6 mo | 25 | 79.6 (21.2) | 24 | 77.4 (16.3) | MD 2.2 (-8.36, 12.76)B | NR |
| WOMAC: pain (0, 20) | Moderate | 6 mo | 25 | 1.1 (1.7) | 24 | 1.0 (1.2) | NMD 0.9 (-0.59, 2.39)B | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, mo = month, HOOS = Hip disability and osteoarthritis outcome, NMD = net mean difference, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, SF-36 = 36-Item short form survey, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index

A Time from surgery

B Calculated

**Range of motion**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Holsgaard-Larsen, 2020, 32376477, Denmark | Knee extension | Moderate | 12 mo | 40 | NR | 40 | NR | NMD 0.10 (0.02,0.22) | 0.088 |
| Hip extension | Moderate | 12 mo | 40 | NR | 40 | NR | NMD 0.09  (-0.05,0.22) | 0.23 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, kg = kilogram, mo = month, NMD = net mean difference, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation

A Time from surgery

**Strength**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rooks, 2006, 17013852, USA | 1-repetition maximum (kg) | Moderate | 6 mo | 25 | 99 (37) | 24 | 117 (51) | NMD -1 (-27.29, 25.29)B | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, kg = kilogram, mo = month, NMD = net mean difference, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation

A Time from surgery

B Calculated

**Energy and vigor**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bitterli, 2011, 21630176, Switzerland | SF-36: vitality (NR, NR) | Moderate | 12 mo | 41 | NR | 39 | NR | **Cohen's d 0.65** | **<0.05** |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SF-36 = 36-Item short form survey, SD = standard deviation

A Time from surgery

**Emotional functioning**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bitterli, 2011, 21630176, Switzerland | SF-36: mental health (0-100) | Moderate | 12 mo | 41 | NR | 39 | NR | **Cohen's d 0.75** | **<0.05** |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SF-36 = 36-Item short form survey, SD = standard deviation.

A Time from surgery

Activity and Participation Outcomes – Prehabilitation for Total Knee Arthroplasty

**Physical function and activities of daily living**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control,**  **N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017, 26768606,  Spain | SF-36: Physical component (0-100) | Moderate | 3 mo | 22 | 55.7 (95% CI 54.6,56.8) | 22 | 53 (95% CI 51.9,54.1) | **2.7 (1.3, 4.1)** | **<0.001** |
| WOMAC: Physical function (0-68) | Moderate | 3 mo | 22 | 18.8 (95% CI 17.8,19.7) | 22 | 22.7 (95% CI 21.7,23.7) | **–3.9 (–5.2, –2.7)** | **<0.05** |
| Huber, 2015,  25925404,  Switzerland | EQ-5D: Self-care (1-3) | High | 3 mo | 21 | NR | 20 | NR | 0.1 (−0.1, 0.3) | NR |
| EQ-5D: Usual activities (1-3) | High | 3 mo | 21 | NR | 20 | NR | 0.0 (−0.4, 0.4) | NR |
| EQ-5D: Mobility (1-3) | High | 3 mo | 21 | NR | 20 | NR | −0.1 (−0.4, 0.2) | NR |
| KOOS: ADL (0-100) | High | 3 mo | 21 | NR | 20 | NR | –4.9 (–16.3, 6.5) | NR |
| KOOS: Sport/rec (0-100) | High | 3 mo | 21 | NR | 20 | NR | 1.0 (–19.9, 21.8) | NR |
| SF-36: Physical role functioning (0-100) | High | 3 mo | 21 | NR | 20 | NR | −3.2 (−32.2, 25.9) | NR |
| SF-36: Physical functioning (0-100) | High | 3 mo | 21 | NR | 20 | NR | −6.6 (−8.5, 17.5) | NR |
| Matassi, 2014,  23271039,  Belgium | Knee Society Score: Knee score | Moderate | 12 mo | 61 | NR | 61 | NR | NR | ns |
| Knee Society Score: Function score | Moderate | 12 mo | 61 | NR | 61 | NR | NR | ns |
| Mitchell, 2005, 15869558, UK | SF-36: Physical role functioning (0-100) | High | 3 mo | 57 | 27.6 (37.1) | 57 | 23.2 (36.2) | Adj MD 7.8 (–5.6, 21.2) | 0.249 |
| SF-36: Physical function (0-100) | High | 3 mo | 57 | 41.6 (22.2) | 57 | 43.3 (27.6) | Adj MD 2.5 (–6.3, 11.3) | 0.579 |
| WOMAC: Physical function (0-68) | High | 3 mo | 57 | 24.9 (13.4) | 57 | 26.4 (14.9) | Adj MD –1.0 (–5.9, 3.8) | 0.677 |
| Skoffer, 2016,  26713665,  Denmark | KOOS: ADL (0-100) | Moderate | 3 mo | 29 | 82.9 (11.7) | 21 | 78.2 (12.9) | 4.7 (–0.3, 9.7)B | NR |
| KOOS: Sport/rec (0-100) | Moderate | 3 mo | 29 | 50.2 (28.4) | 21 | 40 (22.5) | 10.2 (0.2, 20.2)B | NR |
| Soni, 2012,  22914302, UK | Oxford knee score (0-48) | Moderate | 3 mo | 20 | 27.4 (10) | 21 | 25.1 (10.6) | –2.2 (–8.7, 4.3) | NR |
| Villadsen, 2014,  23661494,  Denmark | KOOS: ADL (0-100) | Moderate | 3 mo | 84 | NR | 81 | NR | -5.6 (–12.9, 1.8) | 0.1371 |
| KOOS: Sport/rec (0-100) | Moderate | 3 mo | 84 | NR | 81 | NR | –5.6 (–15.6, 4.5) | 0.2779 |
| Williamson, 2007, 17604311,UK | Oxford knee score (0-48) | High | 3 mo | 23 | 28.3 (9.78) | 19C | 26.7 (7.45) | 1.61 (–3.91,7.13) | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: Adj = adjusted, ADL = activities of daily living, CI = confidence interval, EQ-5D = EuroQual, KOOS = Knee injury and osteoarthritis outcome score, MD = mean difference, mo = month, NR = not reported, ns = not significant, PMID = PubMed identifier, rec = recreation, RoB = risk of bias, SD = standard deviation, SF-36 = 36-Item short form survey, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

A Time from surgery

B Calculated

C Control arm sample size is uncertain from study report. Study was retained despite potential sample size of control being less than 20.

**Repeated stand test (sit-to-stand)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control,**  **N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| Huber, 2015, 25925404, Switzerland | Chair stand test: Time to complete 5 sit-to-stands (s) | High | 3 mo | 21 | NR | 20 | NR | 2.0 (-1.8, 5.8) | NR |
| Skoffer, 2016,  26713665, Denmark | Chair stand test: Total sit-to-stands in 30s (n) | Moderate | 3 mo | 29 | 14.7 (4.7) | 21 | 11.0 (4.4) | **3.3 (0.76, 5.84)**B | **0.001** |
| Topp, 2009,  19695525, USA | Chair stand test: Total sit-to-stands in 30s (n) | High | 3 mo | 26 | 12.87 (SE=0.82) | 28 | 11.25 (SE=0.79) | 1.62 (-0.73, 3.97)B | NR |
| Valtonen, 2015,  CN-01126383, Finland | Chair stand test: Time to complete unspecified number of sit-to-stands (NR) | High | 3 mo | 31 | NR | 24 | NR | **15% decrease in sit-to-stand time** | **0.003** |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, SE = standard error.

A Time from surgery

B Calculated

**Balance**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control,**  **N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017,  26768606,  Spain | Romberg test (eyes open): Anteroposterior range of COP (mm) | Moderate | 3 mo | 22 | 17 (95% CI 16.4,17.6) | 22 | 20.2 (95% CI 19.6,20.9) | **–3.2 (–4.0, –2.4)** | **NR** |
| Romberg test (eyes open): COP area | Moderate | 3 mo | 22 | 42.1 (95% CI 38.4,45.7) | 22 | 49.4 (95% CI 45.6,53.3) | **–7.4 (–12.3, –2.4)** | **NR** |
| Romberg test (eyes open): Medial lateral range of COP (mm) | Moderate | 3 mo | 22 | 14.7 (95% CI 14.2,15.1) | 22 | 15.1 (95% CI 14.7,15.6) | –0.5 (–1.1, 0.2) | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, COP = center of pressure , mm = milimeter, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation.

A Time from surgery

**Walking speed**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control,**  **N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Huber, 2015,  25925404,  Switzerland | 20-m walk testB | High | 3 mo | 21 | NR | 20 | NR | -0.5 (-2.0, 1.0) | NR |
| Skoffer, 2016,  26713665,  Denmark | 10-m walk test (s) | Moderate | 3 mo | 29 | 7.1 (1.5) | 21 | 7.7 (1.2) | **–0.6 (–1.1, –0.1)**C | **0.216** |
| Soni, 2012,  22914302,  UK | 50-m walk test (s) | Moderate | 3 mo | 20 | 64.1 (44.7) | 21 | 55.0 (18.4) | 9.1 (-12.7, 31.0) | NR |
| Valtonen, 2015,  CN-01126383,  Finland | Maximal walking speed (NR) | High | 3 mo | 31 | NR | 24 | NR | **15% increase in walking speed** | **0.005** |
| Williamson, 2007,  17604311, UK | 50-m walk test (s) | High | 3 mo | 23 | 46.6 (11.4) | 19D | 44.1 (6.91) | 2.51 (-3.48,8.51) | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, s = second, SD = standard deviation.

A Time from surgery

B Study reported that the test measures the time it takes to walk 20 meters at the participant’s usual walking pace, and the number of steps that they take to walk 20 meters. Study did not specify what scale was used for reported outcome (i.e., seconds vs. steps)

C Calculated

D Control arm sample size is uncertain from study report. Study was retained despite potential sample size of control being less than 20

**Walking distance**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Skoffer, 2016,  26713665,  Denmark | 6MWT (m) | Moderate | 3 mo | 29 | 449 (94) | 21 | 433 (74) | 16 (-17, 49)B | 0.208 |
| Topp, 2009,  19695525, USA | 6MWT (m) | High | 3 mo | 26 | 1337 (SE=58) | 28 | 1365 (SE=56) | -28 (-194.28, 138.28)B | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: 6MWT = six-minute walk test CI = confidence interval, mo = month, m = meter, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, SE = standard error.

A Time from surgery

B Calculated

**Stair ascent/descent**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud,  2017,  26768606,  Spain | Stair climb test: Ascend descend and descend flight of 4 stairs (s) | Moderate | 3 mo | 22 | 7.9 (95% CI 7.2,8.5) | 22 | 12.1 (95% CI 11.5,12.8) | **–4.2 (–5.1, –3.4)** | **<0.05** |
| Topp,  2009,  19695525,  USA | Stair climb test: Ascend flight of 22 stairs (s) | High | 3 mo | 26 | 8.44 (SE=0.77) | 28 | 7.45 (SE=0.77) | 0.99 (-1.26, 3.24)B | NR |
| Stair climb test: Descend flight of 22 stairs (s) | High | 3 mo | 26 | 8.6 (SE=1.06) | 28 | 8.06 (SE=1.06) | 0.54 (-2.56, 3.64)B | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, s = second, SD = standard deviation, SE = standard error.

A Time from surgery

B Calculated

**Timed Up and Go**

| **Study, Year, PMID, Country** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017,  26768606, Spain | Moderate | 3 mo | 22 | 7.0 (95% CI 6.7,7.3) | 22 | 8.7 (95% CI 8.3,9.1) | **–1.7 (–2.1, –1.3)** | **<0.05** |
| Huber, 2015,  25925404, Switzerland | High | 3 mo | 21 | NR | 20 | NR | 1.6 (-0.1, 3.3) | NR |
| Skoffer,2016,  26713665, Denmark | Moderate | 3 mo | 29 | 7.9 (2.3) | 21 | 8.9 (2.1) | **–1.0 (-1.9. –0.1)**B | **0.05** |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, s = second, SD = standard deviation.

A Time from surgery

B Calculated

Activity and Participation Outcomes – Prehabilitation for Total Hip Arthroplasty

**Physical function and activities of daily living**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bitterli, 2011, 21630176, Switzerland | SF-36: physical functioning (0-100) | Moderate | 12 mo | 41 | 80.0 (SE 93.1B) | 39 | 85.0 (SE 98.9B) | Cohen's d 0.39  MD -5 (-163.93, 153.93)B | 0.39 |
| WOMAC (0, 68) | Moderate | 12 mo | 41 | NR | 39 | NR | Cohen’s d 0.08 | 0.47 |
| Holsgaard-Larsen, 2020, 32376477, Denmark | HOOS: Sport/rec (0-100) | Moderate | 12 mo | 40 | NR | 40 | NR | NMD 6.2 (-3.2,15.6) | 0.20 |
| HOOS: ADL (0-100) | Moderate | 12 mo | 40 | NR | 40 | NR | NMD 2.6 (-4.2,9.8) | 0.44 |
| Rooks, 2006, 17013852, USA | SF-36: role limitation physical (0, 100) | Moderate | 6 mo | 25 | 83.0 (35.2) | 24 | 86.5 (24.4) | NMD -2.4 (-23.02, 18.22)B | NR |
| Rooks, 2006, 17013852, USA | SF-36: physical functioning (0-100) | Moderate | 6 mo | 25 | 81.7 (18.1) | 24 | 76.6 (18.6) | NMD 8.9 (-1.31, 19.11)B | NR |
| Rooks, 2006, 17013852, USA | WOMAC: function (0-68) | Moderate | 6 mo | 25 | 5.4 (5.8) | 24 | 5.3 (5.4) | NMD 0.8 (-5.06, 6.66)B | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: ADL = activities of daily living, CI = confidence interval, HOOS = Hip Disability Osteoarthritis Outcome Score, mo = month, NMD = net mean difference, NR = not reported, PMID = PubMed identifier, rec = recreation, RoB = risk of bias, SD = standard deviation, SF-36 = 36-Item short form survey, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

A Time from surgery

B Calculated

**Transfers**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Holsgaard-Larsen, 2020, 32376477, Denmark | Sit-to-stand (5 times) (s) | Moderate | 12 mo | 40 | NR | 40 | NR | 0.7 (-1.0,4.3) | 0.41 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, s = second, SD = standard deviation, SE = standard error.

A Time from surgery

**Balance**

| **Study, Year,**  **PMID,**  **Country** | **Outcome** | **Overall RoB** | **Outcome Measurement** | **Time pointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rooks, 2006, 17013852, USA | Balance | Moderate | Functional reach (cm) | 6 mo | 25 | 33.5 (5.2) | 24 | 31.4 (7.1) | **NMD 5.9 (1.83, 9.97)B** | **<0.05** |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, cm = centimeter, mo = month, NMD = net mean difference, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation.

A Time from surgery

B Calculated

**Mobility**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Holsgaard-Larsen, 2020, 32376477, Denmark | Stair climb test: ascending stairs (steps/s) | Moderate | 12 mo | 40 | NR | 40 | NR | **1.3 (0.3, 2.3)** | **0.0011** |
| Stair climb test: descending stairs (steps/s) | Moderate | 12 mo | 40 | NR | 40 | NR | **1.6 (0.3, 2.9)** | **0.017** |
| 25-m walk test (normal speed) (m/s) | Moderate | 12 mo | 40 | NR | 40 | NR | 1.4 (-0.07,2.8) | 0.062 |
| 25-m walk test (max speed) (m/s) | Moderate | 12 mo | 40 | NR | 40 | NR | 0.9 (-0.4,2.2) | 0.17 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, m = meter, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, s = seconds.

A Time from surgery

**Timed Up and Go**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time pointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Rooks, 2006, 17013852, USA | TUG (s) | Moderate | 6 mo | 25 | 9.76 (1.29) | 24 | 9.41 (1.46) | NMD -1.04 (-2.4, 0.32)B | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, NMD = net mean difference, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, mo = month, s = second, SD = standard deviation, TUG = timed up and go.

A Time from surgery

B Calculated

Other Patient-Reported Outcomes – Prehabilitation for Total Knee Arthroplasty

**Health-related quality of life**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Huber, 2015,  25925404,  Switzerland | KOOS: QoL (0-100) | High | 3 mo | 21 | NR | 20 | NR | –5.9 (–18.5, 6.8) | NR |
| Skoffer, 2016,  26713665,  Denmark | KOOS: QoL (0-100) | Moderate | 3 mo | 29 | 66.2 (18.9) | 21 | 61.9 (16.6) | 4.3 (–2.7, 11.3)B | NR |
| Study-specific QoL scaleC (0- 100) | Moderate | 3 mo | 29 | 86.7 (10.5) | 21 | 76.4 (20.1) | **10.3 (2.8, 17.8)**B | **NR** |
| Villadsen, 2014,  23661494,  Denmark | KOOS: QoL (0-100) | Moderate | 3 mo | 84 | 23 | 81 | 19 | –4.6 (–12.9, 3.6) | 0.2666 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, KOOS = Knee injury and osteoarthritis outcome score, mo = month, NR = not reported, PMID = PubMed identifier, QoL = quality of life, RoB = risk of bias, SD = standard deviation.

A Time from surgery

B Calculated

C Health-related quality of life was recorded on a rating scale from 0 (worse health-related quality of life imaginable) to 100 (best health-related quality of life imaginable)

**Patient global assessment**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017,  26768606, Spain | WOMAC: Total (0-96) | Moderate | 3 mo | 22 | 25 (95% CI 23.5,26.4) | 22 | 30.7 (95% CI 29.2,32.2) | **–5.8 (–7.6, –3.9)** | **<0.05** |
| Huber, 2015,  25925404,  Switzerland | SF-36: General health (0-100) | High | 3 mo | 21 | NR | 20 | NR | −2.8 (−12.0, 6.3) | NR |
| Mitchell, 2005, 15869558, UK | SF-36: General health (0-100) | High | 3 mo | 57 | 61.0 (23.4) | 57 | 61.0 (22.9) | Adj MD –0.2 (–7.0, 6.7) | 0.964 |
| Villadsen, 2014,  23661494,  Denmark | EQ-5D index (0-1) | Moderate | 3 mo | 84 | NR | 81 | NR | –0.06 (–0.13, 0.01) | 0.0781 |
| Williamson, 2007, 17604311,UK | WOMAC: Total (0-96) | High | 3 mo | 23 | 26 (17.7) | 19 | 24.6 (16.8) | 1.33 (–9.53,12.18) | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: Adj MD = adjusted mean difference CI = confidence interval, EQ-5D = EuroQual, KOOS = Knee injury and osteoarthritis outcome score, mo = month, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, SF-36 = 36-Item short form survey, VAS = visual analogue scale, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

A Time from surgery

Other Patient-Reported Outcomes – Prehabilitation for Total Hip Arthroplasty

**Health-related quality of life**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Holsgaard-Larsen, 2020, 32376477, Denmark | HOOS: QoL (0-100) | Moderate | 12 mo | 40 | NR | 40 | NR | 0.2 (-8.9,9.3) | 0.97 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, HOOS = Hip disability and osteoarthritis outcome score, mo = month, NR = not reported, PMID = PubMed identifier, QoL = quality of life, RoB = risk of bias, SD = standard deviation.

A Time from surgery

Healthcare Utilization Outcomes – Prehabilitation for Total Knee Arthroplasty

**Length of stay**

| **Study, Year, PMID, Country** | **Outcome** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Calatayud, 2017,  26768606, Spain | Length of stay (d) | Moderate | NA | 22 | 4.5 (0.9) | 22 | 6.4 (1.1) | **–1.9 (-2.49, –1.31)B** | **<0.001** |
| Huang, 2012,  22480863,Taiwan | Length of stay (d) | High | NA | 126 | 7 (5) Range (5, 10) | 117 | 8 (1) Range (5, 12) | **–1 (–1.8, 0.2)B** | **0.027** |
| Matassi, 2014,  23271039,  Belgium | Length of stay (d) | Moderate | NA | 61 | 9.1 (2.1) | 61 | 9.9 (2.3) | **–0.8 (–1.58, –0.02)B** | **0.011** |
| Soeters, 2018, 29529614, USA | Length of stay (d) | Moderate | NA | 32 | 2.7 (95% CI 2.4, 3.0) | 31 | 3.0 (95% CI 2.7, 3.3) | NR | 0.161 |
| Williamson, 2007,  17604311, UK | Length of stay (d) | Moderate | NA | 23 | 6.49 (1.99) | 19C | 6.6 (2.62) | –0.12 (–1.11,0.88) | 0.0984 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, d = day, LOS = length of stay, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation.

A Time from surgery

B Calculated

C Control arm sample size is uncertain from study report. Study was retained despite potential sample size of control being less than 20

**Need for postoperative procedures**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Matassi, 2014,  23271039,  Belgium | Need for postoperative procedures: Stiff knee requiring MUA | Moderate | 12 mo | 61 | 5 (8.2%) | 61 | 3 (4.9%) | 1.73 (0.39, 7.57) | NR |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, d = day, MUA = manipulation under anesthesia, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation.

A Time from surgery

**Other healthcare utilization outcomes**

| **Study, Year, PMID, Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control Mean (SD)** | **Effect Size (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Soeters, 2018, 29529614, USA | Met discharge criteria from physical therapy | Moderate | NA | 32 | 1.8 (95% CI 1.4, 2.3) | 31 | **2.9 (95% CI 2.5. 3.4)** | **NR** | **<0.001** |
| Outpatient physical therapy sessions (n) | Moderate | NA | 32 | 3.4 (95% CI 3.0, 3.9) | 31 | **4.6 (95% CI 4.2, 5.0)** | **NR** | **<0.001** |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, n = number, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation

A Time from surgery

Healthcare Utilization Outcomes – Prehabilitation for Total Hip Arthroplasty

**Length of stay**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bitterli, 2011, 21630176, Switzerland | Length of stay (d) | Moderate | 41 | 14.6 (2.5), Range (11-23) | 39 | 14.6 (2.6), Range (8-22) | 0 (-1.12, 1.12)A | NR |
| Pour, 2007, 17768187, USA | Length of stay (d) | High | 46 | 4.2, Range (3-8) | 48 | 3.5, Range (2-5) | NR | **0.001** |
| Soeters, 2018, 29529614, USA | Length of stay (d) | Moderate | 31 | 3.1 (SE: 0.26†)  95% CI 2.6, 3.6 | 32 | 4.1 (SE: 0.26A)  95% CI 3.6, 4.6 | **MD -1 (-1.72, -0.28)A** | 0.15 |
| Vukomanović, 2008, 18499950, Serbia | Length of stay (d) | High | 20 | 9.8 (2.4) | 20 | 10.2 (1.7) | MD -0.4 (-1.56, 0.76)A | 0.67 |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, d= day, MD = mean difference, mo = months, NR = not reported, PMID = PubMed identifier, RoB = risk of bias, SD = standard deviation, SE = standard error

A Calculated

**Other healthcare utilization outcomes**

| **Study, Year,**  **PMID,**  **Country** | **Outcome Measurement** | **Overall RoB** | **Time PointA** | **Prehab, N** | **Prehab, Mean (SD)** | **Control, N** | **Control, Mean (SD)** | **Effect Size  (95% CI)** | **Reported p-Value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pour, 2007, 17768187, USA | Discharge disposition – home (n) | High | NA | 46 | 41B | 48 | 33B | **OR 3.73 (1.23, 11.32)C** | **NR** |
| Discharge disposition – skilled rehabilitation facility (n) | High | NA | 46 | 5B | 48 | 15B | **OR 0.26 (0.08, 0.78)C** | **NR** |
| Soeters, 2018, 29529614, USA | Met PT discharge criteria (d) | Moderate | NA | 31 | 1.3, 95% CI 0.8, 1.8 | 32 | 2.3, 95% CI 2.0. 2.9 | **-1 (-1.68, -0.32)C** | **<0.001** |
| Outpatient physical therapy sessions (PT visits) | Moderate | NA | 31 | 3.1, 95% CI 2.6, 3.6 | 32 | 4.1, 95% CI 3.6, 4.6 | **-1 (-1.72, -0.28)C** | **0.001** |
| Vukomanović, 2008, 18499950, Serbia | Outpatient physical therapy sessions (service utilization - classes needed with the therapist) | High | NA | 20 | 5.2 (2.35) | 20 | 6.85 (1.14) | **-1.65 (-2.68, -0.62)C** | **0.02** |

Statistically significant effect sizes are in bold text. In cases where calculated effect size confidence intervals were not-statistically significant but reported p-values were, we deferred to reported p-values and still bolded results.

Abbreviations: CI = confidence interval, d = day, MD = mean difference, NR = not reported, n = number, PMID = PubMed identifier, PT = physical therapy, RoB = risk of bias, SD = standard deviation.

A Time from surgery

B Categorical outcome; number of patients

C Calculated

1. Time point cutoffs for outcomes were informed through stakeholder feedback which resonated with literature noting a lag in recovery immediately after TKA/THA. Specifically, for postoperative outcomes (for both prehabilitation and rehabilitation), stakeholders agreed that short-term outcomes (less than 3 months for TKA and 6 months for THA) were too early to see functional- and patient-reported improvements and suggested that these outcomes are likely to be influenced by other patient and surgical factors, in additional to any (p)rehabilitation received. The exception was short term post-operative healthcare utilization outcomes following prehabilitation (e.g., length of stay, discharge disposition). [↑](#footnote-ref-1)