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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| In an 18-year-old recovering from anterior cruciate ligament reconstruction (P), are daily physical activity levels and step count (I) a better indicator for recovery and knee health at 1 year follow-up (O) compared to usual PT care (C)? |

**AUTHOR**

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| **Prepared by** | Mary Grace Knoll | **Date** | 11/30/2021 |
| **Email address** | marygrace\_knoll@med.unc.edu | | |

**CLINICAL SCENARIO**

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| The patient is an 18-year-old recreationally active individual that tore their left anterior cruciate ligament (ACL) when playing intermural soccer with friends while changing directions. The patient initially heard a pop and reported feeling unstable, confirmed with MRI showing tear in the L ACL. The patient underwent surgical reconstruction 4 days following ACL injury. The patient would like to return to full recreational activity, playing intermural sports with friends as well as performing resistance training and running, overall remaining active. I would like to know whether physical activity and step count driven monitoring of individuals creates better outcomes for knee health down the road than usual PT care following ACLR (anterior cruciate ligament reconstruction). |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| Eight studies met the inclusion and exclusion criteria including one systematic review, five cross-sectional studies, and two cohort studies.1-8   * Addressing all aspects of recovery in individuals with ACL injuries and/or ACLR prior to surgery, following surgery and returning to sport/activity regarding measurements of ROM and strength, implementation of strengthening exercises, psychological factors, and performance-based testing and objective measures for returning to sport will allow for the best outcomes1 * Individuals following ACLR participate in less moderate to vigorous daily physical activity and have decreased daily step counts than compared to healthy-aged, matched peers.2 * The odds of female individuals participating in greater than 150 minutes of moderate to vigorous physical activity were 2.54 times worse than their healthy, age-matched peers.6 * There is a lack of objectively measured physical activity and patient-reported assessment of physical activity, demonstrating different things2,7 * There is a large psychological component affecting one’s ability to participate and perform physical activity following ACLR, affecting participation and daily step counts1,2,5 |

**CLINICAL BOTTOM LINE**

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| Young adults who have undergone ACLR, looking for the best outcomes for knee health and overall health thought their lifetime, should follow an evidence-based prehabilitation and rehabilitation program facilitated by a physical therapist, such as the one described by van Melick et al1 (clinical practice guidelines endorsed) as well as continue to increase participation in physical activity and daily step counts to stay as active as their healthy peers. By addressing both issues of receiving the best prehabilitation and rehabilitation, as well as receiving education on discrepancies in decreased physical activity and step count, will allow for this young adult returning from ACLR to have the best knee health and overall health outcomes for the rest of their remaining lives, preventing future problems. |

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| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

*The above information should fit onto the first page of your CAT*

**SEARCH STRATEGY**

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| **Terms used to guide the search strategy** | | | |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| 18-year-old ACLR  Young adult ACLR  ACLR | Daily physical activity  Step count  Daily exercise | Clinical Practice Guideline  Exercise program  Exercise therapy  Physical therapy modalities | Knee health  Knee pain  Knee function  Knee joint |

**Final search strategy (history):**

*Show your final search strategy (full history) from PubMed. Indicate which “line” you chose as the final search strategy.*

Search: **young adults AND ACLR AND step count**

("young adult"[MeSH Terms] OR ("young"[All Fields] AND "adult"[All Fields]) OR "young adult"[All Fields] OR ("young"[All Fields] AND "adults"[All Fields]) OR "young adults"[All Fields]) AND ("ann clin lab res"[Journal] OR "aclr"[All Fields]) AND ("step"[All Fields] AND ("count"[All Fields] OR "counted"[All Fields] OR "counting"[All Fields] OR "countings"[All Fields] OR "counts"[All Fields]))

**Translations**

**young adults:** "young adult"[MeSH Terms] OR ("young"[All Fields] AND "adult"[All Fields]) OR "young adult"[All Fields] OR ("young"[All Fields] AND "adults"[All Fields]) OR "young adults"[All Fields]

**ACLR:** "Ann Clin Lab Res"[Journal:\_\_jid101663073] OR "aclr"[All Fields]

**count:** "count"[All Fields] OR "counted"[All Fields] OR "counting"[All Fields] OR "countings"[All Fields] OR "counts"[All Fields]

Search: **young adults AND ACLR AND physical activity**

("young adult"[MeSH Terms] OR ("young"[All Fields] AND "adult"[All Fields]) OR "young adult"[All Fields] OR ("young"[All Fields] AND "adults"[All Fields]) OR "young adults"[All Fields]) AND ("ann clin lab res"[Journal] OR "aclr"[All Fields]) AND ("exercise"[MeSH Terms] OR "exercise"[All Fields] OR ("physical"[All Fields] AND "activity"[All Fields]) OR "physical activity"[All Fields])

**Translations**

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**ACLR:** "Ann Clin Lab Res"[Journal:\_\_jid101663073] OR "aclr"[All Fields]

**physical activity:** "exercise"[MeSH Terms] OR "exercise"[All Fields] OR ("physical"[All Fields] AND "activity"[All Fields]) OR "physical activity"[All Fields]

Search: **young adults AND ACLR AND physical activity AND knee function**

("young adult"[MeSH Terms] OR ("young"[All Fields] AND "adult"[All Fields]) OR "young adult"[All Fields] OR ("young"[All Fields] AND "adults"[All Fields]) OR "young adults"[All Fields]) AND ("ann clin lab res"[Journal] OR "aclr"[All Fields]) AND ("exercise"[MeSH Terms] OR "exercise"[All Fields] OR ("physical"[All Fields] AND "activity"[All Fields]) OR "physical activity"[All Fields]) AND (("knee"[MeSH Terms] OR "knee"[All Fields] OR "knee joint"[MeSH Terms] OR ("knee"[All Fields] AND "joint"[All Fields]) OR "knee joint"[All Fields]) AND ("functional"[All Fields] OR "functional s"[All Fields] OR "functionalities"[All Fields] OR "functionality"[All Fields] OR "functionalization"[All Fields] OR "functionalizations"[All Fields] OR "functionalize"[All Fields] OR "functionalized"[All Fields] OR "functionalizes"[All Fields] OR "functionalizing"[All Fields] OR "functionally"[All Fields] OR "functionals"[All Fields] OR "functioned"[All Fields] OR "functioning"[All Fields] OR "functionings"[All Fields] OR "functions"[All Fields] OR "physiology"[MeSH Subheading] OR "physiology"[All Fields] OR "function"[All Fields] OR "physiology"[MeSH Terms]))

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**knee:** "knee"[MeSH Terms] OR "knee"[All Fields] OR "knee joint"[MeSH Terms] OR ("knee"[All Fields] AND "joint"[All Fields]) OR "knee joint"[All Fields]

**function:** "functional"[All Fields] OR "functional's"[All Fields] OR "functionalities"[All Fields] OR "functionality"[All Fields] OR "functionalization"[All Fields] OR "functionalizations"[All Fields] OR "functionalize"[All Fields] OR "functionalized"[All Fields] OR "functionalizes"[All Fields] OR "functionalizing"[All Fields] OR "functionally"[All Fields] OR "functionals"[All Fields] OR "functioned"[All Fields] OR "functioning"[All Fields] OR "functionings"[All Fields] OR "functions"[All Fields] OR "physiology"[Subheading] OR "physiology"[All Fields] OR "function"[All Fields] OR "physiology"[MeSH Terms]

Search: **young adults AND anterior cruciate ligament reconstruction AND physical activity AND knee function** Filters: **Meta-Analysis, Randomized Controlled Trial, Systematic Review**

(("young adult"[MeSH Terms] OR ("young"[All Fields] AND "adult"[All Fields]) OR "young adult"[All Fields] OR ("young"[All Fields] AND "adults"[All Fields]) OR "young adults"[All Fields]) AND ("anterior cruciate ligament reconstruction"[MeSH Terms] OR ("anterior"[All Fields] AND "cruciate"[All Fields] AND "ligament"[All Fields] AND "reconstruction"[All Fields]) OR "anterior cruciate ligament reconstruction"[All Fields]) AND ("exercise"[MeSH Terms] OR "exercise"[All Fields] OR ("physical"[All Fields] AND "activity"[All Fields]) OR "physical activity"[All Fields]) AND (("knee"[MeSH Terms] OR "knee"[All Fields] OR "knee joint"[MeSH Terms] OR ("knee"[All Fields] AND "joint"[All Fields]) OR "knee joint"[All Fields]) AND ("functional"[All Fields] OR "functional s"[All Fields] OR "functionalities"[All Fields] OR "functionality"[All Fields] OR "functionalization"[All Fields] OR "functionalizations"[All Fields] OR "functionalize"[All Fields] OR "functionalized"[All Fields] OR "functionalizes"[All Fields] OR "functionalizing"[All Fields] OR "functionally"[All Fields] OR "functionals"[All Fields] OR "functioned"[All Fields] OR "functioning"[All Fields] OR "functionings"[All Fields] OR "functions"[All Fields] OR "physiology"[MeSH Subheading] OR "physiology"[All Fields] OR "function"[All Fields] OR "physiology"[MeSH Terms]))) AND (meta-analysis[Filter] OR randomizedcontrolledtrial[Filter] OR systematicreview[Filter])

**Translations**

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Search: **young adults AND anterior cruciate ligament reconstruction AND device based physical activity AND outcomes**

("young adult"[MeSH Terms] OR ("young"[All Fields] AND "adult"[All Fields]) OR "young adult"[All Fields] OR ("young"[All Fields] AND "adults"[All Fields]) OR "young adults"[All Fields]) AND ("anterior cruciate ligament reconstruction"[MeSH Terms] OR ("anterior"[All Fields] AND "cruciate"[All Fields] AND "ligament"[All Fields] AND "reconstruction"[All Fields]) OR "anterior cruciate ligament reconstruction"[All Fields]) AND (("device s"[All Fields] OR "equipment and supplies"[MeSH Terms] OR ("equipment"[All Fields] AND "supplies"[All Fields]) OR "equipment and supplies"[All Fields] OR "device"[All Fields] OR "instrumentation"[MeSH Subheading] OR "instrumentation"[All Fields] OR "devices"[All Fields]) AND ("based"[All Fields] OR "basing"[All Fields]) AND ("exercise"[MeSH Terms] OR "exercise"[All Fields] OR ("physical"[All Fields] AND "activity"[All Fields]) OR "physical activity"[All Fields])) AND ("outcome"[All Fields] OR "outcomes"[All Fields])

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**device:** "device's"[All Fields] OR "equipment and supplies"[MeSH Terms] OR ("equipment"[All Fields] AND "supplies"[All Fields]) OR "equipment and supplies"[All Fields] OR "device"[All Fields] OR "instrumentation"[Subheading] OR "instrumentation"[All Fields] OR "devices"[All Fields]

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**physical activity:** "exercise"[MeSH Terms] OR "exercise"[All Fields] OR ("physical"[All Fields] AND "activity"[All Fields]) OR "physical activity"[All Fields]

**outcomes:** "outcome"[All Fields] OR "outcomes"[All Fields]

Search: **young adults AND anterior cruciate ligament reconstruction AND step count**

("young adult"[MeSH Terms] OR ("young"[All Fields] AND "adult"[All Fields]) OR "young adult"[All Fields] OR ("young"[All Fields] AND "adults"[All Fields]) OR "young adults"[All Fields]) AND ("anterior cruciate ligament reconstruction"[MeSH Terms] OR ("anterior"[All Fields] AND "cruciate"[All Fields] AND "ligament"[All Fields] AND "reconstruction"[All Fields]) OR "anterior cruciate ligament reconstruction"[All Fields]) AND ("step"[All Fields] AND ("count"[All Fields] OR "counted"[All Fields] OR "counting"[All Fields] OR "countings"[All Fields] OR "counts"[All Fields]))

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**count:** "count"[All Fields] OR "counted"[All Fields] OR "counting"[All Fields] OR "countings"[All Fields] OR "counts"[All Fields]

*In the table below, show how many results you got from your search from each database you searched.*

|  |  |  |
| --- | --- | --- |
| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **PubMed**  **CINHAL**  **Embase** | **57, 7, 4**  **10**  **36** | **Systematic Review, meta-analysis and RCT, age 19-24**  **English, adolescent (13-18) and young adults (19-44)**  **Adolescent (13-18) and young adult (19-44), controlled trial, systematic review and meta-analysis** |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| * Published in English * Young adults (ages 18-30) * ACL reconstruction surgery * Peer reviewed RCT or systematic review * Reported outcomes (self-reported and objective) for knee health and/or function * Daily step count- personal or commercial accelerometer * Physical therapy rehabilitation |
| **Exclusion Criteria** |
| * Children (under 18) and adults over 30 * Published earlier than 2000 * Additional knee pathologies other than ACL |

**RESULTS OF SEARCH**

**Summary of articles retrieved that met inclusion and exclusion criteria**

*For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).*

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| **Author (Year)** | **Risk of bias (quality score)\*** | **Level of Evidence\*\*** | **Relevance** | **Study design** |
| **van Melick et al 20151** | **AMSTAR 2: High (No critical errors, however potentially small error)**  **Low Risk of Bias** | **Level 1**  **Grade Up** | **High** | **Systematic Review/CPG** |
| **Bell et al 20172** | **Low Risk of Bias**  **8/8 Yes**  **JBI Critical Appraisal for Analytical Cross-Sectional Studies** | **Level 3** | **High** | **Cross-sectional Study** |
| **Fones et al 20203** | **Low/Mod Risk of Bias**  **8/10 yes, 1/10 no, 1/10 N/A**  **JBI Critical Appraisal for Case-Control Studies** | **Level 3** | **Moderate** | **Case – Control Study** |
| **Ezzat et al 20214** | **Low/Mod Risk of Bias**  **9/11 yes, 1/11 no, 1/11 N/A**  **JBI Critical Appraisal Checklist for Cohort Studies** | **Level 3** | **Mod/Low** | **Cohort Study** |
| **Baez et al 20205** | **Low/Mod Risk of Bias**  **7/8 yes, 1/8 no**  **JBI Critical Appraisal for Analytical Cross-Sectional Studies** | **Level 3** | **Moderate** | **Cross-Sectional Study** |
| **Kuenze et al 2019 Sex Differences in PA following ACL6** | **Low Risk of Bias**  **8/8 yes**  **JBI Critical Appraisal for Analytical Cross-Sectional Studies** | **Level 3** | **Mod/Low** | **Cross-Sectional Study** |
| **Kuenze et al 2019 Relationship between PA and Outcomes after ACL7** | **Low Risk of Bias**  **8/8 yes**  **JBI Critical Appraisal for Analytical Cross-Sectional Studies** | **Level 3** | **High/Mod** | **Cross – Sectional Observation Study** |
| **Ardern et al 20168** | **Moderate risk of Bias**  **6/8 yes, 2/8 no**  **JBI Critical Appraisal for Analytical Cross-Sectional Studies** | **Level 4** | **Mod/Low** | **Cross- Sectional Study: Prognostic Case Series** |

\*Indicate tool name and score

\*\*Use Portney Table 36-1: Summary of Levels of Evidence (2020). If downgraded, indicate reason why.

**BEST EVIDENCE**

The following 2 studies were identified as the ‘best’ evidence and selected for critical appraisal. Rationale for selecting these studies were:

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| * **van Melick N, van Cingel REH, Brooijmans F, et al. Evidence-based clinical practice update: practice guidelines for anterior cruciate ligament rehabilitation based on a systematic review and multidisciplinary consensus. *Br J Sports Med*. 2016;50(24):1506-1515. doi:10.1136/bjsports-2015-0958981**   + This article demonstrated quality evidence found with no critical errors using the AMSTAR. This systematic review demonstrates small risk of bias, being designed, and executed well. This was endorsed by the APTA as the current clinical practice guideline for ACL reconstruction rehabilitation, making it one of, if not, the current gold standard for ACL reconstruction rehabilitation for practicing physical therapist. This is a high-quality comparison in my PICO to address my clinical question. This also is of high relevance to my PICO, being the correct patient population and intervention with associated outcomes that I was looking for. Overall, this high-quality study and highly relevant study to my clinical question is a great article choice for me to use moving forward. * **Bell DR, Pfeiffer KA, Cadmus-Bertram LA, et al. Objectively measured physical activity in patients after anterior cruciate ligament reconstruction. *Am J Sports Med*. 2017;45(8):1893-1900. doi:10.1177/03635465176989402**   + Even though this study was an observational cross-sectional study design, making it only a level 3 evidence category, it was well done. It was shown to be high quality in that it scores an 8/8 yes’ on the JBI cross-sectional design critical appraisal tool indicating a low risk of bias present. Additionally, this article is of high relevance to my clinical question, looking at the objective measurement of physical activity following ACL reconstruction making this is best option to look at my interventional, clinical question for outcomes following ACL reconstruction. Overall, this is the strongest article I could find looking at this topic area of research that also fit well into my clinical question. There is not another one that demonstrated as little risk of bias and increase relevance throughout this search that than article. |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of Evidence-based clinical practice update: practice guidelines for ACL rehabilitation based on a systematic review and multidisciplinary consensus by van Melick et al, 20161**

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| **Aim/Objective of the Study/Systematic Review:** |
| A multidisciplinary group of Dutch Physical therapist specializing in ACL rehabilitation to develop an evidence-based statement for rehabilitation after ACLR endorsed by the APTA for a clinical practice guideline for rehabilitation following ACLR. |
| **Study Design1**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| Search Strategy: done in MEDLINE and Cochrane Library, identifying articles from 1990 up to June of 2015, utilizing specified key words addressing the 9 topics from the PICO question. Meta-analyses, systematic reviews, randomised control trials and prospective cohort studies were included for study selection.  Selection Criteria: Two independent reviewers screened eligible articles based off title and abstract. If two reviewers could not reach a consensus, a third review made a final decision. Following this step, full text articles were screened using inclusion/exclusion criteria. Additionally, reference lists of meta-analysis and systematic reviews for additional studies that were not included in the first search were included and reviewed.  Methodological Quality Assessment: This was performed independently by two reviewers, a third was brought in when a final decision needed to be made. Each article was individually graded for level of methodological quality using the AMSTAR checklist for systematic reviews and meta-analysis, as well as the PEDro scale for RCT with those scoring than equal to or less than a 4 being excluded. Prospective cohort studies were assessed using Cochrane Library Checklist and only used when there was not a RCT to support findings.  Data Extraction: This was performed by one reviewer. Results from the chosen studies were put into evidence statement. From each topic selected, from the relevant articles, a final conclusion was made with level of evidence. RCT that were included in systematic reviews or meta-analysis were not utilized separately. |
| **Setting1**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| Search and data acquisition for this systematic review took place at the Royal Dutch Society for Physical Therapy at the research institute for Health Sciences in The Netherlands. |
| **Participants1**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| All those included in the study were those with history of ACL injury and associated reconstruction. In this being a systematic review, it was not explicitly stated among each study who the participants consisted of, but overall, it was individuals with history of ACL injury and/or ACLR. Of the articles included, they contained criteria about brace-free rehabilitation for bone patellar tendon bone or hamstring graft ACL reconstructions. The articles that were excluded involved individuals receiving other graft types (allograft, quad, etc) or those that received at ACL revision. Additionally, they excluded those that were braced following reconstruction and those that were skeletally immature. They additionally only included human studies, all animal and cadaveric studies were excluded. |
| **Intervention Investigated1**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| This was a systematic review concerning creating a consensus on rehabilitation following ACLR. Therefore, there was a number of controls. In some studies, they compared to a time-based protocol while others compared to the contralateral or uninvolved limb, self-reported measures, or healthy controls. There were various comparisons throughout as the articles were looking at various interventions. There was a large variation in control groups. |
| *Experimental* |
| Regardless, this group consisted of individuals following ACLR reconstruction following a variety of ACLR rehabilitation programs directed by physical therapist. These various rehabilitation programs focused on time-based interventions, performance-based interventions, open kinetic chain versus closed kinetic chain exercises, strength and neuromuscular training, psychological factors, modalities such as ice, e-stim, electromyography, etc and return to play measures and training. There are many various aspects of rehabilitation methods used. |
| **Outcome Measures1**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| There are various outcome measures chosen in the articles included in the systematic review and this information was not explicitly stated. These outcomes were focused on functional performance following ACLR, activity levels, strength, etc. One used commonly among these articles with the Tenger Scale of activity and monitoring change throughout the recovery process. This is a 1 item score on a 1 to 10 scale. Score of 0 indicates the lowest possible demonstrating those who are unable to participate and/or on disability etc, where 10 represents individuals competing at the highest level such as nationally, collegiate, or professionally. For functional performance measures, using extensive testing batteries that includes strength testing, hop testing, video analysis, and movement quantity and quality are to be used. This included the Landing Error Scoring System, performed by the individuals and administered by the therapist with a max score of 19 points indicating lowest performance, with a score of less than or equal to 5 indicating the individual is good and at low risk. Additionally for strength, Limb Symmetry Index done with Isometric dynamometer testing was included, with a goal of greater than 90% symmetry. It is additionally reported that psychological factors should also be looked at, and how they change throughout the recovery process such as Marx Scale and Knee Self-Efficacy Scale. The Marx Scale is an additionally scale determining the physical activity done by individuals, with a total max score of 16, indicating extremely active, participating in many sport-like activities of pivoting, cutting etc, with a 0 indicating no participation in these sport-like activities. The Knee Self-Efficacy Scale is a patient reported scale with 22 items on a 0 to 10 scale, with 10 indicating high self-efficacy and 0 indicating low self-efficacy. There are few specifically stated outcome measures used in the systematic review, however, they identify domains that associated objective measurements and outcomes measures should be administered. |
| **Main Findings1**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. You may summarize results in a table but you must explain the results with some narrative.] |
| There are multiple findings of this article for a consensus of rehabilitation following ACLR. These are divided into three sections.1 For preoperative rehab, they suggest measuring preoperative ROM, as extension deficit is a major risk factor for an extension deficit following surgery.1 Additionally, is to recommend to measure quadriceps and hamstrings strength prior to surgery as a deficit in strength of greater than 20% to contralateral leg has negative consequences at 2-year follow-up after surgery.1 Additionally, recommending individuals participate in preoperative rehab as it has been shown to elecit better results at 2-year follow-up.1 For postoperative rehab, the recommendations are inconclusive on supervision rehab program versus home based rehab etc.1 There were no differences in outcomes when comparing at 19-week program to a 32-week program in terms of laxity, ROM, self-reported knee function, single-leg hip test for distance or quadricep and hamstring strength.1 The recommendation, however, is to continue working on rehab from 9 to 12 months, depending on goal.1 It is also recommended to immediately weight bear following injury as this had no effect on knee laxity and decreased anterior knee pain.1 It’s recommended to use cryotherapy for pain in first week postoperatively to reduce pain.1 It’s recommended to start isometric quadriceps exercises in the first week, as well as use e-stim in conjunction with isometric strength training for re-educating voluntary contracture.1 Once the quadriceps are reactivated, concentric and eccentric exercise should replace isometric.1 Closed chain can be performed from 2 weeks post-op on, where open chain can start 4 weeks on in 90-45 degrees of knee ROM.1 No extra weight can be added to first 12 weeks of hamstring open chain to prevent graft elongation.1 ROM can be increased from 90 to 30 degrees in week 5, 90-20 in week 6, 90-10 in week 7, full ROM in week 8.1 Neuromuscular training is also recommended.1 Checking for psychological changes, prior, during and post rehab is an additional recommendation.1 For return to play criteria, it is recommended that clinicians administer an extensive test battery for quantity and quality of movement, including strength, hop testing, and quality of movement with greater than 90% limb symmetry being cut-off point, with 100% being preferred in pivoting and contact sports.1 In implementing all of these things, this allows for the best outcomes of knee and overall health for individuals following ACLR.  Text  Description automatically generated  Table 6 in van Melick et al1 on page 8 |
| **Original Authors’ Conclusions1**  [Paraphrase as required. If providing a direct quote, add page number] |
| Rehabilitation following ACLR consists of three important phases: preoperative rehabilitation, postoperative rehabilitation, and return to sport/activity.1 In each one of these phases, the goals for progressing on to the next phase should be focused on using the principles of the International Classification of Functioning, Disability and Health, focusing first on impairments and recommendations for protection of healing tissues.1 For return to play, there should be extensive performance testing done, including strength, hopping, and movement quality prior to retuning individuals to full sprot and/or activity and preventing future knee health problems.1 |
| **Critical Appraisal** |
| **Validity1**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| Each article that was included in the review was assessed for quality using an associated risk assessment. For meta-analysis and systematic reviews, the AMSTAR was used, as I also used it for this article demonstrating a low risk of bias with no critical errors associated with the article. RCTs were assessed using PEDro scale and those scoring less than or equal to 4 were not included in the review due to predominantly lack of blinding. Those that were prospective cohort studies were assessed with the Cochrane Library Checklist and were only included if there was not higher evidence on the subject available. This was a strength of this study, including predominately high-level evidence, level 1A or 1B that was assessed prior to being included. An additional strength is quality assessment of each article was done by two separate reviewers with a third stepping in when required. The overall quality of evidence was fairly high, being assessed prior to inclusion, however, going back to 1990, some of the data may be outdated. Having a smaller inclusion window may have caused the results to be as up to date as possible. Overall, the article was high quality evidence as there was a low risk of bias with no critical errors via AMSTAR, but selection and assessment of articles within the review were well done, allowing for this to be strong article. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| This is a strong article with generalizable results and recommendations that can be easily implemented into a clinical setting. This article compiles a lot of information currently in the literature about ways to treat individuals following ACLR and looks at the information present and forms an easy-to-follow recommendation for implementing into the clinic. They divide this into various time frames throughout the process, being even easier to implement. Preoperatively, it is important and recommended to participate in rehabilitation as this has been associated with improved outcomes compared to those who have not, as well as measure knee extension to determine if there is a deficit and determine the difference in strength between quadriceps and hamstrings. For postoperatively, there is a lack of clear evidence determining the level of supervision needed for a successful program so a suggested minimally supervised program may cause the most successful outcome in clinic, continuing rehab over the course of 9 to 12 months. E-stim and cryotherapy can be effective and used early in the rehabilitation process. For strengthening quadriceps isometric strengthening can be started in the first week, then restricted closed and open chain exercises can progress from there. Additionally, neuromuscular training should be added into the program as well as assessing for and addressing psychological factors. As far as return to play, there should be performance testing done in all aspects before returning to sport, as well as ensuring limb symmetry index is tested as at a minimum of 90%, preferable 100%. Overall, this article has strong information with well laid out recommendations and information to implement easily into clinical practice. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| This article is of great relevance and applicability to my intended clinical question. This article being the endorsed clinical practice guideline for ACLR treatment by the APTA, this is the most accurate representation of what is to be considered standard treatment individuals are receiving following their injury and/or surgery. As there is a lot of information among this topic, this article demonstrates accurately depicts the areas in which various clinicians are addressing during care making is very relevant and applicable to clinical question as this is the standard, I am wanting to compare to following this injury and/or reconstruction. This article is very feasible for incorporating into clinical practice in the face of individuals returning to activity or sport following ACL injury and/or reconstruction. This article outlines suggestions for clinicians to use and implement every step of the process, allowing for it to be easy to follow and implement into practice with plenty of suggestion on what to use for each. |

**(2) Description and appraisal of Objectively Measured Physical Activity in Patients after ACLR by (Bell et al, 2017)2**

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| **Aim/Objective of the Study/Systematic Review2:** |
| The aim of this study was to investigate the differences in average time spent in moderate to vigorous physical activity and step count between individuals who underwent ACLR and those of healthy, age-matched controls. |
| **Study Design2**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| This study by Bell et al2 was an observational, cross-sectional study in which objectively measures physical activity of those with ACLR was compared to healthy, age-matched controls. |
| **Setting2**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| This took place in outpatient setting and/or sports laboratory research at the University of Madison Wisconsin and Michigan State University, utilizing both locations. |
| **Participants2**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| Individuals were put into two groups, one being those with history of ACLR and those of health, matched controls. This included 33 patients with history of primary unilateral ACLR within the past 5 years that were cleared for return to physical activity and 33 health, matched controls. All participants were 18 to 35 years old, with no chronic or acute neurological, cardiopulmonary, or any other medication conditions. Individuals with medial collateral ligament injuries who underwent meniscal repair or partial meniscectomy at the time of ACLR were included. Those participants that experienced significant surgical complications with extended medical care of subsequent surgeries were excluded. They were additionally excluded it posterior cruciate ligament or posterolateral corner reconstruction occurred at time of ACLR as well as history of significant lower extremity injuries with associated surgeries. Health controls were matched to those with the ACLR group by +/- 4 years, sex, and physical activity level over the past 12 months by Tenger score. There were no significant differences between groups for height, weight, and body mass index. The ACLR group did report lower IKDC scores than compared to health, matched controls. |
| **Intervention Investigated2**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| This was a cross-sectional, observational study so there were not different “interventions” between groups, however those in the control group were healthy (no prior history of ACL injury or reconstruction) and aged matched to those in other group. They wore an accelerometer for 7 days, going about normal daily life and physical activity, additionally completing the International Knee Documentation Committee (IKDC) subjective form along with the Tenger and Marx activity scales. |
| *Experimental* |
| This was a cross-sectional, observational study so there were not different “interventions” between groups. The “experimental” group consisted of individuals that had previous history of ACL reconstruction, unilaterally or bilaterally, weaking an accelerometer for 7 days, additionally going about normal daily life and physical activity. They also completed the IKDC subjective form and Tegner and Marx activity scales. |
| **Outcome Measures2**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| They used patient reported outcomes of the International Knee Documentation Committee (IKDC) to assess lower extremity function and activities of daily living being affected by ACLR. This scale is out of a total of 87 points, indicating that a score of 87 means no impairments for the individual, 0 meaning incredibly impaired, unable to do anything. Participants also completed the Tenger activity level scale to determine peak physical activity for matching to health control participants. This is a 1 item score on a 1 to 10 scale. Score of 0 indicates the lowest possible demonstrating those who are unable to participate and/or on disability etc, where 10 represents individuals competing at the highest level such as nationally, collegiate, or professionally. The Marx activity scale is an additionally scale determining the physical activity done by individuals, with a total max score of 16, indicating extremely active, participating in many sport-like activities of pivoting, cutting etc, with a 0 indicating no participation in these sport-like activities. These were all self-reported outcome measures given to the patients by the researchers. Objectively, they included accelerometers to determine time spent in physical activity. These are valid and reliable to use in an active, young adult population. The monitors were put on each individual to wear for 7 days, and then upon returning, the researchers analysed the data collected from the accelerometers. Once they were on, individuals did not have to adjust the monitors. |
| **Main Findings (Pages 6 &7)2**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.] |
| One of the main findings of this study was that, after controlling for amount of accelerometer wear time, the patients with a history of ACLR spent significantly less time in moderate to vigorous physical activity than compared to their healthy, age-matched controls (P=0.02, 95% CI for effect size -1.21 to -0.22).2 Additionally, they had a significantly lower step count than the control group (P = 0.02, 95% CI for effect size -1.18 to -0.18).2 Between the groups, there were not differences for patient-reported physical activity levels (P = 0.85).2 42% of control participants met the guideline of 10,000 steps per day while only 24% of ACLR patients did.2 Moderate to vigorous physical activity and step could were significantly, positively, and strong correlated in the ACLR (r = 0.91, P <0.001) and control groups (r = 0.88, P < 0.001).2 Moderate to vigorous physical activity was not significantly correlated with Marx ([ACLR r = 0.05, P = 0.79], [Control r = 0.11, P = 0.55]), Tegner ([ACLR r = 0.25, P = 0.16], [Control r = -0.07, P = 0.69]) or IKDC scores ([ACLR r = -0.02, P = 0.89], [Control r = 0.33, P = 0.06]).2 On average, ACLR group did 15 minutes less physical activity a day and took 1611 fewer steps per day than their healthy, age-matched controls.2 (All pages 6 and 7)2 |
| **Original Authors’ Conclusions2**  [Paraphrase as required. If providing a direct quote, add page number] |
| Individuals who have had previous history of ACLR where less physically active throughout their daily lives than compared to their aged, matched controls even though both seemed to be meeting the recommended guidelines for physical activity.2 ACLR patients had a lower daily step count and spent less time participating in moderate to vigorous physical activity even though they were reporting doing the same amount of physical activity as their healthy peers.2 This demonstrates the need for physical activity to be monitored in an objective way when recovering from ACLR to ensure physical activity continues and patients are not perceiving they are participating more than they assume they are.2 Keeping individuals active following ACLR is important to ensure there are not future health problems due to the lack of inactivity.2 |
| **Critical Appraisal** |
| **Validity2**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| Based on the organization of the study, this is already at a lower level of evidence due to its format, making it a level 3 of evidence, however, to the best of my knowledge, there is not an article investigating similar clinical question of a higher level. The observational, cross-sectional study demonstrates low risk of bias scoring an 8/8 on the JBI Critical Appraisal for Analytical Cross-Sectional Studies. There were equal number of ACLR patients compared to health controls, having good representation of both groups. The outcome measures used are reliable and valid, often being used in this active, young, patient population and diagnosis. They accelerometers used are valid and relatable for young and active populations as well, demonstrating appropriate measures used. Given that this was an observational study, the design, the measures used and the low risk of bias cause of it to be sound evidence to use in practice for this clinical question and patient population. This data is generalizable to those within approximately 5 years of ACLR, especially those assuming they are back to their prior level of function, along with their healthy peers. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| These results are significant in that these two groups of people are stating that they are doing the same amount of physical activity each day, with many of these people with a previous history of ACLR reporting that they are feeling back to their prior level of function since before surgery, however there are significant differences demonstrating that throughout everyday life, that is not the case. They are on average doing 15 minutes less of physical activity a day and taking 1611 fewer steps than their healthy peers.2 This, at first glance, may not seem like much of a difference, but over weeks, months and years that is an extreme difference between individuals who report they are participating in the same amount of physical activity. This study shows there is a clear difference in the amount of physical activity and exercise between individuals who have a previous history of ACLR than compared to those who do not. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| This is very relevant and applicable to my clinical question as this is the aspect of ACLR care that I am wanting to look into a learn more about, and how to implement it with individuals in the clinic. An individual can participate in physical therapy and do the rehab they need to do to feel they are back to their prior level of function; however, objective data is showing us otherwise. This is more difficulty to feasibly implement into the clinic as this shows this is an area that needs to be addressed so that individuals later on in life are remaining as physically active as their peers with no previous ACLR history, however, it does not demonstrate a good way to implement it. With that being said, using this information as an education component for patients following ACLR can be helpful. Implementing accelerometer physical activity monitoring throughout daily life could also be helpful to continue to track throughout the rehabilitation process. This is helpful information to know to ensure this area is being addressed to promote better lifelong health and habits, however, there is limited information in the literature on those trying to implement this into practice currently. Monitoring and using as an education point can be a good place to prevent form happening to other ACLR patient, preventing future health problems related to inactivity in the future. |

**SYNTHESIS AND CLINICAL IMPLICATIONS**

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

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| The combination of these two studies addresses each aspect of my clinical question, looking at and approaching the outcome of ACLR from a traditional standpoint, and the effects of long-term outcomes with physical activity. Unfortunately, my clinical question has not been compared to each other within one study, indicating that further research on this topic is warranted. The first study by van Melick et al1 is very relevant to the clinical question, addressing the typical standard practice individuals following ACLR are receiving, being endorsed by the APTA as being the clinical practice guideline on this topic. This systematic review addresses many aspects that may be associated into individuals’ treatment following ACLR, prior to surgery, following surgery, and returning to sport and/or activity.1 The recommendations of this review determine the evidence provided for each intervention to produce the best outcome for the individual following ACLR.1 It’s an easy-to-follow recommendation list with associated evidence and its corresponding level to easily implement into clinical practice.1 This starts with rehabilitation and determining if there are negative risk factors from the start regarding ROM and strength, to the things that should or should not be implemented into the rehabilitation and their associated timelines such as open chain versus closed chain exercises.1 All ending with what to implement when returning the individual to sport/activity and what to address.1 Overall, this level 1 evidence article contained low risk of bias as determined by the AMSTAR, included articles were also assessed using associated measures, causing for this to be high quality evidence to implement into practice and used in the clinical question. Future studies should include information in this systematic review and compare them to other protocols or treatment types individuals may be implementing into practice, such as physical activity monitoring, to determining what is producing the better outcomes in the long term for this patient population, or how we could adjust or add to this clinical practice guideline.  The article by Bell et al2 addresses the other part of the clinical question, also being very relevant to the question and scenario. This cross-sectional observational study determines the differences in self-reported physical activity and objective, recorded physical activity between individuals following ACLR and those of their healthy-matched peers.2 This study determined that even though individuals following ACLR were reporting the same amount of physical activity participation and exercise as their peers, there were significant differences between the amount of time spent in moderate to vigorous physical activity and a lower overall daily step count associate with these no differences in self-reported.2 Individuals following ACLR on average demonstrated 15 minutes less of physical activity daily and 1611 less steps daily, contributing to a large deficit of physical activity differences between groups over weeks, months, and years.2 Overall, this cross-sectional observational study, level 3 evidence had a low risk of bias as determined by JBI Critical Appraisal for Analytical Cross-Sectional Studies scoring at 8/8 points. Even though this is level 3 evidence, the study was well designed, using valid and reliable measures to determine differences between groups. Future studies should explore interventions that could potentially increase the amount of physical activity and step count for individuals following ACLR in the years and lifetime following their surgery and rehabilitation. Having the knowledge that individuals are participating in less physical activity and decreased step count compared to years is helpful in knowing, however, studying interventions to make this change would be an important next step.  Based on the two studies above, I conclude that both standard ACLR rehabilitation-based approach and implementing increased participation in physical activity and increased step count are needed to produce the best outcomes following ACLR. It is shown that given typical standard rehabilitation, that individuals following ACLR years down the road are still participating less in daily physical activity and have decreased step count compared to healthy peers. With this, there is further research needed comparing interventions addressing the two aspects, one of continued traditional care (clinical practice guidelines) and one addressing the discrepancies in physical activity participation and step count. To provide the best care to this patient and the best outcome, a combination of both things needs to be done. Ensuring they are getting the best care possible with the current clinical practice guidelines, while ensure education and intervention is being done to encourage participation in physical activity and increase daily step count will produce the best outcomes. |

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[List all references cited in the CAT]

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