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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| For a 66-year-old man with knee osteoarthritis, does internet based exercise prescription in conjunction with physical therapy result in a greater decrease in pain than physical therapy alone? |

**AUTHOR**

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**CLINICAL SCENARIO**

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|  Knee osteoarthritis (OA) is a common musculoskeletal condition that is seen in older adults. Many times, physical therapy is prescribed for conservative management of the condition before surgery (total knee arthroplasty, TKA) is done. Physical therapists use strengthening exercises, flexibility stretches, movement retraining and various modalities to treat this condition and physical therapy has been found to be effective in managing pain.1,2 However, general physical activity has also been found to be significantly helpful with decreasing pain in the long term within this population.3 Despite this knowledge, it can be very difficult for a sedentary patient to begin and establish a proper exercise program, especially if the patient believes that physical activity will continue to exacerbate knee pain. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| * Ten articles that included Web based physical activity interventions were chosen for review: six randomized controlled trials, two cohort studies, one systematic review and one meta-analysis.
* There is currently no evidence on the use of Web based physical activity interventions in conjunction with physical therapy or compared to physical therapy alone. The current reviewed evidence studied the use of Web-based exercise programs that were targeted to sedentary adults or patients with OA (hip/knee). Most trials included an intervention group and compared results to a control group that did not have access to the Web based program. The participants of these research studies completed the interventions independently; the participants did not typically have direct contact with researchers unless they were not completing the weekly assigned program. Greater weight was given to the articles that specifically prescribed an actual exercise program rather than provided information focused on pain modulation.
* The majority of evidence found that adults who used a Web based physical activity interventions had greater physical activity levels then a control group that did not have access to the intervention. Studies that included participants with knee OA found a significant reduction in overall pain levels and negative pain perceptions. Participants who used the Web based intervention also had significantly higher function scores and greater levels of self-efficacy to manage arthritis pain.
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**CLINICAL BOTTOM LINE**

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| Web based exercise interventions have been found to increase physical activity in patients with knee OA, as well as improve pain levels, function and self-efficacy to manage pain. Therapists should consider the use of a Web based exercise program targeted to people with knee OA in conjunction with typical physical therapy interventions in order to effectively promote exercise habits and decrease pain within this population.  |

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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*** |

**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) |
| Knee osteoarthritis [MESH] Knee OA OA Osteoarthritis | Physical therapyInternet exercises App Physiotherapy PT Web Exercises Computer exercises Internet based exercise | Physical therapy Physiotherapy PT Therapist  | Endurance Walking endurance Ambulation endurance Exercise tolerance Exercise endurance Aerobic endurance Aerobic capacity |

**Final search strategy:**

*Show your final search strategy from one of the databases you searched. In the table below, show how many results you got from your search from each database you searched.*

#5,"Search (((((knee AND osteoarthritis))) AND ((physical therapy OR physiotherapy OR rehabilitation))) AND (((internet based OR web based OR computer based OR e-health) AND (exercise and physical activity)))) AND pain",8,14:26:33

#4,"Search pain",624348,14:26:23

#3,"Search ((internet based OR web based OR computer based OR e-health) AND (exercise and physical activity))",1806,14:26:19

#2,"Search (physical therapy OR physiotherapy OR rehabilitation)",576372,14:25:44

#1,"Search (knee AND osteoarthritis)",23811,14:25:27

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **Pubmed** **CINAHL (without pain included)** **Web of Science** **PEDro** | **8****2****11****2** | **None** **30, was able to get more when I did not use knee osteoarthritis as a search term** **13 when I did not use pain as a search term, 104 articles appeared when I did not include knee OA as a search term, 30 when I did not use PT as a search term****what did you use to get 11? Was it search line #5 from above?** |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| * Randomized controlled trials, controlled trials, uncontrolled trials
* Systematic review of RCTs
* Published up to September 2015
* Internet based exercise program included
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| **Exclusion Criteria** |
| * Case series studies/cohort studies/case controlled studies
* Expert opinion
* Abstracts, conference proceedings, letters to the editor, dissertations, narrative review articles
* Pain management
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**RESULTS OF SEARCH**

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

*For each article that meets your inclusion and exclusion criteria, score for methodological quality on an appropriate scale, categorize the level of evidence, and note the study design (e.g., RCT, systematic review, case study).*

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| **Author (Year)** | **Study quality score** | **Level of Evidence** | **Study design** |
| **Bossen et al. (2013)**  | **6/11 (Pedro)** | **1b**  | **Randomized Controlled Trial**  |
| **Brooks et al. (2014)**  | **14/26 (Downs and Black)**  | **4**  | **Prospective Cohort Pilot Study (no control)** |
| **Davies et al. (2012)** | **10/11(AMSTAR)\*\*** | **2a**  | **Meta-analysis (25/34 were RCTs)**  |
| **Irvine et al. (2013)** | **5/11 (PEDro)**  | **2b**  | **Randomized Controlled Trial (<85% follow up)**  |
| **Lorig et al. (2008)**  | **5/11 (PEDro)**  | **2b**  | **Randomized Controlled Trial (<85% follow up)** |
| **Pietrzak et al. (2013)** | **6/11 (AMSTAR)**  | **2a** | **Systematic Review (4/5 articles were RCT, 1/5 was a cohort study)** |
| **Rini et al. (2015)**  | **8/11 (PEDro)** | **1b**  | **Randomized Controlled Trial**  |
| **Trudeau et al. (2015)** | **7/11 (PEDro)**  | **1b**  | **Randomized Controlled Trial**  |
| **Wilson et al. (2015)**  | **4/11 (PEDro)**  | **2b**  | **Randomized Controlled Trial (<85% follow up)** |
| **Umapathy et al. (2015)**  | **10/26 (Downs and Black)**  | **2c**  | **Cohort study (non-experimental used in real world conditions)** |

*(All 10 articles should appear in the reference list at the end)*

**BEST EVIDENCE**

The following 3 studies were identified as the ‘best’ evidence and selected for critical appraisal. Reasons for selecting these studies were:

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| * **Trudeau et al., (2015)**4**:** This article is high level evidence (RCT, Level 1b) and had one of the highest quality scores (7/11). The majority of the patients included in this study have osteoarthritis of the knee or hip (59%). Although the majority of the program is focused on pain coping/self management strategies, there is an exercise component included. The study includes change in exercise behaviour as well as pain for outcome measures
* **Bossen et al. (2013)**5**:** Although this article had a lower quality score than the Wilson et al. article, it was directly related to my population, intervention and outcome of my PICO question. Specifically, it described an Internet based physical activity module designed for patients with knee and hip OA and included pain and pain coping as secondary outcome measures.
* **Brooks et al. (2014)**6**:** Although this was the lowest quality evidence of all my studies, it included 3 out of 4 aspects of my PICO question: population, Internet based exercise intervention for the specific population and pain as an outcome measure. The other high quality studies I found primarily focused on pain coping strategies/self management strategies in which exercise was not included. The rest of the studies I found included Internet based intervention to improve overall physical activity but did not include my population or outcome of interest. Many of the authors of this article are involved an RCT which actually compares this intervention to physical therapy, which would perfectly fit my PICO question.
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**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of “Effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis: randomized controlled trial.” by Bossen et al., 2015**

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| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of this study was to determine the short term and long term effects of an internet based exercise prescription program (Join2Move) on physical activity, physical function and self perceived effect in sedentary individuals with knee/hip osteoarthritis |
| **Study Design**[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. |
| * Randomized Controlled Trial – Level IIb (<80% participation at final follow up)
* Participants were randomized into receiving access to the intervention or no access (control group). Neither participants nor researchers were blinded to group assignment.
* Group allocation was concealed; a researcher who was not involved in data collection provided sequentially ordered opaque sealed envelopes with allocation details. Participants received an email indicating access to the intervention or if they were put on a waiting list
* Continuous recruitment occurred for data collection (January 3rd, 2011 to November 5th, 2011); participants began 9 week module program after November 5th.
* 83 participants (41 in control, 42 in intervention group) randomly selected to receive an accelerometer to assess physical activity objectively. The decision to send an accelerometer to only some participants was based off limited resources and time. Accelerometers were sent by post at 3 months and 12 months post-intervention; participants were instructed to wear it for 4 days straight and complete a short wearing diary and then return the accelerometer by post.
* Outcome measures taken at baseline, 3 months and 12 months after the participant completed the modules/after initial assignment via an online questionnaire. Pain was a secondary outcome measure.

No face-to-face contact occurred with participants except for telephone reminders to complete the online survey if they did not do so within 2 weeks. |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| * Study conducted in the Netherlands; advertisements were put in Dutch newspapers and online
* Participants completed the intervention and online questionnaires at home computer
* Only contact was for telephone reminders for people to complete follow up questionnaires
* Accelerometers were sent and received by post
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| **Participants**[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. |
| * Convenience sample done through online and newspaper advertisements in the Netherlands
* N = 199 (99 in control, 100 in intervention group)
	+ N = 83 randomly selected to receive accelerometer (42 in control, 41 in intervention group)
* Demographic Characteristics
	+ No baseline differences found between groups
	+ 129 female, 70 male
	+ Mean age of participants = 62 years (SD = 5.7)
	+ Diagnosis: 127 knee OA, 41 hip OA, 31 both
	+ Mean BMI of participants: 27.6 (SD = 4.5)
	+ Majority of participants had been experiencing knee OA symptoms for > 7 years (36%)
	+ 63% had no additional comorbidities
	+ Educational level: 45% completed high education (college degree of above)
* Program Usage:
	+ Adequate adherence to program set at performing 6 out of 9 modules
	+ Only 94 participants started program, average rate of completion was 5.6/9 modules
		- Only 46% participants (46/100) reached threshold of adherence
	+ Patients with another comorbidity were more likely to be non-adherent
* Follow Up Rate
	+ 3 month follow up online survey completion rate: 84% in intervention group, 85% in control group
	+ 12 month follow up online survey completion rate: 76% in intervention group, 74% in control group
	+ 3 month accelerometer return: 68% return rate in intervention group, 76% in control group
	+ 12 month accelerometer return: 61% return rate in intervention group, 71% in control group
	+ Major reasons for drop out: health/medical issues (37%), personal family reasons (13%), lack of motivation (15%), personal/family reasons (13%) and unknown reasons (22%)
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| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| These patients were on the waiting list to join the intervention and gained access to the intervention after the research trial period. They received a letter with information about physical activity, osteoarthritis in general and about the study. These participants had no contact with intervention group participants and no access to the Join2Move intervention. 42/99 of these participants received an accelerometer. |
| *Experimental* |
| * Participants in the intervention group were provided a username and password to the Join2Move online program. The purpose of Join2Move is to have the participant select their favorite exercise activity and then gradually increase the amount of time they spend performing their favourite exercise activity over a 9-week period. This intervention has been tested in focus and pilot studies; it is based off a previously developed behaviour graded activity program.
* Total of 9 modules to be completed, determined threshold of adherence to be 6/9 modules completed.
* The initial module consists of a 3-day baseline test of physical activity, choosing an activity of interest, creating a goal and providing text messages to promote physical activity. Based on information from this initial evaluation, 8 tailored modules were automatically generated. Participants were able to access this information 24/7.
* Each module included a text based assignment and evaluation form that assessed pain and overall performance on completing the module. The information in the modules discussed how to perform physical activity despite the presence of pain.
	+ Based on the evaluation answers, automated text based messages were sent throughout the week to the participants about overall performance and pain levels
		- Evaluation answers were based on performance on module (completing the module activities) and pain levels (10 point numerical scale)
	+ Self paced module assessment: a new module appeared after patient finished a module OR participants were able to access the new module at the beginning of the week
	+ Participants were allowed to repeat module or continue onto the new module each week
		- Automated email also sent if participant was not on the website regularly
* Along with individually tailored modules, there was access to general information about osteoarthritis as well as supplementary exercise videos participants could view.
* 41/100 participants randomly received accelerometer
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| **Outcome Measures** (Primary and Secondary)[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| Outcome measures were sent via an online questionnaire at 3 months and at 12 months Primary Outcome Measures: * Physical Activity Scale for the Elderly – self reported physical activity measure
	+ 0 – 400 scale, higher score indicating higher activity level
	+ Each question has a specific weight based on the answer that contributes to the final score7
* Physical Activity Monitored by Accelerometers
	+ A random sample of participants in both the control and intervention group received an accelerometer that measured their activity over the course of 5 days. They also completed a diary about wearing time and answered questions about different activities and reason for device removal.
	+ These accelerometers were sent and received by post and participants who had 10 hours of physical activity recorded were analysed and put into various physical activity thresholds (sedentary – vigorous activity)
		- Activity Level: Sedentary activity: 0-99 counts for sedentary activities, Light physical activity (PA): 100-1951 counts, Moderate PA: 1952-5724 counts, Vigorous PA: 5725-9498 counts, Very vigorous: 9499-max counts.
	+ The total time spent in light, moderate and vigorous/very vigorous PA was summed and divided by the number of days worn to determine daily average time spent in PA
* Knee Injury and Osteoarthritis Score (KOOS)/Hip Disability Injury and Osteoarthritis Score (HOOS): Measure of physical function
	+ Subscales: Pain, symptoms, ADL, Sports/Recreation and Quality of Life
	+ Answers on 5 point Likert Scale (0-4, never to extreme)
	+ Each subscale score is normalized to a is scored 0-100; 100 indicating greatest function

 * + 5 point Likert scale asking about: pain, physical function, sport/recreation function, quality of life and symptoms specific to body part
* “What was the degree of change since your previous assessment?” – Measure of self-perceived effect
	+ 7 point Likert Scale ranging from much worse – much better
	+ Outcomes grouped into improved (slightly better to much better) or not improved (much worse to about the same)

Secondary Outcome of Interest: * Pain: 10 Point Numerical Rating Scale
	+ 0 is no pain, 10 is worst possible pain
* Other secondary outcomes included: fatigue, anxiety/depression, quality of life, self-efficacy, pain coping, locus of control and symptoms
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| **Main Findings**[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] |
|  Although the module assessments could be completed within 9 weeks, the authors assessed outcomes at baseline, in the short term (3 months), and long term (12 months). The control group had greater amount of physical activity measured objectively at baseline by the accelerometer (395 min/day) compared to the intervention group (369 min/day), indicating that they may have been more active initially. However, all other baseline physical activity and physical functioning measurements were relatively equal.  At 3 months, the intervention group scored 6.5 points higher than the control group for improved physical functioning, which was found to be significant (95% CI: 1.8-11.2; p < 0.006). They also found that the intervention group had improved self-perceived effect, with an odds ratio of 10.7 (95% CI: 4.3-26.4; p value < 0.001), suggesting that the intervention is associated with higher odds of improved self-perceived effect. However, they did not find any significant differences in subjective reporting of physical activity at 3 months (PASE score of 162 compared to 163 in the control group; 95% CI of -16.6 – 13.5, p < 0.84). Objectively, participants in the intervention group only had 3 minutes more of PA when compared to the control (361 min/day vs. 359 in control group; p < 0.83). There was a small effect size found for physical functioning at 3 months (d = 0.2); the effect sizes for physical activity were negligible (d = 0.01 for PASE, d = 0.02 for accelerometer measure). However, according the accelerometer measures, both groups had decreased PA at both the 3 month and the 12-month mark overall.  At 12 months, there was a significant difference for physical activity; for the PASE measure, there was significant 21.2 point change between groups (95% CI: 3.6-38.9; p value < 0.02; effect size: *d* = 0.18). For the accelerometer group, there was a significant mean difference of 24 min of physical activity/day (95% CI: 0.5 – 46.8 min; p < .045; effect size 0.19). There were no significant differences between groups in physical functioning or self perceived effect at 12 months, but there was still an effect size of 0.17 found for physical functioning at this time.  For general trends, physical functioning remained constant within groups between 3 to 12 months; self – perceived effect was found to decrease for both groups between 3 to 12 months. Total physical activity increased or remained constant in the intervention group within the 9-month period but decreased over the 9-month period for the control group.  Overall, for my specific outcome of interest, there were no significant differences found for pain between groups at either the 3 month or 12 month follow up. However, at baseline, the intervention group had a higher pain score (5.6/10 compared to 4.9/10 for control) but had lower pain scores at the 3-month and 12-month mark compared to the control (despite the lack of significance). At 3 months, there was a small effect size for pain(d = 0.20), and change in pain level since baseline was 1.9 points, which is larger than the MCID for the numeric pain rating scale.2 Therefore, the effects of the intervention on pain may be clinically meaningful for the short term only.  |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| The Join2Move intervention has the potential to improve physical activity levels in patients with knee or hip OA. There were small effect sizes (between 0 – 0.19) for change in physical activity behaviour. For the PASE outcome, there was an increase in scores within in the intervention group both at 3 months and at 12 months. However, the objective and subjective measure of PA was not congruent – this may be due to over-estimation that occurs with subjective measures. Nonetheless, objectively, they found that the control group had a reduction in physical activity levels while the intervention group remained constant with their PA levels. There were significant short-term improvements for physical function and self perceived effect, but these effects did not stay significant in the long term. There were also positive effects found for the intervention group in the following secondary outcome measures: pain, fatigue, self-efficacy, pain coping and anxiety. |
| **Critical Appraisal** |
| **Validity**[Identify the strengths and limitations of the study, including potential sources of bias. Comment on the overall methodological quality (including the score) as you determined from your assessment of the article. Comment on anything you believe was missing in the paper.] |
| * PEDro Scale score: 7/11 based on the following: eligibility criteria: Yes; Random Allocation: Yes; Concealed Allocation: Yes; Baseline Comparison: Yes; Blind Subjects: No; Blind Therapist: No; Blind Assessors: No; >85% participant outcomes: No; Intention to treat analysis: Yes; Between group comparison: Yes; Point estimates and variability: Yes
* Use of a volunteer, convenience sample that was only available via print and online advertisements may have limited the sample to people who were interested in exercising.
* Participants (and researchers) were not blinded to their group and therefore this may have skewed results.
* The use of two measurements for physical activity may have introduced type I error; i.e. the use of the two measurements may have found a significant difference between groups when there was actually not one. For example, the accelerometer found that both groups decreased total time of PA at both 3 months and 12 months, but the PASE score showed an increase in PA levels for the intervention group.
* There was a smaller sample of participants who received the accelerometer data compared to all the participants who completed the PASE outcome and therefore there may have had increased bias in the accelerometer measurements of physical activity. Also, the accelerometer was unable to record swimming activity, which the authors stated was a common cardiovascular activity that people participated in.
* Randomized controlled design decreased overall bias and subjects did not differ significantly at baseline
* Had sufficient sample size of n=199 for overall power of 0.8 to determine a small effect size of 0.2.
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| **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.] |
| Overall, this study found that a web – based physical activity intervention significantly improves physical activity levels in sedentary subjects with knee OA in the long term (12 month) period. The researchers also found a small effect size with both outcome measures (PASE: 0.18, accelerometer: 0.19). This indicates that the web-based intervention may have had a small, clinically meaningful effect on physical activity levels. Although physical activity measure by the accelerometer may have been skewed (due to smaller sample size), the intervention group had higher subjective and objective physical activity measures in the long term. It also found the intervention significantly improved physical functioning; self perceived effect and pain in the short term for participants who used the web-based intervention. This is important because if patients feel like the intervention is improving their overall condition, they are more likely to continue to do it independently. With improved self-effect, patients are understanding that this intervention is affecting their condition positively and therefore will be more likely to continue participation in physical activity. The primary weakness of the study design was that researchers were not blinded to participant’s conditions; however, since the online questionnaires were sent via email, researchers could not affect the data but only record and interpret it. Furthermore, there was a drop out rate of about 25% towards at the 12-month mark, but the researchers intention to treat analysis allowed for the information for these participants to be included. Overall, the strong study design and small effect sizes of this study suggest that there is a positive effect of a web based intervention program on physical activity levels, physical functioning, self perceived effect and pain.  |

**(2) Description and appraisal of “Web-based therapeutic exercise resource center as a treatment for knee osteoarthritis: a prospective cohort pilot study” by Brooks et al. 2014**

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| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of this study was to determine if the use of a Web based Therapeutic Exercise Resource Center (TERC) would result in an improvement of clinical outcomes in patients with knee OA.  |
| **Study Design**[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. |
| * Prospective Cohort Study with no control group, Level IV evidence
* 65 patients consented and were eligible to participate, only 52 participants included in final analysis over the 8 weeks
	+ Participants had mild/moderate OA (as determined by symptoms and radiograph measures) were included in the study for a total of 8 weeks
* Outcomes measures at baseline and at the end of the 8 week trial through online questionnaires and included: mSF-WOMAC, WHO Quality of Life questionnaire, Self Efficacy Scale, Global Rating of Change and user satisfaction.
	+ Knee pain measure was a component of the mSF-WOMAC
 |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| * Participants were recruited from University of Wisconsin Hospital and Clinics in Madison, WI
* Participants completed all program activities, exercises as well as outcome measures at home computer
 |
| **Participants**[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. |
| * 65 participants were eligible to participate in the study, only 52 participants included for final analysis
	+ Only 63 participants initially performed the interventions as 2 of the original participants had health problems.
	+ 6 participants were lost to drop out; these participants were primarily male (53%) and had significantly higher BMI than those that completed the intervention
* These participants either had mild or moderate knee as determined by their medical record, confirmed physician diagnosis as well as with radiographic evidence (using the Radiographic Classification Criteria for knee OA)
* To be included in the study, participants had to had to be older than age 25, have good health overall, be able to walk independently, have a home computer and a personal email account and also were able to read English.
* Patients with major medical issues such as severe cardiovascular conditions or neurological disorders were excluded from the study. Furthermore, patients who had fallen in the past 6 months or were receiving any type of treatment for their knee OA (injections, physical therapy) were also excluded.
* Participants were recruited as a part of a convenience sample at outpatient physician clinics that were part of the University of Wisconsin Hospital system. Patients were either asked by their doctor during a medical visit to participate in the study or potentially eligible patients were sent an informational letter about the study. If the patient was interested, he/she would call the researchers to determine final eligibility and provide consent.
* Demographic Characteristics:
	+ No significant differences found between groups
	+ 48.1% of participants were female
	+ The majority of participants (21.2%) were between the ages of 51-55
	+ Most of the participants had an unhealthy weight as measured by BMI (40.0% overweight, obese 32%).
	+ 63% of participants had completed a 4 year college degree or higher
* All intervention participants received necessary equipment to complete exercise routine by post
 |
| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| As this was a prospective cohort study, there was no control group and all participants had access to the intervention.  |
| *Experimental* |
| All participants were provided access to the Therapeutic Exercise Resource Center (TERC) and completed baseline measurements. The TERC included strength and flexibility exercises that targeted the LE (glutes, hamstrings, quads) and also provided instructions for a progressive aerobic walking program. Exercise programs were prescribed to be performed 5 days a week. Participants provided general health/exercise history information and completed the Modified Short Form Western Ontario and McMaster Universities Arthritis Index (mSF-WOMAC) so that the program could create an initial, individualized routine. Exercise intensity was increased progressively by increasing the number of exercises, increasing the resistance for strength exercises and increasing the speed/time spent walking. Each exercise had an accompanying video and written instructions that explained how to perform the exercise. The TERC program also included educational information about knee osteoarthritis and how to manage and cope with pain.After each exercise session was reviewed, the participants were required to record if they were able to complete the daily program and report if they had an increase in knee pain during the program. Patrticipants had the ability to request a more difficult or an easier program than the daily program that was prescribed. Participants were only allowed to complete a more difficult program only if they had a msf-WOMAC score equal or greater than before. The TERC program would alert patients to try a more difficult routine if they were able to exercise for 2 weeks without pain; the program also would alert someone with continued knee pain for 3 days to perform an easier exercise program. All required exercise equipment was mailed to the participants without charge. Participants who did not complete online logs during a one-week period received an email from the program. If patients had any questions about the program, exercises or symptoms, they were able to contact the researchers, their primary physician or their physical therapist for an answer.  |
| **Outcome Measures** (Primary and Secondary)[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| Modified Short-Form WOMAC* Assesses knee pain, stiffness and daily function for people with knee osteoarthritis
* Participants answer questions on 7 measures of function on a Likert Scale of 0 -5; 0 no dysfunction worse, 4 indicating extreme dysfunction.
* Total score possible: 0 – 56, lower score indicates greater functionality
* Administered at baseline at and 8 weeks and as needed when a participant wanted to increase difficulty of exercise program

World Health Organization - Quality of Life Scale * Short form measures that assesses psychological and physical health
* Likert scales for each question representing different scoring; raw scores have to be specifically converted to transformed score
* Higher score represents greater quality of life

Self – efficacy (Knee Self Efficacy Scale), Global Rating of Knee Symptom Change and user satisfaction with the program were all secondary outcome measures in this study.  |
| **Main Findings**[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] |
| All patients accessed the TERC program for an average 47.2/56 total days; patients reported completing the exercise program 4-5 days per week on average. After 8 weeks, a significant effect for stiffness (mean difference: 1.27 points, 95% CI: 0.70-1.84), pain (mean difference: 2.07 points, 95% CI: 1.01-3.13) and daily functioning (mean difference: 3.23 points, 95% CI: 1.68-4.78) on the msf-WOMAC were found. An overall large effect size (0.70) for composite functional score was found; the pain domain specifically had an effect size of 0.66. There was also a significant increase in self-efficacy with a medium effect size (0.54). There were also small-medium effect sizes found for physical and psychological quality of life (0.33 and 0.18 respectively). The majority of patients (51%) reported that their knee pain was “somewhat better” after the 8-week intervention. There was a high rate of satisfaction with the program, with 53.8% of participants stating that aspects of website were easy to use and 46.8% stating that they would use this program in the future.  |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| The authors state that this 8-week Web based TERC intervention demonstrated a significant improvement in pain, stiffness, daily function, physical health quality of life and self-efficacy. They reported that 4 out of 5 patients explicitly stated that they had an improvement in knee symptoms. Overall, participants were highly satisfied with the program and the majority of participants stated that they would use this program in the future. The authors also state that the high adherence rate to this program was due to the requirement of having patients record their daily exercise programs as well as due to the individualized modification to the exercise routines. The authors also discuss how the individualization of the program may be why the fact that BMI, duration of symptoms and age did not seem to have an effect on efficacy of treatment and thus makes it generalizable to a larger patient population. The authors suggest that this type of Web based intervention could be a potential alternative to direct physical therapy for patients who live in rural areas or who are primary caregivers and do not have the time to attend physical therapy on a regular basis. Furthermore, they stated that primary care physicians who may not have the time or knowledge to discuss physical activity with their patients with knee OA could potentially prescribe this TERC program for pain management and exercise.  |
| **Critical Appraisal** |
| **Validity**[Identify the strengths and limitations of the study, including potential sources of bias. Comment on the overall methodological quality (including the score) as you determined from your assessment of the article. Comment on anything you believe was missing in the paper.] |
|  This study had a score of 14/26 on the Downs and Black Checklist primarily due to the convenience sample of the population, the lack of blinding of participants and researchers, and the lack of a control group. Overall, due to the design of this study, there is a high probability that bias has affected the final outcomes found. There was no control group for comparison to see if the intervention was the sole reason for the change in scores. The use of the convenience sample may not represent the entire population in an outpatient physical therapy setting and thus decreases overall external validity. Furthermore, this type of intervention would not be applicable to anyone with significant cardiovascular disease, neurological condition and/or balance problems due to the exclusion criteria.  Moreover, there was a 20% drop out rate (13/65) and these participants were primarily male and had a higher BMI then those who completed the 8 weeks. The lack of these participants could have resulted in could have positively skewed the data.  There was no general indication of physical activity level beforehand. Although the study mentioned that some participants had been doing physical therapy prescribed exercises before the initiation of the program, they did not have a measure of baseline physical activity levels. Although they provided averages of how many times the program was accessed and days that people completed the exercise program, they did not report specifically how exercise activity improved. Nonetheless, if this cohort was more active initially, this may have accounted for the increased adherence and positive outcomes found.  The study was sufficiently powered to determine a medium – large effect size and medium to large correlations (requirement of 37 participants total, n = 52 analysed). Also, in order to decrease confounding factors of other treatments, the study excluded patients who were receiving any other type of treatment for their knee OA (such as injections, physical therapy or a previous knee replacement). They also performed a moderating factor analysis on potential demographic characteristics that could have affected outcomes. These practices contributed to the overall internal validity of the study.  |
| **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.] |
| The TERC program seems like an excellent resource that includes strength, flexibility and aerobic exercises that are based off clinical guidelines for exercise in this population. The program can be individualized based off pain outcomes after exercise as well as by patient choice (the participants can choose to have an easier or more difficult routine than the one prescribed). There was large effect sizes found for pain (0.68), stiffness (0.68), daily function (0.66) and self-efficacy as well (0.54). However, due to the lack of a control group, it cannot be stated that these results solely occurred due to the intervention. Furthermore, the population may not be representative of an outpatient orthopaedic population due the exclusion of patients with cardiovascular/neurological conditions and patients who received other common treatments for OA such as injections and physical therapy. Nonetheless, despite the low quality design of the study, the positive results of this study indicate that the Web based intervention has the potential to improve pain in patients with knee OA and did not cause adverse effects on functioning. However, due to the weak study design, there is a lot of potential bias that could have affected the final results. Future research needs to be done with stronger study design in order to truly understand the effect of this intervention.  |

**(3) Description and appraisal of “A randomized controlled trial of an online self management program for adults with arthritis pain” by Trudeau et al., 2015**

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| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of this research of this study was to determine the effect of a Web based arthritis pain management program (painACTION ) on pain self management, cognition about condition, pain levels and functioning in patients with knee OA.  |
| **Study Design**[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. |
| * Randomized controlled trial; parallel group design
* Randomized using stratified block randomization using the conditions of gender and type of arthritis. A computer generated programming performed the randomization
* No blinding of participants or researchers occurred in the study as the measures were self reported through an online questionnaire
* Participants completed baseline, 4 week and 6 month assessments through online questionnaire \
* Participants were compensated $250 for participation in the study
 |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| * Flyers distributed at doctor’s offices, senior citizen service organization and events held by the Arthritis Foundation – MA chapter for recruitment
* Actual intervention occurred on participants’ computer of choice (private or public)
 |
| **Participants**[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. |
| * N = 228, randomized into 113 in intervention group, 115 in control group
* Greater attrition rate in the intervention (6.2% at 1 mo, 10.6% at 3 mo, 14.2% at 6 mo.) than in the control group (2.6%, 8.7%, 6.8% respectively)
	+ Researchers used an intention to treat analysis; overall follow up greater than 85% at all time points
* Demographic Characteristics: No significant differences found between groups
	+ Average age: 49 years old for both groups
	+ 44.3% were 4 year college graduate
	+ 63% had an income of $75,000 – $99,000
	+ Majority were married (55.3%) and were employed full time (58.8%)
	+ Majority of participants had osteoarthritis (59%); rheumatoid arthritis or arthritic diagnosis made up 41%
	+ 87.3% of participants were white
* Recruitment occurred via flyers passed out doctor’s offices, events conducted by the arthritis foundation, social media and at senior citizen service organizations. Online ads were distributed through email announcements, web postings and Google ads.
	+ Recruitment began in September 8, 2011
	+ Final data analysis occurred for all participants in November 11, 2012
* Participants were compensated $250 for being in the study
 |
| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| This was a wait-list control group, and these participants were able to access the intervention program after the 6 months. They were encouraged to continue any medical treatment they had been receiving.  |
| *Experimental* |
| Participants were given access information to the painACTION education intervention. This intervention utilizes cognitive behavioural therapy techniques to help users learn how to cope and manage their chronic condition. Content includes information about how to communicate about their chronic pain with healthcare professionals, how to promote positive cognitions about pain, self check assessments for self-efficacy and also inspirational stories from other people facing similar conditions. There were also tools for managing pain that provided information about how to perform physical activity while having an arthritic condition. Participants were asked to complete at least 2 twenty-minute sessions for 4 weeks (8 sessions, 160 minutes total) initially. After completing these 8 sessions, participants were then asked to perform five 20-minute sessions once a month for 5 months. Researchers tracked participant access and use of the program by their personal ID number and sent out weekly reminders via email to complete the assignment for the week. Phone calls were made to participants if there was a large period of inactivity to determine the cause and to encourage continued participation.  |
| **Outcome Measures** (Primary and Secondary)[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| Primary Outcome Measures: * Pain Catastrophizing Scale: measures elements of catastrophizing
	+ 13 item scale, 4 point Likert Scale
	+ Maximum score of 52, higher score indicates greater pain catastrophizing
* Arthritis Self Efficacy Scale: assesses confidence to manage pain from arthritis
	+ 8 item questionnaire, 0-10 score
	+ 80 points total, higher score indicates greater self efficacy to manage arthritis pain
* Pain-Awareness Questionnaire: assess awareness patient has of current pain
	+ 7 item questionnaire, 0 (never)-5 scale (always)
	+ 28 points total, higher score indicating greater awareness of pain
* Exercise Behaviours
	+ 6 item questionnaire assessing total time patient does exercise (aerobic, strengthening)
	+ 0-4 scale, 0 indicating no participation in the activity, 4 indicating at least 3 hours a week of this activity
	+ Greater score indicates greater amount of exercise
* Brief Pain Inventory: assesses pain severity and pain interference on daily function
	+ 11 items, 0-10 numeric rating scale
	+ High score indicates greater pain severity/interference
* Global Rating of Change Scale
	+ Patients score how they feel about their condition after completing the intervention on a 1-7 scale; 1 indicating condition “has much improved”, 7 indicating condition has become “very much worse”

Other measures for depression/anxiety, pain coping, global rating of change and data for site usage were included in this study.  |
| **Main Findings**[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] |
| * Significantly greater increase for intervention group for self efficacy measure from baseline to 1 month and baseline to 6 month follow up compared to the control group
	+ 1 month: ES = 0.53, t = 2.64, p = 0.0222
	+ 6 month: ES = 0.66, t = 2.75, p =0.0164
* Significant decrease in pain catastrophizing total score from baseline to 6 months in intervention group compared to control group
	+ 6 month: ES = -4.22, t = -3.53, p = 0.0013
* No statistical significance for pain intensity, pain severity, pain interference, physical function and frequency for participating in pain self management activities
* No significant change in exercise behaviour between groups at any time point; both groups had about a 28 min increase in time spent in aerobic exercise from baseline to 6 months
* Global rating of change from baseline to 6 months significantly improved in patients in the experimental group compared to the control group
	+ 6 month: ES = -0.61, t=3.38, p < 0.001
* Moderating Variables:
	+ Post-hoc comparisons between patient diagnoses found that patients with osteoarthritis in the experimental condition had a significant decrease in Pain Catastrophizing total score (t = -2.82, p = 0.0282) from baseline to 6 months, but this change was not found in the other types of arthritis in the intervention groups
	+ Gender, race, age or baseline pain intensity did not moderate effects of intervention on final outcomes
* User engagement was significantly associated with improved outcomes between baseline and 6 months (no data provided for this information)
	+ 57.5% participants completed the two sessions a week over 4 weeks (160 minutes total)
 |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
|  The authors state that they did not find a significant between group difference in the various domains of pain outcomes, such as: change in worst pain, pain severity, pain interference, pain intensity or pain awareness. There were also no significant differences between groups for stress levels, depression or exercise behaviour, which could have influenced pain levels. They did find significant differences for improvement of pain self-efficacy, a decrease in pain catastrophizing and a positive global impression of change. Participants with high engagement levels had significantly better outcomes and the authors suggest that they may have seen more significant differences between groups if they had required more than 160 minutes of program use time. They also suggest that the lack of significant differences for outcomes (such as exercise behaviour) were not seen because the material of painACTION was primarily focused on education about the psychological aspects of pain and not about true health behaviour change.  |
| **Critical Appraisal** |
| **Validity**[Identify the strengths and limitations of the study, including potential sources of bias. Comment on the overall methodological quality (including the score) as you determined from your assessment of the article. Comment on anything you believe was missing in the paper.] |
| * PEDro Scale score: 7/11 based on the following: eligibility criteria: Yes; Random Allocation: No; Concealed Allocation: Yes; Baseline Comparison: Yes; Blind Subjects: No; Blind Therapist: No; Blind Assessors: No; >85% participant outcomes: Yes; Intention to treat analysis: Yes; Between group comparison: Yes; Point estimates and variability: Yes
* The lack of blinding of the participants and the researchers may have introduced bias into the situation as participants in the intervention group may have acted differently because they knew they were being studied.
* In order to decrease bias from moderating factors, authors used exploratory analyses to determine if type of arthritis condition, gender, initial pain score at baseline, age, race or if low engagement (< 204.5 min) or high engagement (> 204.5 min) were potential moderating factors for final outcomes. Post hoc analyses were done on significant interactions found.
* To improve overall validity, they utilized an intention to treat analysis to adjust for participants who had dropped out of the study at different time points so that the lack of these participants would not skew the final outcomes
* Participants did not have the same start and end point; variable factors such as time of year could have affected participation with the program and pain perception
* They found that higher engagement led to greater results; setting a higher threshold of adherence initially may have resulted in better results
 |
| **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.] |
| Overall, the use of this painACTION program did not demonstrate a significant change in participants in exercise behaviour/self management of pain. Although this program did have an effect on the perception of pain (i.e. pain self efficacy and pain catastrophizing), the change of these two factors did not seem to correlate with a change in overall pain severity. There seemed to be large amounts of data dredging within the specific scales to show large effect sizes when there was not an overall change in the total score of an assessment. Nonetheless, there were also large effect sizes found for self-efficacy, pain catastrophizing and for global rating of change, indicating that participants felt that their condition was getting better with the use of this program. As the authors stated, information in this painACTION program targeted psychological factors associated with pain (such as self-efficacy) and thus may have been why specific physical activity behaviours did not change. Greater adherence to the program was associated with better outcomes. Overall, this research provides strong evidence that the use of Web based intervention will improve self efficacy to manage pain, but not overall pain severity in patients with knee OA. However, it does support the fact that greater adherence to a Web based program is associated with better outcomes.  |

**EVIDENCE SYNTHESIS AND IMPLICATIONS**

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|  The evidence reviewed suggests that the use of a Web based exercise program in older adults with knee osteoarthritis was effective in decreasing pain levels as well as improving pain perceptions. Participants also reported increased physical activity levels after the use of the interventions. There was also an improvement in overall every day function and the majority of participants stated that they felt like their condition “had improved” after using the intervention. Furthermore, all the research studies reviewed found that participants had greater self-efficacy for controlling their arthritis condition. Self-efficacy has been theorized as an important factor in developing meaningful health behaviour changes as well as improving patient’s ability to cope with pain.8–10   It should be noted that the RCTs that included physical activity4,5 as an objective measure did not find as large of an effect size for pain as did the results from the case study6. The case study was fraught with bias that could have contributed to more significant outcomes and did not control for potential variables that could have affected the final outcome. Nonetheless, the overall results were still found to be clinically meaningful for patients with knee OA, as the stronger randomized controlled trials still found small effect sizes for change in physical activity5 and for changes in pain/pain perceptions.4,5  There was an overall trend that increased program adherence was associated with greater improvement in final outcomes. Many participants enjoyed using the Web based intervention and found it easy to navigate, which may have been a factor that promoted adherence. However, a physical therapist could provide the external verbal accountability needed for behaviour change; i.e. providing verbal support and encouragement for an exercise habit.9 Increased physical activity would not only decrease arthritic pain, but would also have many other positive effects such as: decreased body mass, decreased cardiovascular risk, increased quality of life and a decrease in cognitive decline.11–13 A Web-based physical activity intervention that targets patients with knee OA can educate patients about exercise and pain coping strategies while providing a structure to create an exercise habit. This type of intervention has been found to be successful in increasing physical activity in the general adult population as well as in older adults.14,15 Physical therapists can incorporate this intervention as part of a home exercise program and keep track of patient’s progress/adherence to the program. Physical therapists are knowledgeable about promoting positive health and wellness behaviours, but many do not have the time to thoroughly address general exercise with patients during a therapy session. If these types of programs were found to be efficacious, a physical therapy practice could justify buying this software and be able to provide the access to their patients with knee OA. The patient’s access to this program would then continue after the PT episode of care, which would further aid the maintenance of this exercise habit. This type of intervention could also become a potential solution for a patient who cannot attend multiple physical therapy visits due to monetary concerns, lack of time, or difficulty traveling. A PT could prescribe this exercise program and monitor patient use of program to track progress toward a physical activity goal. The PT would also have the ability to modify the exercises as needed and also troubleshoot any issues that may arise. Future Research Implications In order to increase clinical relevance and justify cost and efficacy, these Web interventions need to be utilized in conjunction with physical therapy and in comparison to physical therapy alone. There also needs to more studies that target the use of this type of intervention to patients with knee osteoarthritis; many of the stronger research studies I found focused on the general adult/older adult/cardiovascular condition population. Specifically, these trials need to include objective measures of physical activity (such as accelerometers) to measure baseline and short term/long term outcomes for physical activity for greater validity. Randomized controlled trials (with objective measures of physical activity and a physical therapy intervention) and larger sample sizes would provide better evidence supporting the use of a Web based exercise intervention in practice.   As technology becomes more accessible (via computers, phones etc.) and more people are more adept in using it, this type of intervention could be an impactful tool for older adults with knee osteoarthritis to help decrease pain, improve health and overall quality of life. |

*Notes*

* *This section synthesizes your appraisal of your articles; you may mention other related research that you have read or that supports your interpretation and discussion of this evidence. Please be sure to address the quality of the evidence available to guide clinical practice related to your PICO question. Discuss the implications for clinical practice and research.*
* *Students may wish/need to discuss implications with clinicians or peers for suggestions*
* *This section should be ¾-1 page*
* *Be sure to address both implications for clinical practice and future research (separately)*

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[List all references cited in the CAT]

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