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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| In women over 70 years old with knee osteoarthritis (P), is aquatic therapy (I) more effective than land-based therapy (C) in decreasing pain with ambulation (O)? |

**AUTHOR**

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**CLINICAL SCENARIO**

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| The patient is a 72-year-old female who has had bilateral knee osteoarthritis (OA) diagnosed 10 years ago and has associated pain with ambulation. The pain has been limiting her ability to participate in community ambulation and is affecting her quality of life. The pain has been getting progressively worse and she has stopped going to the grocery store or other areas that require walking due to unmanageable pain. The patient does not yet want to have surgery to replace her knees and would like to explore conservative options first. To help my patient reach her goals and facilitate return to prior level of function, I would like to know if aquatic therapy or land-based therapy is more effective in decreasing pain with ambulation.OA is an extremely common pathology today and patients often seek physical therapy care to address the related pain and limitations. Having an improved understanding of what interventions are most efficacious in OA rehabilitation could be extremely useful to improve patient outcomes and reduce burden on the health care system. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| Eight studies were found that met the inclusion and exclusion criteria, and all were randomized controlled trials (RCT’s). * Both land based and aquatic exercise are superior in reducing pain and arthritis limitations than no exercise.
* Aquatic based exercise is significantly better than land-based exercise in reducing pain interference and arthritis related disability.
* Neither aquatic or land- based exercise were significantly better than the other at improving body weight, BMI, lean body mass, 6MWT, knee flexor and extensor strength, knee range of motion, pain intensity, and knee related quality of life.
* The majority of research on the efficacy of aquatic therapy compared to land-based exercise for older adults with knee OA is conducted in group exercise settings.
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**CLINICAL BOTTOM LINE**

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| Older women who have knee OA that causes pain with ambulation may benefit from either aquatic or land-based exercise. Aquatic exercise may be superior in reducing pain interference with daily functions as well as arthritis related disability, but a pool must be available and the patient must not have any contraindications to being in the water. Overall, therapy recommendations for one intervention over the other should be based on patient preference, available resources, patient status etc. and should aim to minimize barriers to exercise for optimal adherence and functional improvement. |

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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) |
|  “Osteoarthritis”, “knee osteoarthritis”, “women”, “elderly”, “older women”, “OA”, “women with OA” |  “Aqua therapy”, “aquatic therapy”, “hydrotherapy”, “water therapy”, “water exercise” | “Physical therapy”, “land therapy”, “physiotherapy”, “traditional physical therapy”, “land” | “pain”, “ambulation”, mobility”, “amb\*”, “walking”, “walk\*”, “pain with walk\*”, “gait” |

**Final search strategy (history):**

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

Search #6 (top line) represents the search strategy used.



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

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| * Pubmed using “Osteoarthritis AND (aqua\* OR hydro) AND (physical therapy OR PT OR Land) AND amb\*”
 | 0 results | Revised to Osteoarthritis AND (aqua\* OR hydro) AND (physical therapy OR PT OR Land) AND (amb\* OR gait) and got 6 resultsI selected human studies and studies written in English. |
| * PEDro using “osteoarthritis AND aquatic therapy AND ambulation”
 | 0 results | Revised to be broader using “Osteoarthritis AND aquatic therapy” which yielded 12 results, 3 of which were rated below 5/10. |
| * EMBASE using “Osteoarthritis AND (aqua\* OR hydro) AND (physical therapy OR PT OR Land) AND pain”
 | 137 results | Revised to using “Osteoarthritis AND (aqua\* OR hydro) AND (physical therapy OR PT OR Land) And pain AND walk” which narrowed the search to 18 results |
| * CINAHL using “Osteoarthritis knee AND (aquatic therapy OR hydrotherapy OR aquatic exercise OR water exercise) AND ambulation”
 | 2 results | The studies that were displayed were not exactly what I was looking for, so I revised it to “Knee Osteoarthritis AND (aquatic therapy OR hydrotherapy OR aquatic exercise OR water exercise) AND (amb\* OR walk\* OR gait)” and selecting adults over 65, from academic journals, women, and written in English, which brought up 12 studies.  |
| * Cochrane using “Knee osteoarthritis AND aqua\* therapy”
 | 2 results | This was narrow enough and the studies were applicable so I did not need to revise. |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| I will only include RCT’s, meta-analyses and, systematic reviews as evidence, articles written in English, adults >40 years with knee OA, and published in the past 20 years. Studies that measured pain with ambulation via patient reported outcomes will be included.  |
| **Exclusion Criteria** |
| I will exclude articles written in a different language, articles that do not compare aquatic therapy interventions to land based interventions, and those that do not perform outcome measures particular to improved function. Participants with a TKA will also be excluded to focus on more conservative treatment options. Additionally, participants with neurologic co-morbidities will be excluded. |

**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** |
| **Lund et al (2008)** | **8/10 on PEDro** | **2** | **high** | **RCT** |
| **Wang et al (2007)** | **7/10 on PEDro** | **2** | **High** | **RCT** |
| **Lim et al (2010)** | **7/10 on PEDro** | **2** | **High**  | **RCT** |
| **Foley et al (2003)** | **8/10 on PEDro** | **2** | **High** | **RCT**  |
| **Fransen et al (2007)** | **8/10 on PEDro** | **2** | **Low** (This one excluded those with TKA in past year so not sure if it fully met my criteria. Also, land-based therapy was Tai chi rather than traditional. Pain with ambulation was not specifically addressed.) | **RCT** |
| **Silva et al (2008)** | **7/10 PEDro** | **2** | **Moderate** (Participants also took Diclofenac so I am unsure if results are from medication or exercise. However, pain with walking was directly assessed.) | **RCT** |
| **Assar et al (2020)** | **8/10 PEDro** | **2** | **Low-Moderate** (Addressed pain and walking separately but focused more on knee instability.) | **RCT** |
| **Wyatt et al (2001)** | **6/10 PEDro** | **2** | **Moderate** (Used outcome measures that included pain and ambulation but focused a lot more on thigh girth and ROM.) | **RCT** |

\*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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| * Wang TJ, Lee SC, Liang SY, Tung HH, Wu SF, Lin YP. Comparing the efficacy of aquatic exercises and land-based exercises for patients with knee osteoarthritis. *J Clin Nurs*. 2011;20(17-18):2609-2622. doi:10.1111/j.1365-2702.2010.03675.x

This study utilized 3 different groups including an aquatic therapy intervention group, land-based intervention group, and a control group, which allowed me to assess the efficacies of both interventions alone and compared to one another. They also included a very specific protocol for what exercises were included in the study, giving me insight regarding possible contributing factors to the results. Both intervention groups also followed very similar protocols which increased control parameters. Participant adherence to the protocol was decent, being over 86% in both groups, which was higher than many of the other studies. This increases likelihood that the results are correlated with the intervention. This study also had 84 participants, which was on the higher end compared to the other studies evaluated. Overall, the quality of the data was higher than some of the others, it matched my question better, and clinical insight could be gained from this study.* Lim JY, Tchai E, Jang SN. Effectiveness of aquatic exercise for obese patients with knee osteoarthritis: a randomized controlled trial. *PM R*. 2010;2(8):723-793. doi:10.1016/j.pmrj.2010.04.004

Similar to the study above, this study had 3 different groups including an aquatic therapy intervention group, land-based intervention group and a control group. The researchers also clearly defined the intervention protocol which helped me understand the results better. The intervention groups both followed the same parameters including a warm up, strengthening exercises, endurance exercises, balance exercises, stretching, and a cooldown for a total of 50 minutes. Since the parameters were more similar between groups, results could be compared more. The researchers also went to extreme measures to reduce variability by playing the same music during both land and pool exercise sessions. This displays a great degree of control within the study to improve the strength of their findings. Comprehensive measures pertinent to the population were used including pain, stiffness, physical function, quality of life, strength, and BMI. Although a specific physical walking test was not used as an outcome, pain with ambulation was measured with the Brief Pain Inventory test, correlating with my clinical question. |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of (Comparing the efficacy of aquatic exercises and land-based exercises for patients with knee osteoarthritis) by (Wang et al., 2011)**

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| **Aim/Objective of the Study/Systematic Review:** |
| The aim of the study by Wang et al. was to compare pain, other OA symptoms, activities of daily living function, sport/ recreation function, knee related quality of life, knee range of motion (ROM) and the six-minute walk test (6MWT) results to ultimately determine if aquatic exercises were more effective than land-based exercises to reduce OA related pain. |
| **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. |
| The study by Wang et al. is a randomized controlled trial including 84 participants with knee OA. Participants were randomly allocated to either a control, aquatic, or land-based exercise group, with each intervention group having 2 smaller subgroups that were staggered 3 months apart. The reason for staggering the groups was not described in the study.Data was collected at baseline, at 6 weeks, as well as at week 12. Data included the Knee Injury and Osteoarthritis Outcome Score (KOOS), knee ROM measured with a plastic goniometer, and a 6MWT. Data was collected by 5 blinded nursing students using standardized instructions for the 10-page self-report questionnaire and physical measurements. Data for each participant was collected in the order of the questionnaire followed by the knee ROM and 6MWT. Prior to administration, a practice session was conducted for the 6MWT the day prior to reduce potential learning effects. Two repeated measurements were taken for active knee flexion and extension were taken for higher reliability. A general linear model was used to assess changes in study outcomes at each data extraction point for main group effects and main time effects. An interaction term was added to the model to assess between group difference by time. A generalized estimation equation was used for stability analysis due to variable distributions in the data over time. |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| Aquatic rehabilitation exercises were performed at the public swimming pools at the Taipei City Beitou Sports Center in Taipei. The land-based exercise classes took place at the same sports center, but at the indoor basketball court.  |
| **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. |
| There were 84 participants with knee OA that were included in the study. Eligibility criteria were age over 55 years, diagnosis with knee OA by a physician through symptoms and X-ray, and consent to participation. Exclusion criteria included having a medical condition that would limit participation in exercise (uncontrolled arrhythmias, third degree heart block, myocardial infarction within 6 months, unstable angina, acute congestive heart failure, and uncontrolled epilepsy), having an intra-articular corticosteroid injection in the past 30 days, had a joint replacement, and currently exercising more than 60 minutes per week for the past two months. Participants were recruited over a 6-month period from local community centers, sport centers, and orthopaedic clinics in Taipei, Taiwan through flyers, posters, and a social event. The social event included a researcher lead informative speech on what OA is and how to protect the joints, and participants received free joint check-ups. This event was reported via a sport TV channel which promoted the program. Out of the initial 84 participants who met the inclusion and exclusion criteria, 6 dropped out (2 lost in each of the 3 groups) leaving a total of 78 participants. The researchers determined that a minimum of 18 participants in each group were needed to determine exercise effects across the outcome measures, the and the remaining 78 participants (26 per group) could fulfill this requirement. There were no significant differences in demographics, BMI, disease severity or outcome variables between those that dropped out and those that completed the study. Out of the participants who completed the study, 67 were female (85.9%) and 11 were male (14.1%). The majority were either a homemaker or retired (94.8%), were living with family (82.1%), had an individual income of less than 10,000 NT dollars (52.6%), and the mean age was 67.7 years (ranged from 54-81 years; SD 5.9). Education level varied from illiterate to post college, with the majority having an education level of primary school or below. BMI values ranged from 20.5 to 31.5 with a mean of 26.2. The mean length of time that participants were diagnosed with OA was 6.8 years. Baseline testing of outcome measures assessing pain, symptoms, ADL function, sport/recreation, QOL via the KOOS, knee ROM, and 6MWT were not significantly different between groups at baseline. Baseline characteristics were balanced between all 3 groups.  |
| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| A total of 28 participants were randomly allocated to the control group, with 26 available for follow up. This group acted solely as a control, although the exact parameters of control group was not described in the study.  |
| *Experimental* |
| For both the aquatic and land-based exercise intervention groups, the participants participated in 60-minute group exercise programs, 3 days a week for 12 weeks. The exercise classes took place every other day rather than consecutively. Attendance was taken for both intervention groups, and trainers were present to monitor for adverse effects. The aquatic treatment was provided at the Taipei Citea Beitou Sports Center public swimming pool by a trained exercise instructor. A standardized aquatic exercise protocol was used based on the Arthritis Foundation Aquatics Program instructors’ manual and included flexibility, aerobic, balance, and coordination exercises. Exercises focused on the trunk, shoulders, arms, and legs and variables in training included speed changes, changes in surface area, direction of movement, water turbulence. Water temperature was 86 degrees Fahrenheit throughout the program. The protocol is outlined in Wang et al.’s9 previous study: *Effects of aquatic exercise on flexibility, strength and aerobic fitness in adults with osteoarthritis of the hip or knee*. The land-based exercise class was conducted at the Taipei City Beitou Sports Center indoor basketball court by a trained instructor. A standardized land-based exercise protocol was derived from the People with Arthritis Can Exercise (PACE) program instructor’s manual and consisted of flexibility, aerobic, balance, and coordination focusing on the trunk, shoulders, arms, and legs. The classes included information on the basic principles of arthritis, correct body mechanics, and joint protection. Exercise varied by using long to short levers against gravity, or using multiple extremities for increased intensity. The average amount of repetitions of each exercise began at 10 repetitions and gradually increased to 15. The protocol for the land-based program was clearly outlined in the study including duration of each component, the exercises, and dosage for each. For more detailed information on the land-based program exercise parameters, refer to the original article. Participants self-monitored their intensity using the Borg CR10 scale with the goal of being between level 3 and 4 (moderate to somewhat strong).  |
| **Outcome Measures**[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| Improvements were measured via a questionnaire and nursing student administered physical tests at baseline, 6 weeks, and at 12 weeks when the program concluded. These measures included the KOOS, 6MWT, and knee flexion and extension ROM. The KOOS is a measure of knee OA specific health related quality of life and is a 42-item questionnaire assessing pain, other disease specific syndromes, ADL function, sport/recreation function, and quality of life using a 5-point Likert scale. The sum of the scores is obtained and assessed with 0 indicating extreme knee problems and a score of 100 indicating no knee issues. Change was deemed clinically significant if they were greater than 8 which is the MCID for the KOOS. A goniometer was used to assess knee flexion and extension ROM using the Norkinn and White protocol. Range of motion was measured in degrees. Normative knee ROM values were not outlined in this study. However, Roach et al10 report that for adults between 60 and 74 years old, which includes the mean age for the participants (67.7 years), full ROM for the knee is 0-131 degrees. Two measures were taken consecutively for each flexion and extension. The 6MWT followed standard administration protocol and was outlined in Wang et al.’s study from 2007 called *Effects of aquatic exercise on flexibility, strength and aerobic fitness in adults with osteoarthritis of the hip or knee,*9 and all participants completed this test independently without a walking aid. Feet ambulated in 6 minutes was measured and compared to normative data, although reference values were not noted in the study. Naylor et al11 indicate that 79 meters (95% CI) is the minimal detectable change value on the 6MWT used for those with knee OA. Overall, significance was assessed using p<0.05 value. Although not a formal outcome measure, the researchers tracked attendance to determine exercise adherence. Adherence to the exercise program was calculated by the number of classes attended divided by 36 which was the total number of offered classes. Location of testing was not provided in the study description. |
| **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. You may summarize results in a table but you must explain the results with some narrative.] |
| The exercise adherence for the aquatic group was 86.4% (SD 10.9%) and 86.5% (SD 13.5%) for the land-based program.

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| Table 1: Effectiveness of the Intervention Compared to the Control Group for Pain Reduction |
|  | Aquatic Group | Land-Based Group |
| Pain Score Difference at 6 weeks (from KOOS) | 7.91-points (p<.001) at 6 weeks. | 6.02-points (P= .002) at 6 weeks. |
| Pain Score Difference at 12 weeks (from KOOS) | 9.86-points (p<.001) at 12 weeks | 9.31-points (p<.001) at 12 weeks |
| Mean Pain Score Change (from KOOS) | 8.8 (95% CI=4.8-12.8) | 9.1 (95% CI = 5.1-13.2) |

Both interventions yielded significant reductions in pain (higher KOOS score) compared to the control group, although no significant differences were found between intervention groups to suggest that one is more effective than the other. Significant pain reductions were found at both 6 and 12 weeks.

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| Table 2: Mean Change in Outcome Scores at 12 Weeks Compared to Baseline |
|  | Aquatic Group (n=26) | Land-Based Group (n=26) | Control Group (n=26) |
| Pain (Pts on KOOS) | (+) 11 | (+) 11 | (+) 2 |
| Symptoms (Pts on KOOS) | (+) 7 | (+) 8 | (-) 2 |
| ADL (Pts on KOOS) | (+) 3 | (+) 7 | (-) 1 |
| Sport/Recreation | (+) 11 | (+) 5 | (-) 3 |
| QOL (Pts on KOOS) | (+) 6 | (+) 8 | (-) 1 |
| Total KOOS | (+) 38 | (+) 39 | (-) 5 |
| ROM (degrees Flex/Ext) | (+) 3.1deg/ (+) 1.3deg | (+) 2.8deg/ (+) 1.7deg | (+) 0.6deg/ (-) 0.1deg |
| 6MWT | (+) 55.1 ft | (+) 41.2 ft | (+) 7.1ft  |
| (+) indicates improvement(-) indicates regression |

Improvements in all outcome scores were found for both aquatic and land-based groups, whereas the majority of outcomes for the control group declined. Total mean KOOS score improved by 38 and 39 points for aquatic and land-based interventions respectively, indicating reduced knee limitations.After applying a generalized linear model on the KOOS data and using established levels of significance (p-values), significant differences between aquatic intervention at 12 weeks and control at baseline were found for pain (p<.001), disease specific symptoms (p<.001), sport/recreation (p<.001), and quality of life (p<.001). However, no significant change was seen for ADL (p=0.66). At 6 weeks, only significant improvements for the aquatic vs control were found for pain and symptoms. In regards to the land exercise at 12 weeks compared to the control at baseline, significant improvements were found for pain (p<.001), symptoms (p<.001), ADL’s (p<.002), sport/recreation (p<.001), and quality of life (p<.001). At 6 weeks, the land group only showed significant improvements in quality of life and disease related symptoms compared to the control at baseline. Knee flexion and extension ROM was statistically significant at 6 and 12 weeks for both interventions. 6MWT scores were also significantly improved in both groups at 6 and 12 weeks with the exception of land-based exercise at 6 weeks compared to the baseline of the control (p=.450). Although no mean improvement values were noted for the 6MWT distances, it does not appear that either group improved by the MDC of 79 meters based on Figure 2 in the original study.11 |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| Wang et al. found that both aquatic and land-based exercise were beneficial for reducing pain, improving knee ROM, ambulation distance in 6 minutes, and knee related quality of life in those with knee OA after their 12-week intervention. Their findings disprove their hypothesis that aquatic exercise was more efficacious as their results yielded that neither was superior to the other. Moderate intensity exercise, in either mode is safe and effective for older adults with OA. |
| **Critical Appraisal** |
| **Validity**[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| This level 2 randomized controlled trial by Wang et al. has good internal validity based on having a 7/10 PEDro Scale score. With measuring ambulation and pain among older adults with OA, it highly correlates with my clinical question and improves external validity through higher likelihood of the results being applicable to my patient. Also, the participants were community dwelling adults who don’t use an assistive device and are undergoing conservative OA care, which aligns with my patient case. A main strength of this study is that aquatic exercise was compared to both a land-based and a control group to better be able to evaluate the effectiveness of the treatment. Furthermore, the interventions were very similar and had the same major components which allowed a closer comparison and strength of the results. The exact protocols were outlined and appear to be easily replicated by another health professional. Validity and reliability of the outcome tools were described and related to this population, indicating increased meaning of the results. A major limitation of this study is that 12 months is a relatively low duration with no extended follow period for a chronic disease. Also, it was unclear what the control group was supposed to do and what, if any, exercise they participated in. This uncertainty reduces the confidence in the treatment vs control group effects are due to the intervention and not cofounding factors. The authors suggest that there have may been selection bias due to only selecting people who do not exercise and haven’t had neither a corticosteroid nor a total knee replacement. However, I do not necessarily see this as a limitation, but rather it increases external validity to possibly translate the results to my specific patient. No effect size was reported either so the magnitude of the effects of intervention is unclear. Lastly, although pain and ambulation ability were measured using different measures and certain aspect of the KOOS may have addressed this, pain with ambulation which is the outcome of interest was not directly evaluated. Therefore, additional studies specifically addressing this would be beneficial to answer my clinical question. |
| **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.] |
| Both land-based and aquatic exercise for 3 hours a week for at 12 weeks is efficacious in improving pain, disease specific symptoms, sport/recreation, quality of life, knee ROM, and distance ambulated in the 6MWT. Although land-based therapy additionally showed significant improvements in ADL function, neither intervention was deemed superior to the other for conservative knee OA care in adults. The aquatic and land followed same exercise dosages and had the same targets of flexibility, aerobic, and balance training for the trunk, shoulders, arms, and legs, which better allows one to draw comparisons between groups and reduces the effects of confounding factors. Furthermore, treatment durations of 12 weeks yielded better results than at 6 weeks for both groups (refer to table 4 on page 2616 of the study). Having the majority of p-values being < .001 indicates low risk of results being due to chance. While the confidence interval for pain does not come near to 0 for both interventions individually, the 95% CI ranges were 4.8-12.8 and 5.1-13.2 for aquatic and land respectively which are rather large. This indicates a reduced precision.  |
| **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.] |
| The study by Wang et al is highly relevant to the patient case as the population demographics (age, diagnosis, symptoms, etc) with the exclusion of nationality/location and inclusion of men matches that of the patient scenario. However, the guidelines used to develop the exercise regimens are from the US, so would likely be culturally accepted and yield similar results here. Implementing a program for 3 hours a week seems to be feasible and achievable if a pool is available. The design of this study correlates more closely to an arthritis-based group fitness class rather than the physical therapy setting, so I may refer my patients to participate in this type of class with supplemented PT treatment for further individualized interventions rather than trying to recreate this myself in the clinic. Also, since one intervention was not necessarily better than the other, selection may be based off of patient preference, available resources, or other clinical factors. Regardless of which intervention is chosen, exercise following these parameters may assist my patient in her goals of ambulating with reduced pain. |

**(2) Description and appraisal of (Effectiveness of Aquatic Exercise for Obese Patients with Knee Osteoarthritis: A Randomized Controlled Trial) by (Lim et al., 2010)**

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| **Aim/Objective of the Study/Systematic Review:** |
| Lim et al. aimed to evaluate the effectiveness of both aquatic exercise (AQE) and land-based exercise (LBE) in improving knee function and reducing body fat in obese patients with knee OA. The researchers’ goal was to provide a safe exercise program with high compliance for those with obesity, knee OA, and difficulty participating in conventional exercise. |
| **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. |
| This study is a randomized controlled trial including 75 obese participants with knee OA. Using blocked randomization, the participants were matched base on their Western Ontario and McMasters Universities’ Osteoarthritis Index (WOMAC) scores and age to classify them using two strata. Stratum 1 divided participants by WOMAC scores above and below group median. Stratum 2 divided participants by age over or under 65 years. They were then randomly assigned to an intervention group so that the strata were evenly distributed throughout the aquatic group (n= 26), land-based group (n=25) and control group (n=24). Although participants were unable to be blinded to the intervention, both interventions were described to the participants as equally effective treatments. Furthermore, data was recorded by different physiotherapists so that the participants’ progress was unknown and they were also blinded to the intervention for each group. The data manager was a 3rd party researcher who collected all the data and recorded everything into a database using unique codes. Data was collected at baseline and at the follow up which occurred at the end of the 8-week program. Data including height, weight, percentage of body fat, lean body mass, and BMI. The outcomes measures used included the brief pain inventory (BPI) for pain intensity, the WOMAC, Medical Outcome Study Short From 36-time Health Survey (SF-36) for quality of life, and the isokinetic flexor and extensor muscle strength at an angular velocity of 60 radians per second. These measures could be used to determine if the exercise program had effects on one’s overall function, obesity status, pain, strength, and quality of life. Adherence was measured by class attendance, using a cut off value of attending 2/3rds of the sessions. Those that did not participate in at least 2/3rds or 16 sessions were considered drop outs. The Wilcoxon signed rank test was used to see changes from pre and post intervention testing within each individual, and a Kruskal-Wallis test was used to compare changes between all three groups. When a significant difference was identified, a post-hoc analysis using a Mann-Whitney U test was utilized. An intention to treat analysis was used due to 9 participants dropping out. Their last observation data was carried forward to represent the final data. All analyses were performed through a Statistical Package for the Social Sciences (SPSS 15.0) and used a P<.05 significance value.  |
| **Setting**[e.g., locations such as hospital, community; rural; metropolitan; country] |
| This study took place in an outpatient clinic associated with the Seoul National University Bundang Hospital. |
| **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. |
| The study included 75 obese participants with knee OA that were recruited via their registration status at a rehabilitation, arthritis, and/or geriatric clinic at Seoul National University Budang Hospital. Obesity was classified as having a BMI over 25 kg/m2 as well as having an abdominal circumference over 90cm for men and 85cm for women. Other inclusion criteria were age over 50 years, having a Kellgren-Lawerence grade 2 or higher diagnosis from radiologic assessment, and were able to walk in independently without an assistive device. Per Kohn et al.,12 a grade 2 on the Kellgren-Lawerence scale is indicative of joint space narrowing and osteophyte formation. Participants were excluded if they had progressive ankylosing inflammation, central nervous system lesions, inadequate cardiac functions, infectious or skin diseases. All 75 participants provided a written informed consent, and completed testing at baseline and at 8 weeks. The mean age of the participants was 69.5 +/- 7.9 years with a range of 52 to 77 years old. Over 80% of participants were female. The mean body weight was 66.8 +/- 6.0kg with the mean BMI being 27.7 kg/m2 indicating that most participants were moderately to severely obese as the Korean guidelines consider a BMI of 27 kg/m2 or higher being moderately obese. Mean percent bodyfat was found to be 33.9% +/- 4.7% which was considerably higher than the normative range of 20%-27%. The average pain intensity measured through the BPI was 4.23 at baseline. Average baseline quality of life between the groups based on SF-36 scores was 34.30 for the physical component, and 47.71 for the mental component. WOMAC average scores were 33.49 at baseline. Lastly, average knee extensor torque was measured to be 53.43 Nm and the knee flexor torque mean was 27.55 Nm. Baseline characteristics were analysed using a nonparametric Kruskal-Wallis test, and no significant differences were found among groups prior to initiating the intervention. A total of 9 participants did not complete the study (2 dropped out of the aquatic group, 3 from the land-based group, and 4 from the control) for various reasons including heart problems, time constraints, pain, and other personal reasons.  |
| **Intervention Investigated**[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| The participants in the control group participated in only the home-based exercise classes. These classes included Q-sets for quadriceps strengthening, partial squats, and behavioural and lifestyle correction for ADL’s. The nature of the corrections of behaviour and lifestyle were not described in the study. |
| *Experimental* |
| This randomized control study had 2 intervention groups, one being an AQE, and the other being LBE. Both programs were 8 weeks long and consisted of a 40-minute session conducted 3 times a week. Each exercise session had a 5-minute warm up and 5-minute cool down period that was part of the total 40-minute session. The AQE was performed in a water gym kept at 93.2 degrees Fahrenheit and was 115cm deep. Intensity of the workout was monitored through intermittent heart rate checks during exercise with the goal of maintaining 65% of their heart rate max. A physician was present to monitor symptoms and pain throughout the session. Warm up activities consisted of floating, wall slides, squatting, and walking forward, backwards, and sideways with manipulation of buoyancy principles. The intervention targeted aerobic endurance training through underwater bicycling and running with aquatic cuffs at the ankles and wrists. Strength was targeted via arm and leg movements against water resistance such as leg swings. Also, participants kept an exercise diary in which they were to record all the exercises performed each session, which aided in determining compliance. Interviews were also conducted to assess pain with exercise. The LBE group partook in a generalized conditioning program with knee specific exercise that was derived by from the Exercise Guidelines for the Elderly of American Congress of Sports Medicine. The exercises included joint mobilization, strengthening, flexibility (tensor fascia lata, hamstrings, rectus femoris, and calf muscles) and aerobic conditioning through bicycling. Specifically for quadriceps strengthening, Q-sets were done in addition to leg presses and leg extensions. These exercises were instructed by a physiotherapist at the gym near the pool. Intensity ranged from 40% of 1 repetition maximum for beginners to 60% of 1 repetition maximum which was considered normal for average geriatric patients. It is unclear if the LBE group also had to report their exercises using a self-report diary and participate in interviews like the AQE group did. Also, it is not evident regarding whom was considered a beginner in the LBE program and how their 1 repetition maximum was determined.  |
| **Outcome Measures**[Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| The effects of aquatic vs land-based exercise vs the control was assessed at baseline and after the 8-week intervention based on pain, arthritis related disability, quality of life, and knee musculature strength. Pain was assessed using a brief pain inventory (BPI) which consisted of a 0–10-point scale with 0 indicating no pain and 10 being pain as worse as you can imagine. The BPI evaluated both pain intensity as well as pain interference with the participant’s life. The WOMAC is a 24-question patient-reported questionnaire that investigates arthritis related pain stiffness, and physical function using a 5-point Likert scale. The cumulative score may range from 0-96 points, with higher scores suggestive of increased arthritis related disability. Quality of life was measured using the SF-36 which is another patient reported measure. It includes 8 subscales and 2 summary measures including physical function, role physical, bodily pain, general health, vitality, social functioning, role emotional, mental health, physical component summary, and mental component summary. Although not stated in the study, scores on the SF-36 range from 0-100 with higher scores indicating a higher health state.13 Strength of the affected and unaffected knee musculature and were assessed using an isokinetic device set at 60 radians per second. The subjects performed 2 sets of 5 repetitions of knee flexion and knee extension with 30 seconds in between. They were instructed to move through their full range of motion and exert their maximum amount of pressure. The amount of concentric torque generated was identified using 5 torque angle curves from each set of movements and were then used to figure out the participants’ flexion-extension muscle strength at the knee. Additionally, height, weight, percent body fat, lean body mass and BMI were measured using an 8-polar bioelectrical impedance analysis ZEUS 9.9 device. Before these measures were taken, the subjects were instructed to fast for 4 hours prior, not exercise within 12 hours prior, to go to the bathroom within 30 minutes prior, and to wear light clothes without any metallic substances in order to improve accuracy. Different physiotherapists were used to lead the exercise sessions and to take the strength measurements so that they were blinded to the participants’ progressions. It is unclear where the measurements were taken and if the location differed from the training location. |
| **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. Use a table to summarize results if possible.] |
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| Table 3: Differences Between Pre and Post Intervention Outcome Means for all 3 Groups |
|  | AQE (n= 26) | LBE (n=25) | Control (n=24) |
| Body Weight (kg)  | (+) 1.06\* | (+) .96\* | (+) .47 |
| BMI | (+) .69\* | (+) .49\* | (+) .15 |
| Body Fat Percentage | (+) 1.1%\* | (+) .1 | (-) .3 |
| BPI Intensity  | (+) 1.14\* | (+) .56 | (-) 4.43 |
| BPI Pain Inference  | (+) 8.6\* | (+) 3.9 | (-) 1.1 |
| WOMAC  | (+) 14.2\* | (+) 10\* | (+) 2.8 |
| SF-36 Physical/Mental  | (+) 4.4\* / (+) 7.5 \* | (+) 5.1\* / (+) 2.3  | (+) 1.2/ (+) 1 |
| Peak Torque Knee Extensor/Flexor (Nm) | (+) 3.4/ (+) .1 | (+) .9/ (+) .9 | (+) 5.9/ (+) 2.6 |
| \*P<.05 indicating statistically significant changes from pretesting to post-testing (+) indicates improvement(-) indicates regression |

LBE and AQE showed improvements across all outcomes, although not all were significant. Although mean body weight increased across all three groups after the 8 weeks, only the exercise groups showed significant changes using a 95% CI and P<.05. Both interventions showed significant improvements in body weight, WOMAC, BMI, and physical state of health. Body fat proportion, pain intensity, and pain interference, and mental health only significantly changed amongst the AQE group. Overall, the AQE showed more improvement than the LBE group in all outcomes other than the SF-36 physical component. The control group improved more for knee torque in both directions than the intervention groups, although no significance was found.

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| Table 4: Between Group Differences Assessed After Using the Mann-Whitney Test for Post-hoc Analysis |
|  | AQE vs LBE | AQE vs Control | LBE vs Control |
| Pain Interference | -8.6 vs -3.9 (4.7 pt difference)\* | -8.6 vs .4 (9 pt difference)\* | -3.9 vs .4 (4.3 pt difference)  |
| WOMAC | -13.8 vs -9.9 (3.9 point difference) | -13.8 vs -2.7 (11.1 point difference)\* | -9.9 vs -2.7 (7.2 pt difference)\* |
| \* P<.05 indicating statistically significant between group changesScores listed per group respectively.  |

Between group differences were not significant for all outcomes other than pain interference and WOMAC scores based on post-hoc analysis through the Mann-Whitney U test. AQE was significantly superior to both LBE and the control in regards to pain interference, and was statistically significantly better than the control at reducing arthritis related disability based on WOMAC scores. Also, LBE reduced WOMAC scores significantly more than the control.  |
| **Original Authors’ Conclusions**[Paraphrase as required. If providing a direct quote, add page number] |
| After an 8-week exercise intervention, BMI reduced in both the AQE and LBE groups. Overall function improved significantly in both exercise groups, but one intervention was not found to be significantly better than the other. AQE was found to be superior in reducing pain interference for activity, so this intervention may be beneficial for those who are obese and have pain or difficulty with general exercise. AQE is deemed safe and effective for patients with obesity and degenerative knee arthritis and may help them overcome barriers limiting their functional improvement. |
| **Critical Appraisal** |
| **Validity**[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| This randomized control study was rated 7/10 on PEDro level 2 suggesting good internal validity and low risk of bias. One major strength of the intervention was that the researchers designed the two intervention groups to be as similar as possible to be able to better compare the outcomes. The frequency, duration of sessions and the program, session designs and some modes of exercise were the same between groups. Another example of similarity between LBE and AQE was that both did cycling for aerobic endurance training although the AQE group did this in the warm water. This reduces the chance that cofounding factors could have attributed to the results. A major limitation within this study was the relatively high dropout rate of 12%. However, they did perform an intention to treat analysis and provided the reasoning for why the participants did not complete the study. Also, they did not describe what the behaviour and lifestyle interventions were for the control group, nor if this was implemented in all 3 groups. This information gap reduces ability to compare one group to another and makes it more difficulty to replicate this program if desired. Along the same lines, the researchers only described that the AQE group was to keep a journal and participate in interviews and did not explicitly state that the LBE group did that as well, which also creates more disparity between the groups. The intensity for the LBE group was determined based on a percentage of their 1 repetition maximum but the means in which this was determined was not described, nor the criteria for determining which participants were considered beginners. This also highlights the lack of description in the participants baseline level of activity, which is problematic as it could drastically change the degree of improvement possible in only 8 weeks. 8 weeks is also an extremely short duration to expect significant functional and strength gains. Since the control group actually showed improved knee flexor and extensor torque in comparison to the LBE and AQE groups, although this change wasn’t significant, the strengthening interventions and programming may not have been sufficient enough to target this aspect. Furthermore, movements in real life are not conducted at a constant speed throughout the range, so isokinetic strength may not be functional nor translate into real world application. This reduces the external validity of the study. Also, the results failed to report effect size, so the magnitude of the effects of intervention is unknown. |
| **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.] |
| Both interventions were beneficial in reducing body weight, BMI, WOMAC scores, and physical SF-36 scores, however AQE proved to have statistically significant improvements from baseline in many more areas than the LBE group which suggests that it may be the superior method for optimizing function for older adults with obesity and knee OA. Although both groups had participants dropout of the study, 3 participants dropped out of the LBE group due to pain and discomfort during exercise whereas the 2 that dropped out of the AQE did so because of time constraints and non-arthritis related heart problems. This information paired with the significant pain interference differences found between LBE and AQE are suggestive that AQE may be a better tolerated and preferred form of exercise. Because none of the 3 groups displayed change in knee flexor or extensor strength, the program may have lacked adequate strengthening parameters required to make adaptations. Perhaps the resistance and dosage were too little and forced them into a maintenance phase, or perhaps the load was too great which could have made them tired and weak upon testing. There are many possible reasons for why no change was seen, but future studies may need to alter this aspect to better gain the desired outcome.  |
| **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 study is highly applicable with the clinical case as the participants age, BMI, and knee function are similar to my patient’s. Although not explicitly stated, the participants had joint space narrowing and osteophyte formation which suggests that they had not had a total knee arthroplasty at the time of the study, which makes it more applicable to my population of interest. As noted by the researchers, a common barrier to being compliant with exercise amongst this population is pain and discomfort, but since aquatic exercise is shown to reduce this, using this intervention form may help patients be more compliant and consistent with exercise for health augmentation. However, although they were trying to combat barriers to exercise, warm water pools are hard to find in the community, so this intervention may not be highly feasible depending on the resources available. Because there were not many significant differences between AQE and LBE, and LBE did improve bodyweight, BMI, WOMAC scores, and SF-36 physical function scores, LBE may be a justified intervention for this population as well. If looking to improve knee extensor or flexor strength, I would adjust the dosage parameters set in this study or find another guideline to better target strength adaptations since neither intervention was able to do so. My patient is having difficulty ambulating due to pain which was not a major outcome of the study, but it is a component of the SF-36 and WOMAC, so the data could be applicable.The aim of the study was to find a means of exercise that older obese patients with OA would be able to safely and compliantly perform as well as one that may improve their function. Therefore, the study’s goal aligns with the goals of the physical therapy profession. Also, the clinicians were physiotherapists which highlights the relevancy of the intervention to our profession. Although I do not anticipate this drastically affecting the outcomes, this study did take place in Korea which would pose different cultural perspectives, values, interests, and possibly different anthropometrics. I found it interesting that moderate obesity in Korea is considered to be 27+ kg/m2 whereas in the US obesity is considered to be a BMI over 30 kg/m2. A large proportion of our population is obese, and by the Korean standards this proportion would be even higher. |

**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 studies analysed in this CAT investigated the efficacy of land and aquatic exercise compared to a control in reducing pain and arthritis related limitations in older adults with knee OA. Both studies highlighted that aquatic and land-based exercise are similarly beneficial in improving pain and function among other adults with OA. Either mode of exercise may be indicated as neither was found to be significantly superior to the other. However, the study by Lim et al. demonstrated that although aquatic exercise yields similar results to land based in regards to pain intensity, weight loss, and body composition, it is superior in reducing pain interference and arthritis related disability. As outlined by Wang et al. and Lim et al., because these interventions are relatively comparable, selection of exercise mode should be decided with patient preference, presence of contraindications, resource availability, and possible tolerance to weight bearing exercise in mind. The study by Wang et al. is highly applicable to the patient case and provides thorough detail on the interventions which improves the ability of the program to be replicated. They found that scores improved more at 12 weeks compared to 6 weeks, suggesting that longer durations of exercise programming may be necessary for significant functional improvements. The study by Lim et al. is also relevant to my patient case, but was less thorough in describing their interventions. They emphasized the need to address barriers to activity amongst this population, which is extremely important to consider as a physical therapist when trying to improve our patients’ overall health. With low risk of bias per the articles scoring 7/10 on the PEDro scale, having similar study aims as the clinical goal, and the participant characteristics closely matching that of my patient, the interventions outlined in both studies can be utilized in determining best treatment options for the clinical case. Further research is needed to determine the effects of aquatic vs land-based exercise over longer durations as both of these studies were relatively short. This would provide more insight on exercise adherence to and ability of the patients to maintain a consistent workout regimen for improved health and wellbeing. Increased emphasis on performance-based measures and specific outcomes on pain with ambulation would be beneficial to help me better answer my clinical question. The studies described above both inquired about pain with ambulation and with functional tasks, but this was not a major outcome and it is unclear if that specific component improved with the intervention. Furthermore, both studies were conducted in Asia which poses potential socioecological differences that may limit the degree of translation of the results to the American population. Lastly, the majority of the evidence found for this PICO question utilized group exercise classes rather than a 1:1 physical therapist to patient ratio which limits the feasibility and replicability of the intervention in the clinic. Nevertheless, the data has allowed me to consider both land based and aquatic based exercise groups as potential referrals or recommendations for my patients. In conclusion, when recommending exercise and creating the treatment plan for the patient in this case, I would have a slight preference in prescribing aquatic-based therapy due to the improvements in function and pain found by Lim et al. However, I would consider patient preference, contraindications to aquatic therapy such as infectious skin diseases, and if a pool is available. Ultimately, I would determine which intervention to use based on which would lead to better compliance and engagement in regular physical activity since exercise in general was shown to be better than none. |

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[List all references cited in the CAT]

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