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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| For a 45-year-old male with bone cancer, is a land-based resistance exercise program or aquatic therapy more effective in increasing muscle strength? |

**AUTHOR**

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**CLINICAL SCENARIO**

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| The patient was a 45-year-old male who was at UNC Hospital for chemotherapy following diagnosis of bone cancer. He had become deconditioned and lost a lot of muscle strength during his hospital stay, due to not exercising. The doctors told him they did not want him exercising because his bone cancer put him at a higher risk of fractures. This patient was a member of a local gym that had a pool and wanted to know if it would be beneficial for him to start aquatic therapy once he was out of the hospital to improve his muscle strength. He also wanted to know if an aquatic program would be more effective and safer at improving his muscular strength compared to a land-based exercise program. Aquatic therapy could be an alternative treatment option to use with this patient that would allow him to work out in a safer manner to prevent further deconditioning and loss of overall muscle strength. Aquatic therapy has been proven beneficial to reduce the stress and weight on the bones and improve muscle strength, which would help prevent fractures from occurring in patients with bone cancer.1 Studies have found the overall health benefits of aquatic therapy are comparable to land based activities.1 With this being known, comparing aquatic therapy to a land-based program to see the benefits of each and if one is safer and more applicable to this patient population can prove useful. Knowing this information will give additional treatment options to recommend to future patients based on research evidence. Gaining evidence-based knowledge on whether a land-based resistance exercise program or aquatic therapy is more effective at increasing muscle strength would improve the quality of care provided to this patient, as well as, increasing the effectiveness and safeness of the rehabilitation program. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| * Eight studies were found that matched the inclusion/exclusion criteria, including six randomized controlled trials, one non-randomized controlled trial, and one systematic review and meta-analysis of randomized controlled trials.2–9 No literature was found that clearly and directly compared a land-based resistance training program to aquatic therapy for improving muscle strength in patients who have cancer. Only one study was found that included participants who had bone cancer.7 * Studies focusing on the effects of a land-based program were more common than studies looking at the effects of aquatic therapy on muscle strength in this patient population. A land-based resistance exercise program produced statistically and clinically significant results in improving muscle strength in the short term of 12 weeks in patients with bone cancer. * An aquatic exercise program produced statistically and clinically significant results in increasing muscle strength in the short term (8 weeks) and medium term (6 months) in patients with cancer. * Both land-based resistance exercise programs and aquatic programs are recommendable and effective programs to increase muscle strength in patients who have cancer in the short term. The long-term outcomes of either of these programs were not studied. |

**CLINICAL BOTTOM LINE**

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| Both a land-based resistance exercise program and an aquatic therapy program produce statistically and clinically significant improvements in muscle strength in patients with cancer in the short term. In a 45-year-old male with bone cancer, either of these programs could prove beneficial in significantly improving his muscle strength for the short term. More high-quality studies are needed to determine the long-term effects of these programs on muscle strength, as well as, the effects of these programs on participants with bone cancer. |
| ***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) |
| Cancer  Tumor  Malignancy  Bone cancer | Resistance program  Exercise program  Resistance exercise  Strength  Resistance | “Aquatic therapy”  “Pool therapy”  Aquatics  Hydrotherapy | Muscle strength |

**Final search strategy (history):**

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

#1- Cancer [MeSH term]

#2- (resistance OR strengthening) AND (exercise OR therapy OR rehabilitation)

#3- (aquatic therapy OR pool therapy OR aquatics)

#4- muscle strength

#5- #1 AND #2 AND #3 AND #4 (produced no results)

#6- #1 AND (#2 OR #3) AND #4

#7- (bone cancer OR tumor OR malignancy)

**#8- #7 AND (#2 OR #3) AND #4 (final search + filters below)**

Filters: Randomized Controlled Trials, published in the last 10 years, English, Cancer, Middle Aged: 45-65 years, Middle Aged+ Aged: 45+

*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**  **CINAHL**  **Cochrane** | **303**  **52**  **247** | **66 – Applied filters: RCT, published after January 2008, English, cancer, Middle Aged Adults 45-64 years**  **Limited to middle aged, published after January 2008, English**  **30- Applied filters: published after January 1, 2008, cancer** |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| - Studied a population of middle aged and/or older adults (45+) with cancer  - Measured muscle strength before and after intervention  - Randomized controlled trials, clinical trials, systematic reviews, meta-analysis  - Published in English  - Protocol that included land-based resistance exercise program or aquatic therapy |
| **Exclusion Criteria** |
| - Not published in English  - Abstracts, conference proceedings, letters to the editor, narrative review articles  - Articles published prior to 2008  - Case studies or case series  - Studies that involve adults with orthopaedic diagnoses (fractures, sprains) that would prevent patient from performing strengthening exercises |

**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** |
| Furzer BJ, et. al.; 2016 | PEDro score: 5/10 | Level 1B | Low | RCT |
| Cormie P, et. al.; 2013 | PEDro score: 6/10 | Level 2B, This study only had a 75% follow up rate. | High | RCT |
| Cantarero-Villanueva I, et. al; 2013 | PEDro score: 7/10 | Level 1B | Moderate | RCT |
| Cheema BS, et. al; 2014 | AMSTAR score: 9/11 | Level 1A | Moderate | Systematic review and meta-analysis of randomized controlled trials |
| Travier N, et. al; 2015 | PEDro score: 8/10 | Level 1B | Low | RCT |
| Winters-Stone KM, et. al; 2015 | PEDro score: 7/10 | Level 1B | Moderate | RCT |
| Winters-Stone KM, et. al; 2012 | PEDro score: 7/10 | Level 1B | Low | RCT |
| Reis AD, et. al; 2018 | Downs and Black Checklist: 17/26^ | Level 2B | Low | Non-randomized Controlled Trial |

^Scoring does not include power analysis

\*Indicate tool name and score

\*\*Use Portney & Watkins Table 16.1 (2009); 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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| * Cantarero-Villanueva (2013)2: This is the only research study that was found during my search that focused on the effects of aquatic therapy on patients with cancer. This high quality randomized controlled trial has a low risk of bias as determined by the high PEDro score and provides a good level of evidence. Muscle strength was included as an outcome measure using a validated and reliable test, which aligns specifically with my PICO question. This study is very detailed and describes in depth the effects of the aquatic program on the experimental versus the control group for muscle strength, which aligns perfectly with my PICO question. * Cormie (2013)7: This is the only highly relevant randomized controlled trial that was found during my search. This study provides moderate quality level 2B evidence, due to the study only having a 75% follow up rate. This study included men aged 57-83 who had bone metastatic cancer secondary to prostate cancer, which aligns with the patient in my clinical scenario. This study also examines the effects of a 12-week land-based resistance exercise program on muscle strength using several validated and reliable tests, which also aligns with my clinical question. This study is very detailed and describes in depth the effects of the resistance training program on the experimental versus control group. Even though this study was not a high-quality study, it is highly relevant to my clinical question. |

**SUMMARY OF BEST EVIDENCE**

1. **Description and appraisal of *The Effectiveness of a Deep Water Aquatic Exercise Program in Cancer-Related Fatigue in Breast Cancer Survivors: A Randomized Controlled Trial* by (Cantarero-Villanueva, 2013).**2

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| **Aim/Objective of the Study/Systematic Review:** |
| The objective of this study was to determine if an 8-week aquatic exercise program was effective at improving “fatigue levels, psychological outcomes, muscular strength, and endurance in participants who were breast cancer survivors.” (pg.223)2 |
| **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 * 2 group study design including aquatic exercise group and control group; Each group had 32 participants who were randomly assigned. * A web-based system calculated a sequence of numbers that were kept in envelopes, which were only opened after the first outcome measure by a blinded researcher. * Single blinded study- all assessors were blinded to treatment allocation, but not the therapists or participants * Outcome measures, including the multiple sit to stand test, were assessed at baseline, 8 weeks, and 6 months. * An a priori power analysis was conducted to determine the sample size needed with a significance level of p < 0.05. With 80% power, a sample size of at least 22 patients per group was needed in order to detect clinically important changes.2 A “decrease of 2.5 points with a standard deviation of 2 (15%) was seen as being a clinically important change” on the outcome measures in this study.(pg. 225)2 |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| * Outpatient clinic, university clinical laboratory at the University of Granada, and sport university swimming pool * Metropolitan area * Granada, Spain |
| **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. |
| * This study included 68 women recruited from the Hospital Virgen de las Nieves in Granada, Spain who were breast cancer survivors. Oncologists and nurses from the breast oncology and radiation units enrolled participants in this study. * Eligibility criteria included: age between 25-65 years old, diagnosed with stage I-III breast cancer, within the past year and a half had finished cancer treatments except hormone therapy, and scored greater than 3 on the Piper Fatigue Scale indicating significant fatigue levels2 * Patients were excluded if they were limited in their physical abilities due to orthopaedic conditions or if they were currently receiving cancer treatment. * The sample included in this study was a convenience sample with a purposeful group of participants who were breast cancer survivors. * All 34 participants finished the 8-week aquatic exercise program. Seven patients total were lost to follow up at six months leaving 29 in the usual care group and 32 in the aquatic exercise group. * The mean age for the usual care group was 47 years old (SD 8). The mean age for the aquatic exercise group was 49 years old (SD 7). All of the participants were female in this study. For the usual care group, 20 participants had reached menopause. For the aquatic group, 24 participants had reached menopause. * 24 of the participants in the usual care group were less than 12 months’ time post cancer treatment, and 5 were greater than 12 months’ time post treatment. 22 of the participants in the aquatic exercise group were less than 12 months’ time post cancer treatment, and 10 were longer than 12 months post treatment. * Physical activity levels in minutes per day in the usual care group was 32.3 (SD 22.6) and for the aquatic group it was 38.2 minutes (SD 21.3). * At baseline, both the aquatic exercise group and control group participants were comparable in sociodemographic features and medical features, as well as, study variables including muscle strength, profile of mood states, and score on the Piper Fatigue Scale. |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| * The usual care group (34 participants) did not receive any supervised aquatic exercise therapy session. * An oncologist gave this group recommendations on eating a healthy diet, energy balance, and continuing their activities of daily living in order to promote healthy lifestyles. * The usual care group continued their daily activities at home throughout the study and were assessed in the university laboratory at the beginning of the study, 8 weeks, and at 6 months follow up after the study was completed. * The specific recommendations from the oncologist were not provided, as well as, the types of daily activities these participants performed. * The average minutes of physical activity performed per day in this group was 32.3 (SD 22.6). |
| *Experimental* |
| * 34 participants were in the experimental aquatic exercise group. * This exercise group participated in the aquatic program 3 times per week for 8 weeks in a deep water university swimming pool in Granada, Spain. The 34 participants were divided into groups of 10-12 women who were supervised during each session by a fitness specialist and two physical therapists. If a participant was unable to swim, then a physical therapist assisted them throughout the sessions. * Each of the aquatic exercise sessions lasted an hour including a “10 minute warm up, 40 minutes of aerobic and endurance exercises, and a 10 minute cool down.”(pg. 225)2 Warm up activities included aerobic activities, mobility, and stretching exercises. All participants performed 2-3 sets of 8-12 reps of the endurance exercises. The cool down exercises included slow walking and stretching of the muscles used in the session. * During the first four weeks of the program, the aerobic exercises lasted 5-10 minutes including forward and back jogging with arms moving, pulling, and pressing, leaps, and hopping in multiple directions. The endurance exercises included bicycling, flexion/extension of elbow, wrist, and shoulder, hip rotation, abduction, adduction, and extension. During weeks five to eight, the aerobic exercises stayed the same, but the time was increased to 10-15 minutes. The endurance exercises also stayed the same, however, equipment such as pool noodles, buoys, and swimming boards were added. * The Borg Rating of Perceived Exertion Scale was used to monitor the intensity of the program, and the intensity followed the American College of Sports Medicine and American Heart Association guidelines. The program was individualized to each participant and gradually progressed throughout the 8 weeks. The velocity of movement during the exercises was a way to progress the intensity. |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| * All outcome measures were assessed at baseline, 8 weeks, and 6 months after discharge by the same trained assessor who was blinded to the treatment allocation. Data collection took place in the University of Granada clinical laboratory. * **Primary Outcome Measure:**    + Piper Fatigue Scale (PFS):     - Contains 22 questions rated on a scale of 0-10 that assess four subdomains of fatigue levels as self-reported by patients including “behavioural, affective, sensory, and cognitive/mood” (pg.224)2     - This scale has been proven to be a valid and reliable measure of fatigue in patients who have breast cancer.10     - Total score ranges from 0-10; higher scores correlate with higher levels of fatigue. Total scores are calculated by adding the four scores from the subscales and dividing them by 4. Subscale scores are determined by adding scores on each number together and dividing by number of items in scale.10     - Greater than 2 points improvement on the total score from this scale was seen as a minimally important difference and determined to be “clinically significant improvements in fatigue levels” (pg. 224)2 * **Secondary Outcome Measures:**   + Profile of Mood States:     - Contains 63 questions that participants rate on a 0-4 point scale     - 6 subscales addressing factors including “tension, depression, anger, fatigue, vigour, and confusion” (pg. 224)2     - Tension subscale score range 0-36, depression subscale score range 0-60, anger subscale score range 0-48, vigour subscale score range 0-32, fatigue subscale score range 0-28, confusion subscale score range 0-2811     - Total score range 0-200. Total score is calculated by summing the totals for the negative subscales and subtracting the positive subscale scores.11 Higher scores indicate higher levels of mood disturbances.     - This scale has been proven to be valid and have high reliability for identifying participants’ mood states.   + Multiple Sit to Stand Test:     - Used to assess lower body muscular strength     - Time in seconds for participants to achieve 10 sit to full stands from a chair without using arms to push off     - Test-retest reliability is good to high for this test and is a proven valid measure to assess lower body strength12     - Lower times correlate with a better score on this test     - MCID: 2.3 seconds, Greater than 12 seconds correlates with an increased falls risk12   + Trunk Curl Static Endurance Test:     - Used to assess muscular endurance of the abdominal muscles by participants holding an isometric abdominal curl at 60 degrees     - Mean endurance for healthy men and women is 134 seconds13     - This test is a reliable test for abdominal muscular endurance     - Longer times correlate with higher levels of muscular endurance |
| **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 secondary outcome measure of lower extremity muscular strength using the multiple sit to stand test is the outcome of relevance to the clinical question for this CAT. Data synthesized just includes findings relevant to this clinical question. Findings are as follows:   |  |  |  |  | | --- | --- | --- | --- | | **Multiple Sit to Stand Test (seconds)** | | | | |  | Preintervention  (mean +/- SD) | Postintervention  (mean +/- SD) | 6 month follow up  (mean +/- SD) | | Aquatic Exercise Group | 26.48 +/- 4.40 | 13.33 +/- 1.91 | 19.45 +/- 3.76 | | Usual Care Group | 27.72 +/- 7.28 | 21.88 +/- 6.57 | 28.02 +/- 7.33 |  * The aquatic exercise group improved in the time in seconds to perform the multiple sit to stand test at the 8-week post intervention and the 6 month follow up. * The usual care group had less overall improvement in this outcome measure at post-intervention and were worse at the 6 month follow up.  |  |  |  | | --- | --- | --- | | **Within-Group Change Scores** | | | |  | Pre-post intervention  (mean, 95% CI) | Preintervention to 6 month follow up (mean, 95% CI) | | Aquatic Exercise Group | -13.15, (-15.25 to -11.05) | -7.03, (-9.03 to -5.04) | | Usual Care Group | -5.83 (-8.59 to -3.07) | 0.30 (-1.19 to 1.80) | | Between-Group Differences | -7.32 (-10.77 to -3.87) | -7.34 (-9.75 to -4.95) |  * Statistical significance was set at an alpha level of p<.05 for this study. * At baseline, there were no significant differences between the groups on this outcome measure. At baseline, the p value for multiple sit to stand between the aquatic exercise group and the usual care group was 0.43, indicating there was not a significant difference between the groups. * Using ANOVA, “a significant group x time interaction was found for the multiple sit to stand test (F=20.011, P<.001).” (pg. 226)2 * Large intergroup effect sizes were found for this outcome measure at post aquatic exercise intervention (d= 1.10, 95% CI: -.55 to 2.76) and moderate effect sizes were found at the 6 month follow up (d= .50, 95% CI: .27-.90).2 * The mean difference between the two groups at the post intervention was 7.32, and the mean difference at the 6 month follow up was 7.34. * From the table, it is evident that there was a significant difference in overall leg strength between the aquatic exercise group and the usual care group at 8 weeks and at the 6 month follow up. The aquatic exercise group significantly improved their leg strength from the 8-week aquatic program and maintained that improvement at the 6 month follow up. The results of this outcome measure are statistically and clinically significant as demonstrated by a p value of <.001 and the moderate-large effect sizes. The narrow confidence intervals that do not include 0 for the aquatic exercise group and the between group difference at the 6 month follow up also indicate the results from this study are more precise, have less variability in the data, and are statistically significant. |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| The authors concluded that in breast cancer survivors an 8-week aquatic exercise program is an effective way to improve cancer related fatigue, improve leg strength and abdominal endurance, and improve overall mood states in these participants in the short and medium term of at least 6 months. |
| **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.] |
| * PEDro score: 7/10 based on:   + Eligibility criteria: yes, random allocation: yes, concealed allocation: yes, baseline comparability: yes, blind subjects: no, blind therapists: no, blind assessors: yes, adequate follow up: yes, intention to treat analysis: no, between group comparisons: yes, point estimates and variability: yes * Significant strengths of this study include assessors blinded, randomization of participants to groups, high ratio of supervision of the exercise program, inclusion of a control group, and having an 89% follow up rate. Blinding of the assessors in this program helps reduce the risk of bias with the results and improves the validity of them. Having 100% follow up at 8 weeks and a large follow up at 6 months helps validate the results and prove that the aquatic intervention was effective at improving muscle strength in these participants. Having a control group helps prove the validity of this program and that there was an actual change in the outcome measures with the aquatic intervention. * The baseline demographics of each group were comparable due to the randomization, which is another strength for this study. Another strength of this study is that the outcome measures used are proven to be reliable and valid measures that can show change in participants’ status over time. * Limitations of this study include:   + The participants were a specific population of women patients with breast cancer that were referred by their oncologists, which affects the generalizability of the results to all patients who have breast cancer or other types of cancer.   + Intention to treat analysis was not included in the study to assess the patients who dropped out after the 8-week intervention.   + Lack of blinding of participants and therapists in the study.   + There is no data on whether the participants continued their exercise program post intervention, which could lead to the results at 6 months not being accurate.   + The usual care group was not monitored during the study, and there was no record on what type of exercises these patients performed and their daily activities. Without this knowledge, there is no way of knowing if their results were accurate or biased if some of these participants were already using a daily exercise training program or participating in aquatic therapy. * Even though this study had a few limitations, overall the quality of evidence was high and the researchers did a good job of reducing bias in order to improve the validity of the study. The study was able to obtain 64 participants and had a loss of only 7 participants, which satisfied the sample size determined necessary for 80% power in their a priori power analysis. From this evidence, the results from this study could be applied and used in future research studies with patients who have breast cancer. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| This is a higher-level evidence study that has a lower risk of bias as evidenced by the high score on the PEDro scale. With the baseline demographics being comparable between the two groups (p value 0.43), this helps prove the effectiveness and validity of the results found in this study between the two groups. There were larger intergroup effect sizes found for the multiple sit to stand test at post aquatic exercise intervention (8 weeks) and moderate effect sizes were found at the 6 month follow up, which indicates a statistically significant improvement in overall muscle strength in these participants. The aquatic intervention group had a significant decrease in the time to perform the multiple sit to stand test as compared to the usual care group, which further proves the effectiveness of the aquatic exercise program at improving the muscle strength in these participants. The within group mean change for the aquatic exercise group at 8 weeks and 6 months post intervention was statistically significant based on the interpretation of their confidence intervals. The between group mean differences are also statistically significant based on the interpretation of their confidence intervals.  The results from this study on improving cancer related fatigue, leg strength, and abdominal endurance were all statistically significant as evidenced by a p value of less than .001. The small confidence interval for the multiple sit to stand test proves that the results were more precise and had less variability, further proving its statistical significance. The moderate to large effect sizes in the aquatic group also prove the results of the aquatic intervention were clinically significant. These results indicate that the aquatic exercise group did significantly improve their overall muscle strength as seen in the multiple sit to stand test from participating in an 8-week aquatic exercise intervention program. Based on the power analysis used in this study, there was an 80% probability that a Type II error was not made, which is a high percentage.  Based on the results, the aquatic exercise intervention group had statistically and clinically significant improvements in their overall muscle strength at 8 weeks and 6 months follow up. The researchers improved the validity of the results by blinding the assessors in the study, having a control group, randomizing the participants to groups, and having a high percentage at follow up. The comparable baseline measures and demographics between the two groups also help strengthen the validity and reliability of the results found in this study. From this, it is reasonable to conclude that an aquatic exercise program is more effective than usual care at improving muscular strength in patients with breast cancer in the short and medium term. |
| **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 population included in this study is similar to my patient case as far as age and diagnosis of having cancer. However, the participants included in this study were in recovery from breast cancer and finished with their cancer treatments, which is different than my patient case. It is hard to determine if these same results would be applicable to my patient who has bone cancer and if an aquatic program would have the same overall effect on muscle strength.  The aquatic therapy intervention aligns perfectly with my clinical question that was comparing this type of program to a land-based resistance training program. This also aligns with my clinical case scenario, since my patient wanted to know if aquatic therapy could be a beneficial program for him. Also, the outcome measure included in this study looking at overall leg muscular strength aligns with my clinical question. This study addresses the benefits of aquatic therapy intervention in the short and medium term, however, it does not address long term outcomes, which would be beneficial to know for my patient case.  The program described in this study may not be feasible for a typical PT outpatient clinic unless they already have a pool. The different resources needed including the deep water pool and high supervision ratio during the exercise program reduce the practicality and feasibility of this program. However, since my patient had a pool at his gym this type of program may be more feasible for him. The results from this study show that it would be more beneficial for my patient to have a supervised aquatic exercise program, which could prove a problem if he is going to his own swimming pool instead of one at a therapy clinic. Other than this, the resources needed for this program are few, which improves the feasibility of using this intervention.  Based on this study, it is evident that an aquatic exercise program could be beneficial in improving my patients’ muscular strength. I would suggest my patient try an aquatic therapy program based on the positive results found in this study, however, I would also tell him that he needs to be supervised when doing this type of program. Depending on what is available at local clinics, I would suggest that he may try to see an aquatic PT who could develop an effective and individualized exercise program for him to follow before he starts his own program in the pool. This would ensure his safety with the program and help determine if this type of program is effective and applicable to patients who have bone cancer. |

**(2) Description and appraisal of *Safety and Efficacy of Resistance Exercise in Prostate Cancer Patients with Bone Metastases* by (Cormie, et. al, 2013)7:**

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| **Aim/Objective of the Study/Systematic Review:** |
| This study aimed to study the effects of a land-based resistance training program on physical functioning (muscle strength, aerobic capacity, and ambulation), physical activity level, body composition, fatigue, quality of life, and psychological distress in patients with bone metastases secondary to prostate cancer and to determine if this training program was safe for this patient population. |
| **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 randomized controlled trial * Participants were randomized into 2 groups: Exercise group (Group 1) or Usual Care group (group 2), using a random assignment computer program with an allocation ratio of 1:1.7 * There were a total of 10 participants in each group. * When assigning participants to groups, the project coordinator and exercise physiologists were blinded to the allocation sequence. * Patients, therapists, nor assessors were blinded in this study. * Patient assessments were made at baseline and at the end of the 12-week program by the therapists. * All of the data collected during the assessments was paired with a 2 tailed test with a p-value <0.05 being considered statistically significance. |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| * The exercise group performed their exercise sessions in an exercise clinic. * The usual care group continued their regular daily self-management activities at home. * This study took place in Perth, Western Australia. |
| **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. |
| * This study included 20 male participants who were diagnosed with metastatic bone cancer secondary to prostate cancer. There were 10 participants in each group who all met the eligibility criteria. * In order to be eligible, participants had to get approval from their physician, were diagnosed with prostate cancer, and diagnosed with bone metastatic disease found by a full body scan. * All of the participants in this study were male. The average age of the participants in the exercise group was 73.1 years old (SD 7.5). The average age of the usual care group was 71.2 years old (SD 6.9). * In the exercise group, the average time since prostate cancer diagnosis was 3.9 years (SD 3.8), and the time since diagnosed with bone metastatic disease was 1 year (SD 1.1). In the usual care group, the average time since prostate cancer diagnosis was 4.9 years (SD 2.9), and the time since bone metastatic disease diagnosis was 1 year (SD 1). * All participants were referred by their oncologists and urologists to participate in the study making the sampling method purposeful and convenient. Once the 20 participants were screened, they were randomly split into the two groups. * The number of comorbidities in the exercise group was a mean of 1.7 (SD 1.3) and for the usual care group this mean was 1.5 (SD 1.1). All of the participants in both groups had previous androgen suppression therapy for their cancer. * The number of regions affected by the bone metastatic disease in the exercise group was a mean of 3.1 (SD 2), and the usual care group had a mean of 2.3 (SD 1.4). * There were no significant differences found between the two groups at baseline for characteristics or outcome measures assessed, including bone pain- VAS, physical functioning on the TUG, 6 minute walk test, ABC confidence scale, and leg extension 1 RM, physical activity level, body composition, self-reported fatigue levels, quality of life measured on the SF-36, and psychological distress measured on the BSI-18. The average Gleason score at baseline in the exercise group was 8.4, and the average score for the usual care group was 8.0. * There were 5 dropouts total: 2 in the exercise group and 3 in the usual care group. Among those who did and did not complete the intervention, there were no demographic or clinical differences. 75% of the participants were available for follow up at the end of the study. |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| * The usual care group (10 male participants) did not receive any type of the land-based resistance exercise interventions. This group was instructed to continue performing their regular daily activities, self-management programs, physical activity levels, and continue with their normal diets and social patterns. * The usual care group continued their daily activities at home throughout the intervention and were assessed in the exercise clinic at baseline and at 12 weeks. * The specific self-management programs and types of physical activities these participants performed daily were not mentioned in this study. * In this group, there were 4 participants who met the physical activity guidelines of greater than 150 minutes per week, 2 participants who had insufficient activity of less than 150 minutes per week, and 4 participants that were sedentary. |
| *Experimental* |
| * 10 male participants were in the experimental exercise group. * The exercise group involved a 12-week land-based resistance training program, where the participants participated in two exercise sessions a week in an exercise clinic in Western Australia. Participants were divided into smaller groups of one to five participants to perform the exercise interventions. * All exercise sessions were 60 minutes in duration. They all began with a 5-minute warm up and ended with a 10-minute cool down period, which included low level aerobic exercises and stretching. * All exercise sessions were supervised by a licensed exercise physiologist. * The exercises included in the resistance training program included all major muscle groups of the upper and lower body. Exercises were chosen that minimized the compressive and shear forces on the affected bones with metastatic disease. The exact exercises used in this exercise intervention were not stated specifically. * A cadence of 1-2 seconds for the eccentric and concentric phases of lifting were set for these participants, as well as, instructions provided on how to perform smooth and controlled movements throughout the exercises. 2-4 sets were performed of each exercise, and the load was progressed from a 12 to 8 rep maximum (RM). The resistance was increased when patients could perform more than the number of sets and reps that were prescribed to them with no difficulty. Every 2 weeks the number of reps and sets were increased, and the load progression was individualized for each patient based on how they were performing. * Participants also received a home-based moderate intensity aerobic exercise program involving walking or stationary biking for at least 150 minutes per week. |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| * All of the outcome measures in this study were assessed at baseline and at 12 weeks (end of the intervention study). * All outcome measures were administered by the exercise physiologist at the exercise clinic who was not blinded. * **Functional Assessment of Cancer Therapy Bone Pain Questionnaire:**   + 16 item questionnaire used to assess cancer related bone pain and the effects it has on participants’ quality of life14   + 0-4 scale used for each question   + Maximal possible score: 64 points   + MID score: 3-6 points14   + Higher scores on this assessment represented lesser bone pain and a better quality of life. * **Visual Analog Scale for Bone Pain:**   + This is an easy to use pain scale that patients can rate their pain levels on a continuum from no pain to worse possible pain. The higher the rating, the worse the pain.   + Range: 0- no pain to 10- very severe pain   + Maximal possible score is 10 * **One RM in leg extension:**   + Used to measure muscular strength in lower extremities   + Found to correlate with dynamometer results which is considered the gold standard for measuring muscle strength15   + Valid and reliable measure to assess leg muscle strength15 * **400 meter walk test:**   + Used to measure submaximal aerobic exercise capacity in participants   + Longer time it takes to walk this distance correlates with increased risk of mortality * **6-minute walk test:**   + Assesses the ambulation potential in these participants   + Distance is measured in meters   + Average distance covered in this test for this patient population is 594 +/- 81 m16   + Farther distance correlates with better exercise capacity   + Change of at least 60 meters indicates a true change16 * **Timed Up and Go Test (TUG):**   + Assesses muscle power, mobility, falls risk, and ambulation ability in the participants   + Lower times correlate to lower falls risk and better ambulation ability   + Time greater than 13.5 seconds correlates with an increased falls risk in older adults17 * **Sensory organization test (SOT):**   + Performed on the Neurocom Smart Balancemaster   + Assesses participants’ ability to maintain postural stability in stance by using visual, proprioceptive, and vestibular cues17   + Includes 6 sensory conditions that are tested and scored from 0 (falls or stopped trials) to 100 (good stability and minimum sway)   + Higher score indicates more stability and decreased falls risk   + Score less than 38 increases risk of being a repeated faller17 * **Activities-Specific Balance Confidence Scale:**   + Subjective assessment used to measure confidence in performing activities without falling17   + 16 questions rated on a 0-100 scale with 0 meaning no confidence and 100 meaning completely confident, maximum score is 100%   + Higher scores on this scale represented participants’ having greater confidence in their balance ability   + Scores less than 67% can indicate increased falls risk17 * **Short-Form Health Survey (SF-36):**   + Assessed quality of life in different domains including: physical functioning, body pain, overall health, vitality, social functioning, emotionally, and mental health7   + 36 items on this questionnaire that are scored on a 0-100 scale with 0 being maximum disability and 100 being no disability   + Lower scores indicate higher disability levels and higher scores represent lower disabilities |
| **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.] |
| The outcome measure of muscular strength using the 1 RM leg extension is the most relevant to the clinical question for this CAT. Both groups of participants were similar at baseline. This data synthesizes just the findings relevant to the clinical question for this CAT. The findings are as follows:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Main Findings From Study** | | | | | | |  | | Baseline | | 12 weeks | | |  | | Mean +/- SD | | Mean +/- SD | | | **Resistance Training Exercise Group:** | |  | |  | | | 1 RM leg extension (kg) | | 76.2 +/- 17.6 | | 80.3 +/- 16.7 | | | **Usual Care Group:** | |  | |  | | | 1 RM leg extension (kg) | | 71.4 +/- 23.5 | | 68.7 +/- 21.4 | | | **Adjusted group differences in mean change over 12 weeks** | | | | | | | | |  | | Mean | | 95% CI | | P value | | | 1 RM leg extension (kg) | | 7.9 | | 1.8-14 | | 0.016 | |  * At baseline, there were no significant differences between the exercise group and the usual care group on this outcome measure. * The maximal muscular strength differed significantly between the exercise group and the control group for the leg extension 1 RM with the resistance training exercise group having better overall results. The results from the 1 RM leg extension show statistically significant improvements from baseline with a p value of 0.016. At 12 weeks, the exercise group had increased in their overall muscular strength levels, while the usual care group had decreased their overall strength levels. The overall results show an approximate 11% improvement in overall strength with the exercise group throughout the course of 12 weeks. * The mean change between the groups over the 12 weeks was 7.9, which represents a large effect size that is a clinically and statistically significant difference. * The large confidence interval of the adjusted group difference of the 1 RM leg extension means that the results are less precise and there is more variability of the overall data. * The usual care group did not have any significant improvements in the 1 RM leg extension test at 12 weeks. |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| * Authors concluded that a supervised land-based resistance exercise program created with careful attention to the location and severity of bone metastasis in participants is a safe and effective program that can lead to improvements in overall physical functioning (muscle strength), physical activity levels, and body mass in 12 weeks. They conclude that this type of program can help prevent the functional decline and further complications associated with cancer. |
| **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.] |
| * PEDro Score: 6/10 based on:   + Eligibility criteria: yes, Random allocation: yes, Concealed allocation: yes, Baseline comparability: yes, Blind subjects: no, Blind therapists: no, Blind assessors: no, Adequate follow up: no, Intention to treat analysis: yes, Between group comparisons: yes, Point estimates and variability: yes * The baseline demographics of each group were comparable due to the stratified randomization, which is a strength for this study. Another strength of this study is that the outcome measures used are proven to be reliable and valid measures that can show change in participants’ status over time. * Limitations of this study presented by the author include: small number of participants, higher functioning level of patients, and lack of follow up assessment. * Since many of the patients were higher functioning and motivated to participate, this study is not representative of all males with prostate cancer and bone metastatic disease, thus decreasing the generalizability and external validity of this study. The participants in this study were also referred to this study by their doctors, which also decreases the generalizability of these results. Also, the small sample size in this study decreases the external validity because it is hard to determine if the same results would occur in a bigger group. * Another limitation includes the lack of blinding of the subjects, therapists, and assessors in this study. Lack of blinding in the study increases the risk of bias and decreases the validity of the overall study results. With the assessors knowing the group that was obtaining the treatment, they could have inaccurately presented the results of the study. * Another limitation was the low number of participants who followed up at 12 weeks. This study had a 25% drop out rate by 12 weeks, which means only 75% of patients followed up at the end of the study. This higher dropout rate could have led to more biased results of the study. The level of evidence provided by this study is level 2B due to only having a 75% follow up result of the participants. There was only a 75% probability of not making a type 2 error in this study. * Another potential limitation of this study is the usual care group was not monitored during the study, and there was no record on what type of exercises these patients performed and their self-management techniques. Without this knowledge, there is no way of knowing if their results were accurate or biased if some of these participants were already using a daily resistance training program. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| This study provides moderate quality evidence that has a higher risk of bias as evidenced from the PEDro scale score. The between group results for the 1 RM leg extension test proved to be statistically significant at a p value of <.05. There was a mean improvement on this test of 7.9 for the exercise group compared to the control group, which represents a large effect size between the groups. This proves that these results are clinically significant as well. The large between group confidence interval indicates the mean between group estimate from the study is less accurate or precise.  These results indicate that the exercise group did significantly improve their overall muscle strength as seen on the 1 RM leg extension from participating in the 12-week land-based resistance exercise program compared to the control group. The control group had a decline in their overall strength levels over the 12 weeks, which also proves the effectiveness and significance of the exercise intervention on improving muscular strength in the participants. Also, based on the current study design it is unknown whether the improvements were due to the study interventions or if there was bias caused by a lack of blinding of participants, therapists, and assessors. It is also unknown if the lack of supervision and monitoring of the exercises performed by the participants in the usual care group led to biased results overall. However, by using a control group to compare the exercise group helps prove the effectiveness and validity of the results of this program on muscle strength. With the baseline demographics also being comparable between the two groups (p value 0.43), this helps prove the effectiveness and validity of the results found in this study between the two groups. Also, since the effect size was large in this study the small sample size was acceptable to determine the results were statistically and clinically significant. Based on this study, it is evident that a resistance exercise program can be effective at improving the muscle strength in patients with pancreatic cancer and bone metastatic disease, however, it is uncertain whether these results can be generalized to other patients based on the limitations that decreased the validity of the study. It is also uncertain whether the improvements in muscle strength will be maintained in the long term, since this was not assessed. |
| **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 participants included in this study (males aged 57-83) match the age and gender of the patient in my clinical scenario. The diagnosis of bone metastases in these patients also matches my patient’s diagnosis. The participants in this program were also highly motivated to participate in exercise, which aligns with my patient scenario since he was asking which exercises he could do once he leaves the hospital. The land-based resistance exercise program is the exact program I was comparing in my clinical question to aquatic therapy. This study also assessed muscular strength, which was the key outcome I was comparing in my clinical question. This study proved that a land-based resistance exercise program could be effective in improving muscular strength, which is what my clinical question was addressing. I would promote this type of program to my patient and explain the benefits that could occur in a short amount of time. The results from this study prove that resistance training can be a safe form of exercise that will help improve overall muscle strength. When creating the exercise program for the patient in my clinical scenario, it would be vital to use exercises and a strengthening program that did not put extra stress on the locations where this patient had bone metastases. This will help reduce the risk of fracture or other types of injury.  Implementing this type of exercise program would be easy and feasible to do, since therapists could create a program based on the exercise equipment that is available in the clinic. This study does not specifically state which exercises the patients performed, which makes it harder to know which exercises were most effective in improving the patients’ muscle strength. It would be easy to follow the program’s duration, number of sets and reps, and speed. One issue is that this study only focuses on a short-term program and short-term effects, however, it does not address the long-term outcomes. It would be hard to determine how long this program should continue and what the long-term outcomes would be after participating in this program. Overall, this 12-week resistance exercise program seems to be an effective, feasible, and safe option for improving my clinical scenario patient’s overall muscle strength. |

**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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| **Implications for clinical practice:**  Loss of muscular strength is a common side effect of cancer treatments, which can lead to physical impairments.3 Finding an effective and safe exercise program, such as a land-based resistance program or aquatic exercise program, is vital for patients with cancer in order to maintain their overall muscle strength and physical activity levels. Both of the studies included in this project provide moderate to higher level evidence that either type of program is effective at improving muscular strength in patients with cancer.2,7 The article by Cantarero-Villanueva provided high levels of evidence with a low risk of bias that an aquatic program is effective at improving patients with cancer muscle strength in the short term (8 weeks) and medium term (6 months).2 These results were statistically and clinically significant which further support their validity and reliability in the effectiveness of an aquatic program. Even though this paper did not use patients with bone cancer, its low risk of bias and higher validity allows the generalizability of the results to the patient case described above.  In addition to the aquatic program, it was evident from the research that a land-based resistance training program is also effective at improving muscular strength in patients with cancer. The Cormie article reported that a land-based resistance training program was found to significantly improve overall muscle strength in these patients at 12 weeks.7 Even though this article was not as high of evidence, the results found in the study were statistically and clinically significant in favour of the exercise group.7 A systematic review by Cheema, which included the Cormie article as well as other higher level evidence studies, reported that land-based resistance training programs significantly improved upper and lower body muscular strength compared to the control groups.3 These improvements in muscular strength were found to be clinically significant as well.3 Other studies have found similar results that resistance training can significantly increase maximal strength measures compared to control groups.5  As evidenced by both research articles, either type of program is effective at improving muscular strength compared to usual care groups who do not participate in exercise programs. The between group mean differences for both studies were high and proved the effectiveness of the included exercise programs as compared to control groups. Including usual care control groups in both studies helps validate the improvements made were due to the specific exercise programs in the studies. The results from the study using an aquatic exercise program prove that this type of program can be confidently applied to my patient case scenario, since the results had a low risk of bias, high external and internal validity, and were clinically and statistically significant.2 The generalizability and external validity of the Cormie article is questionable due to its higher risk of bias.7 However, the systematic review includes other higher quality studies using land-based resistance exercise programs that provide higher quality evidence and stronger validity that this type of program would be applicable to my patient with bone cancer.  Based on all of the research provided, clinicians should feel confident in recommending either a land-based resistance exercise program or an aquatic exercise program to patients with cancer in order to increase their muscle strength. Clinicians and physical therapists should use their best judgement regarding which program to recommend based on patient accessibility, feasibility, and safety. PTs should assess all patients individually and create a safe, effective, individualized program for all patients with cancer that will benefit them in the short and long term. PTs should also take into consideration the patients’ age and severity of the disease in order to make sure they are designing and implementing the program safely to avoid unnecessary injuries.3 Improving muscle strength in this patient population is vital, which is why clinicians and PTs should work together to find the most appropriate and beneficial program for each individual with cancer.  **Implications for future research:**  With the research evidence found, it seems that either program could effectively improve my patient’s overall muscle strength, however, it would be helpful if future studies included participants with bone cancer to test the effectiveness and safety of aquatic exercise programs and land-based resistance exercise programs on this specific patient population. The Cormie article was the only research article I found that specifically used participants with bone cancer, which further supports the need for more high-quality evidence-based studies on the effects of these programs on this patient population. Also, future research should focus more on the effects of aquatic therapy on this patient population, as the Cantarero-Villanueva article was the only one I found that tested the effects of aquatic therapy on patients with cancer. Having more research on aquatic therapy will allow more confidence when recommending this type of program to patients. Future studies should also focus more on the long-term effects of these programs as neither study addressed the long-term outcomes past one-year post program. This lack of high-quality, long term studies limits the readers understanding of whether or not these programs are an effective option for patients with cancer that will have lasting positive results. It would be helpful to have more studies that assess muscular strength at least one- and five-years post intervention program to see the longer term effects. Included in these studies should be whether or not the patients continued with the specific program after the intervention study was complete in order to provide accurate results. In addition, there is a need for future studies to compare the effectiveness of an aquatic program versus a land-based resistance program on improving muscle strength in this patient population, as currently there is a lack of evidence in this area. Having comparison studies will allow therapists to recommend the program that will be most effective at improving overall muscle strength in order to provide the highest quality of care to patients and improve the overall safety and effectiveness of the rehabilitation program. |

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