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Summaries of all studies (2013-2022)

1- Aquatic Cycling Improves Knee Pain and Physical Functioning in Patients With Knee Osteoarthritis: A Randomized Controlled Trial.

Objective

To assess the efficacy of a 12-week aquatic cycling training program for improving knee pain and physical functioning in patients with knee osteoarthritis (OA).

Design

Two-arm, single-blind, parallel-group randomized controlled trial.

Settings:

OA outpatient clinic of the Maastricht University Medical Center+.

Participants:

Patients (N=111, 50-70y) with unilateral mild-to-moderate knee OA.

Interventions

Participants (aquatic cycling [AC] group, n=55) received AC sessions of 45 min each 2 times per week. Each session combined upright seated cycling with out-of-saddle positions and exercises for the upper and lower body. The usual care (UC) group (n=47) continued with UC and was offered 12 AC sessions in a local swimming pool after their trial participation.

Main outcome measures:

The Knee Injury and Osteoarthritis Outcome Score (KOOS) on knee pain and physical function was assessed at baseline, postintervention, and at 24-wk follow-up. Multilevel (mixed regression) analysis examined the effects.

Results

Average attendance rate for the AC sessions was 80%. Statistically significant differences at postintervention and follow-up were found for knee pain in mean \pm SD (UC pretest, 57.89 \pm 15.26; posttest, 55.90 \pm 18.04; follow-up, 57.24 \pm 19.16; and AC pretest, 56.96 \pm 12.96; posttest, 63.55 \pm 15.33; follow-up, 64.35 \pm 17.26; estimate, 8.16; SE, 3.27; 95% confidence interval [CI], 1.67-14.64; effect size [ES], 0.50) and physical functioning (UC pretest, 66.32 \pm 16.28; posttest, 66.80 \pm 19.04; follow-up, 65.42 \pm 17.98; and AC pretest, 61.89 \pm 17.151; posttest, 70.14 \pm 17.52; follow-up, 69.00 \pm 16.84; estimate, 7.16; SE, 3.19; 95% CI, 0.83-13.49; ES, 0.43) in favor of the aquatic group.

Conclusions

The results suggest that a 12-week AC training program improves self-reported knee pain and physical functioning in patients with mild-to-moderate knee OA compared to UC.

Keywords: Exercise therapy; Knee; Osteoarthritis; Pain; Randomized controlled trial; Rehabilitation.

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2- Aquatic circuit training including aqua-cycling in patients with knee osteoarthritis: A feasibility study

Background

Aqua-cycling is easy to learn, acceptable, and safe for patients with knee osteoarthritis. It can therefore be an ideal component of aquatic circuit training. Objective: To investigate the feasibility of a small group based aquatic exercise programme including aqua-cycling. Design: A feasibility study using quantitative (pre-post) and qualitative (cross-sectional) assessments. Participants: A volunteer cohort of 10 women and men, age range 46-77 years, with knee osteoarthritis.

Methods

Focus group interviews explored participants' experience with the training. Pre- and post-exercise knee pain, attendance, progression in training, and adverse events were registered.

Results

Seventy percent of patients attended all sessions. Focus groups revealed high levels of satisfaction with the selection of exercises, and participants valued the immediate pain relief experienced. Participants progressed well. However, aqua-cycling in an out-of-the-saddle position was too demanding for most participants.

Conclusion

An aquatic circuit training that includes aqua cycling is feasible for patients with knee osteoarthritis. Participants reported pain reduction and were positive about the diverse exercise programme. Aqua-cycling in a seated position is a safe and controlled type of movement.

3- Systematic review of aquatic physical exercise programs on functional fitness in older adults

Abstract

The practice of physical exercise is recommended in the prevention of the deterioration of neuromuscular functions in aging. **The objectives** of this systematic review were to describe the protocols used and the functional fitness indicators evaluated in aquatic exercise programs in adults aged 50 to 80 years. The Pubmed database was used. The keywords were: 1) Physical exercise program or protocols or duration or type of exercise or aquatic exercise, frequency or intensity or indicators; 2) Adults or older adults; 3) Training or indicators, functional fitness, physical fitness. **The search strategy** considered the components of the Population, Interventions, Comparators, Outcomes, and Study design (PICOS) tool. Nine experimental studies were identified. These studies developed protocols to improve functional fitness in adults aged 50 to 80 years. They were based on sessions of 2 to 5 per week, the work time per session was 30 to 60min, intensities varied between 50 to 95% and totaled between 4 to 24 weeks of intervention. The activities were based on aquatic gymnastic exercises aimed at muscular strengthening of the upper and lower extremities, as well as coordination, balance, agility, cycling and walking exercises submerged in water. **The protocols** developed to improve functional fitness in adults aged 50 to 80 years were based on general physical exercise prescription guidelines (frequency, duration, intensity and type of activity). The application of aquatic exercises based on gymnastic exercises can



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provoke positive responses on functional fitness if worked at least 2 to 5 times per week, 30 to 60min/day and at intensities of 50 to 95%. These systematized indicators can be used by professionals working with adults to create and promote aquatic programs to improve functional fitness.

Key Words: Intervention programs; functional fitness; aquatic activities; adults.

4- Discussion of “concurrent and construct validation of a scale for rating perceived exertion in aquatic cycling for young men”

Abstract

Aquatic cycling is a program of physical exercises performed with immersed stationary bikes. Few studies have provided evidence about the intensity control during its practice. Therefore, **the primary aim** of this study was to examine the concurrent and construct validity of a new scale for rating perceived exertion (RPE) during aquatic cycling in young men. Thirty physically active, healthy young men performed a load-incremented aquatic cycle ergometer protocol. Concurrent validity was established by correlating the Aquatic Cycling Scale (ACS) with oxygen uptake, pulmonary ventilation (VE), heart rate (HR), and blood lactate concentration (BL) responses to the maximal load-incremental test. Construct validity was established by correlating RPE derived from the Aquatic Cycling Scale (0–10) from the Borg Scale (6–20). RPE-overall, maximal oxygen uptake (VO₂max), oxygen uptake indexed to body weight (VO₂), VE, HR, and BL were measured during each exercise stage. The range of exercise re-responses across the incremental test were VO₂max = 1.07–3.55 L/min, VO₂ = 14.26–46.89 ml/Kg/min, VE = 23.17–138.57 L/min, HR = 99.54–173.31 beats/min, BL = 1.18–11.63 mM, ACS RPE-overall = 1.11–9.33.

Correlation/regression analyses showed ACS RPE as a positive linear function of VO₂max ($r = 0.78$; $p < 0.05$), VO₂ ($r = 0.87$; $p < 0.05$), VE ($r = 0.86$; $p < 0.05$), HR ($r = 0.77$; $p < 0.05$), and BL ($r = 0.85$; $p < 0.05$). RPE-ACS distributed as a positive linear function of the RPE-Borg Scale ($r = 0.97$; $p < 0.05$). ANOVA indicated that an incremental pedalling cadence of 15 revolutions per minute (rpm) provoked significant differences ($p < 0.05$) regarding previous stages in the majority of the variables analysed. The Aquatic Cycling Scale is an appropriate tool for monitoring exertion intensity during aquatic cycling in fit men. A brief increment in the aquatic pedalling cadence of 15 rpm increases the intensity of the aquatic pedalling exercise.

Keywords: Perceived effort, intensity monitoring, maximum oxygen consumption, pulmonary ventilation, heart rate, blood lactate



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5- Aquatic cycling - What do we know? A scoping review on head-out aquatic cycling

Abstract

Over the past few years, aquatic cycling has become a trending fitness activity. However, the literature has not been reviewed exhaustively. Therefore, using the scoping review methodology, the aim of this review was to explore the current state of the literature concerning aquatic cycling.

This study specifically focused on study designs, populations, and outcomes. **A**

comprehensive search of seven databases (PubMed, MEDLINE, Cinahl, Em- base, PEDro, Web of Science, WorldCat) was conducted up to 30th September 2016. Google Scholar, World Cat, ResearchGate, specific aquatic therapy websites, and aquatic therapy journals were searched to identify additional literature. Full-text publications in English, German or Dutch were included. Studies were included when the intervention involved head-out cycling carried out in 10° to 35° Celsius water. **Exclusion criteria** were the use of wet suits or confounding interventions that would affect participants' homeostasis. **63 articles** were included and the study parameters of these studies were summarized. Using three grouping themes, included studies were categorised as 1) single session tests comparing aquatic versus land cycling, or 2) aquatic cycling-only sessions investigating different exercise conditions, and 3) **aquatic cycling** intervention programmes. Although the experimental conditions differed noticeably across the studies, shared characteristics were identified. Cardiovascular parameters were investigated by many of the studies with the **results** suggesting that the cardiac demand of aquatic cycling seems similar to land-based cycling. Only six studies evaluated the effect of aquatic cycling interventions. Therefore, **future research** should investigate the effects of aquatic cycling interventions, preferably in individuals that are expected to gain health benefits from aquatic cycling. Moreover, this comprehensive outline of available literature could serve as a starting point for systematic reviews or clinical studies on the effects of aquatic cycling on the cardiovascular responses.

6- Effect of aqua-cycling on pain and physical functioning compared with usual care in patients with knee osteoarthritis: Study protocol of a randomised controlled trial

Rehabilitation, physical therapy, and occupational health.

Abstract

Over the last decade aquatic exercise has become more and more popular. One of the latest trends is aqua-cycling, where participants sit on a water-resistant stationary bike and, while immersed chest deep in the water, combine continuous cycling with upper body exercises that utilise water resistance. Since stationary cycling and aquatic exercises are frequently recommended to patients with knee osteoarthritis, combining both would seem an obvious step, and an aqua-cycling exercise programme for patients with knee osteoarthritis has indeed been developed. This study protocol gives a detailed description of the exercise programme and the methodology of a study to compare this programme with treatment involving usual care only.



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Methods

The study is a single-blind, parallel-group, randomised controlled trial of Maastricht University Medical Centre+, the Netherlands. Inclusion criteria: knee pain of four to seven on a 10-point pain rating scale; a Kellgren/Lawrence score between one to three; ability to cycle; good mental health; sufficient language skills; indication for physical therapy in conjunction with impairments due to OA. Exclusion criteria: any contra-indication for aquatic exercise; planned total knee replacement; corticosteroid injection <3 months and/or hyaluronic acid injection <6 months; severe joint complaints (other than knee joint); symptomatic and radiological apparent hip OA; inflammatory joint diseases; inability to safely enter and exit the pool; fear of water. Participants will receive two 45-min moderate intense aqua-cycling sessions weekly over a period of 12 weeks in addition to usual care or usual care only. Usual care consists of an individual intervention plan comprising lifestyle recommendations, medication routine and referral to a physical therapist. Participants will be assessed at baseline, and at 12 and 24 weeks after baseline.

The primary outcome is self-reported knee pain and physical functioning. **Secondary outcomes** are lower limb muscle strength, functional capacity, self-reported disease severity, physical activity level, quality of life, self-efficacy and fear of movement. Daily diaries will collect information on knee pain, physical functioning, level of physical activity, pain medication routine and physical therapy (control group only) or exercise participation over two 30-day periods (during the intervention period).

Discussion

To our knowledge the present study is the first randomised controlled trial evaluating the effects of aqua-cycling in the pre-surgical stage of knee osteoarthritis. This trial will demonstrate if the newly designed aqua-cycling intervention, in supplement to usual care, can help to improve impairments due to knee osteoarthritis. Trial registration: Netherlands Trial Register NTR3766 (21-12-2012).

Keywords: Osteoarthritis, Aquatic exercise, Aqua-cycling, Immersed cycling, Underwater cycle-Ergo

7- Aqua cycling for immunological recovery after intensive, eccentric exercise.

Purpose

Alterations in immunological homeostasis induced by acute exercise have been frequently reported. In view of the growing amount of repetitive exercise stimuli in competitive sports, quick recovery plays a superior role. Therefore, we examined whether aqua cycling affects cellular immunological recovery.

Methods

After performing 300 countermovement jumps with maximal effort male sport students (n = 20; 24.4 ± 2.2 years) were randomized into either an aqua cycling (AC) or a passive recovery (P) group. AC pedaled in chest-deep water without resistance, while P lay in a supine position. Each recovery protocols lasted 30 min. Blood samples were taken at Baseline, Post-exercise, Post-recovery and 1 h (h), 2 h, 4 h, 24 h, 48 h and 72 h after recovery. Outcomes comprised white blood cell (WBC) counts, lymphocyte (LYM) counts and LYM subsets (CD4/CD8 ratio). Additionally, cellular inflammation markers (neutrophil/lymphocyte ratio (NLR), platelet/lymphocyte ratio (PLR) and systemic immune-inflammation index (SII)) were calculated.



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Results

In both groups, WBC, NLR and SII were significantly increased compared to Baseline up to and including 4 h after recovery. Significant interaction effects were found for WBC (Post-recovery, 2 h and 4 h), NLR (Post-recovery), SII (Post-recovery) and CD4/CD8 ratio (2 h) with values of AC being higher than of P.

Conclusions

Interestingly, AC provoked a stronger but not prolonged immunological disturbance than P. NLR and SII may present simple, more integrative markers to screen exercise-induced alterations in immune homeostasis/recovery in athletes and clinical populations. More research is warranted to elucidate the clinical and practical relevance of these findings.

Keywords: Aqua cycling; Exercise; Immune cells; Inflammation; Recovery.

8- Effects of Water Immersion on the Internal Power of Cycling.

Purpose

Water immersion adds additional drag and metabolic demand for limb movement with respect to air, but its effect on the internal metabolic power (\dot{E}_{int}) of cycling is unknown. We **aimed** to quantify the increase in \dot{E}_{int} during underwater cycling with respect to dry conditions at different pedaling rates.

Methods

Twelve healthy subjects (four women) pedaled on a waterproof cycle ergometer in an experimental pool that was either empty (DRY) or filled with tap water at $30.8^{\circ}\text{C} \pm 0.6^{\circ}\text{C}$ (WET). Four different pedal cadences (fp) were studied (40, 50, 60, and 70 rpm) at 25, 50, 75, and 100 W. The metabolic power at steady state was measured via open circuit respirometry, and \dot{E}_{int} was calculated as the metabolic power extrapolated for 0 W.

Results

The \dot{E}_{int} was significantly higher in WET than in DRY at 50, 60, and 70 rpm (81 ± 31 vs 32 ± 30 W, 167 ± 35 vs 50 ± 29 W, 311 ± 51 vs 81 ± 30 W, respectively, all $P < 0.0001$), but not at 40 rpm (16 ± 5 vs 11 ± 17 W, $P > 0.99$). \dot{E}_{int} increased with the third power of fp both in WET and DRY ($R^2 = 0.49$ and 0.91 , respectively).

Conclusions

Water drag increased \dot{E}_{int} , although limbs unloading via Archimedes' principle and limbs shape could be potential confounding factors. A simple formula was developed to predict the increase in mechanical power in dry conditions needed to match the rate of energy expenditure during underwater cycling: $44 \text{ fp}^3 - 7 \text{ W}$, where fp is expressed in Hertz.



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9- Cold-water effects on energy balance in healthy women during aqua-cycling

Abstract

While the popularity of aquatic physical activities continues to grow among women, the effects on energy expenditure and appetite control remain unknown. **The objective** of this study was to examine the effect of water temperature during aqua-cycling session on energy expenditure, rate of perceived exertion, energy intake, appetite sensations, and food reward in healthy premenopausal women. **Methods:** Participants completed three experimental session, in the postprandial condition, in a randomized order: a land control session (CON); an aqua-cycling session in 18°C (EXO18); an aqua-cycling session in 27°C (EXO27). Energy expenditure, food intake, appetite sensations, and food reward were investigated for each conditions.

Results

EXO18 induced a significant increase in energy expenditure ($p < 0.001$) and oxygen consumption ($p < 0.01$) compared to EXO27. CHO oxidation was higher in EXO18 session compared to EXO27 and CON ($p < 0.05$ and $p < 0.001$, respectively). While fat oxidation was higher in exercise sessions compared with CONT ($p < 0.01$), no difference was observed between EXO18 and EXO27. Exercise sessions did not alter absolute energy intake session but induced a decrease in relative energy intake ($p < 0.001$) and in hunger, desire to eat, and prospective food consumption compared with CON ($p < 0.001$). We also show here that cold water exposure can increase EE while RPE is lower at the end of exercise session compared to the same exercise at 27°C ($p < 0.05$).

Conclusion

An exposure to a moderately cold water during aqua-cycling is an efficient strategy to promote increased energy expenditure and decreased hunger, which may be effective for energy balance management in healthy premenopausal women.

Keywords: water, cold, food intake, exercise, women.

10- Energy intake and appetite sensations responses to aquatic cycling in healthy women: The wathealth study.

Abstract

The aim of this study was to investigate energy expenditure, food intake and appetite feelings in response to water- vs. land-based cycling exercises in healthy young women.

Methods

Anthropometric measurements and body composition were assessed among 20 women who performed four experimental sessions in a randomized order: (i) a rest condition (CONT); (ii) a 30-min aqua-cycling exercise session (WAT), (iii) a 30-min land-cycling exercise session at the same rpm (LAND), (iv) a land-cycling session at the same heart rate and isoenergetic to WAT (LAND-Iso). Energy expenditure and substrate oxidation were measured by indirect calorimetry; ad libitum energy intake during subsequent lunch was assessed with appetite feelings recorded at regular intervals.



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Results

Energy expenditure was higher during the 30-min WAT than during CONT and LAND ($p < 0.001$). Carbohydrate oxidation was higher in the WAT session compared to CONT and LAND ($p < 0.05$). LAND-Iso duration was significantly increased (+14 min) to reach the same energy expenditure as in the WAT condition ($p < 0.05$). There was no differences in food intake between sessions.

Conclusion

While further studies are needed to optimize the chronic energetic effects of aqua-cycling, the present study suggests that this exercise modality could represent an efficient strategy to induce acute energy deficit.

Keywords: immersed exercise; appetite; energy intake; energy expenditure.

11- Effects of aqua cycling as exercise therapy for lipoedema Wirkung von Aqua-Cycling als Bewegungstherapie bei der Diagnose Lipödem oedema

ABSTRACT

In the following overview, the general advantages of movement interventions in water, within the physical therapy options, in the diagnosis of lip- and lymphoedema are addressed. Due to positive experiences in patients with lymphoedema, case reports concerning the use of aqua cycling in lipoedema are presented, which should trigger further investigations.

12- Aqua Walking as an Appropriate and Healthy Winter and Summer Physical Practice? An Exploratory Study

Abstract

Aqua-walking in a natural environment is a health-promoting physical activity that is gaining popularity and appropriate for a variety of populations, however, to date, there is little scientific evidence supporting the efficacy and safety of this activity for older adults. The objective was to propose a preliminary exploration of psychometric and metabolic responses to an acute Aqua walking session either during winter or summer in older adults Aqua walking exercisers.

Methods

Heart rate, body temperature, glycemia, and blood pressure were monitored in 37 (30 women, 7 men) participants aged 52 to 83 years old in two Aqua walking sessions (water at 13 °C and 18.5 °C, respectively). Anthropometry (body weight, waist, and hip circumferences), body composition, physical activity level, sedentary time, sleep quality, quality of life, physical self-perception, and perceived health and feelings on various parameters were also assessed.



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Results

Present results revealed a greater quality of life, physical self-perception, and perceived health in aging Aqua walking exercisers compared to those found in the literature in younger populations. None of the metabolic or psychometric measurements were found to be different between classically calibrated Aqua walking sessions performed in winter compared to summer. By contrast, there was a time effect during the sessions for body temperature ($p < 0.001$), SBP ($p = 0.17$), perceived mental and physical well-being ($p = 0.006$ and $p < 0.001$, respectively), and anxiety ($p < 0.001$). Leg discomfort also showed a time effect ($p = 0.0009$) and interaction effect ($p = 0.025$).

Conclusion

Aqua walking appears here to be an accessible practice that can be performed all year long with a range of physical and mental benefits for older adults. Future studies should investigate the metabolic responses of Aqua walking in different populations.

Keywords: Aqua walking; water temperature; health outcomes; quality of life.

13- Design of an Underwater Treadmill System for rehabilitation of older obese adults: a pre-post study

Abstract

Patients with knee osteoarthritis (OA) who are obese have problems performing land-based exercises. The reduced joint stress associated with aquatic exercise may benefit these patients. This study aimed to develop an underwater treadmill (UTM) machine that is affordable and suitable for use in developing countries, and to evaluate its efficacy in decreasing pain and increasing functional improvement.

Methods

Clinical testing of the UTM machine was performed in an outpatient setting at Siriraj Hospital during January–June 2017. Patients with knee OA, aged 50–85 years, numerical rating scale (NRS) $\geq 5/10$, and body mass index (BMI) ≥ 25 kg/m² were recruited. The UTM exercise protocol was 30 min/session, 3 days/week, for 4 weeks. The main outcomes were NRS pain score, 6-min walk distance (6MWD), quadriceps strength (QS) and body weight. Those outcomes were evaluated at baseline and at week 4. Results: The UTM was constructed with safety, ergonomically designed and user-friendly control panel with push button for emergency stopping. Thirty patients were included for clinical testing. The mean age was 62.8 years, and almost all were female. The mean BMI was 28.9 kg/m². Most patients (65.0%) developed bilateral knee OA, used pain medication (56.7%), and engaged in regular knee exercise (73.3%). Of the 30 enrolled patients, 6 withdrew. All of the remaining 24 patients attended all 12 sessions. The mean difference between baseline and the end of the study was -2.3 (95% CI: -3.0, -1.5; $p < 0.001$) for NRS pain; 34.9 m (95% CI: 14.1, 55.8; $p = 0.002$) for 6MWD; and, 1.8 kg (95% CI, 1.1, 2.6; $p < 0.001$) for QS. Concerning adverse events, 4 patients (15.4%) developed muscle pain, 2 patients (7.7%) had joint pain, and 1 patient (3.9%) withdrew due to severe knee pain. Two-thirds of patients described themselves as being 'very satisfied' with UTM exercise, and approximately 90% of participants rated their symptoms as 'improved' or 'much improved'.



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Conclusions

4-week exercise with UTM can significantly improve NRS pain, 6MWD, and QS. UTM could be an alternative treatment for patients with knee OA who are obese due to small size, durability, and ecofriendly design as an exercise modality.

Keywords: Underwater treadmill, Quadriceps strength, Pain, Obesity, Knee osteoarthritis.

14- Is four-week underwater treadmill exercise regimen compared to home exercise efficacious for pain relief and functional improvement in obese patients with knee osteoarthritis? A randomized controlled trial

Abstract Objective

To investigate the efficacy of a four-week underwater treadmill exercise regimen compared to a home exercise regimen relative to pain relief and functional improvement in obese patients with knee osteoarthritis. Design: Single-blind randomized controlled trial. Setting: Outpatient.

Participants

Eighty primary knee osteoarthritis with pain $\geq 5/10$ and body mass index ≥ 25 kg/m². Interventions: Daily quadriceps exercise at home for 30 minutes (control group) or underwater treadmill exercise (study group) for 30 minutes/day, three times/week for four weeks.

Main outcomes

Pain score, six-minute walking distance, quadriceps strength, and body weight were evaluated at baseline and after four weeks. Adverse events, global assessment, and satisfaction index were assessed at the end of the study.

Results

All outcomes in both groups were significantly improved at the end of the study, except for body weight. The mean difference (95% confidence interval (CI)) in outcomes between groups were -0.53 (-1.31, 0.26) for pain; 10.81 (-11.9, 33.53) meters for 6-minute walking distance; 0.67 (-0.10, 1.44) kilograms for quadriceps strength; and 0.01 (-0.66, 0.68) kilograms for body weight. No significant differences were observed between groups, for the per-protocol analysis or the intention-to-treat analysis. Participants in the study group evaluated significantly better global improvement and higher patient satisfaction than those in the control group (13 (39.4%) vs. 4 (10.8%); $P = 0.014$ and 23 (69.7%) vs. 16 (43.2%); $P = 0.021$, respectively).

Conclusion

Exercise using an underwater treadmill was found to be as efficacious as home exercise for relieving pain and improving function in obese people with mild to moderate knee osteoarthritis.

Keywords: Underwater treadmill, pain relief, functional improvement, obesity, knee osteoarthritis.



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15- The Effects of a Motorized Aquatic Treadmill Exercise Program on Muscle Strength, Cardiorespiratory Fitness, and Clinical Function in Subacute Stroke Patients: A Randomized Controlled Pilot Trial

Objective

The aim of this study was to assess whether the effects of a motorized aquatic treadmill exercise program improve the isometric strength of the knee muscles, cardiorespiratory fitness, arterial stiffness, motor function, balance, functional outcomes, and quality of life in subacute stroke patients.

Design

Thirty-two patients were randomly assigned to 4-week training sessions of either aquatic therapy (n = 19) or land-based aerobic exercise (n = 18). Isometric strength was measured using an isokinetic dynamometer. Cardiopulmonary fitness was evaluated using a symptom-limited exercise tolerance test and by measuring brachial-ankle pulse wave velocity. Moreover, motor function (Fugl-Meyer Assessment [FMA] and FMA-lower limb [FMA-LL]), balance (Berg Balance Scale [BBS]), Activities of daily living (Korean version of the Modified Barthel Index [K-MBI]), and quality of life (EQ-5D index) were examined.

Results

There were no intergroup differences between demographic and clinical characteristics at baseline ($P > 0.05$). The results show significant improvements in peak oxygen consumption ($P = 0.02$), maximal isometric strength of the bilateral knee extensors ($P < 0.01$) and paretic knee flexors ($P = 0.01$), FMA ($P = 0.03$), FMA-LL ($P = 0.01$), BBS ($P = 0.01$), K-MBI ($P < 0.01$), and EQ-5D index ($P = 0.04$) after treatment in the aquatic therapy group. However, only significant improvements in maximal isometric strength in the knee extensors ($P = 0.03$) and flexors ($P = 0.04$) were found within the aquatic therapy group and control group.

Conclusions

Water-based aerobic exercise performed on a motorized aquatic treadmill had a beneficial effect on isometric muscle strength in the lower limb.

Key Words: Exercise Test, Hydrotherapy, Muscle Strength, Stroke, Cardiorespiratory Fitness

16- Efficacy of aquatic treadmill training on gait symmetry and balance in subacute stroke patients

Objective

To determine the efficacy of aquatic treadmill training (ATT) as a new modality for stroke rehabilitation, by assessing changes in gait symmetry, balance function, and subjective balance confidence for the paretic and non-paretic leg in stroke patients. Methods Twenty-one subacute stroke patients participated in 15 intervention sessions of aquatic treadmill training. The Comfortable 10-Meter Walk Test (CWT), spatiotemporal gait parameters, Berg Balance Scale (BBS), and Activities-specific Balance Confidence scale (ABC) were assessed pre- and post-interventions. Results From pre- to post-intervention, statistically significant improvements were observed in the CWT (0.471 ± 0.21 to 0.558 ± 0.23 , $p < 0.001$), BBS (39.66 ± 8.63 to 43.80 ± 5.21 , $p < 0.001$), and ABC (38.39 ± 13.46 to 46.93 ± 12.32 , $p < 0.001$). The step-length symmetry (1.017 ± 0.25 to 0.990 ± 0.19 , $p = 0.720$) and overall temporal



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symmetry (1.404 ± 0.36 to 1.314 ± 0.34 , $p=0.218$) showed improvement without statistical significance. Conclusion ATT improves the functional aspects of gait, including CWT, BBS and ABC, and spatiotemporal gait symmetry, though without statistical significance. Further studies are required to examine and compare the potential benefits of ATT as a new modality for stroke therapy, with other modalities.

Keywords Stroke, Rehabilitation, Gait, Hydrotherapy

17- Effects of a 6-Week Aquatic Treadmill Exercise Program on Cardiorespiratory Fitness and Walking Endurance in Subacute Stroke Patients: A PILOT TRIAL.

Objective

To assess the feasibility and safety of a 6-week course of water walking performed using a motorized aquatic treadmill in individuals with subacute stroke for cardiorespiratory fitness, walking endurance, and activities of daily living.

Methods

Twenty subacute stroke patients were randomly assigned to aquatic treadmill exercise (ATE) or land-based exercise (LBE). The ATE group ($n = 10$) performed water-based aerobic exercise on a motorized aquatic treadmill, and the LBE group ($n = 10$) performed land-based aerobic exercise on a cycle ergometer. Both groups performed aerobic exercise for 30 minutes, 5 times per week for 6 weeks. Primary outcome measures were 6-minute walk test for walking endurance and cardiopulmonary fitness parameters of a symptom-limited exercise tolerance test, and secondary measures were Korean version of the Modified Barthel Index (K-MBI) for activities of daily living. All variables were assessed at baseline and at the end of the intervention.

Results

The ATE group showed significant improvements in 6-minute walk test ($P = .005$), peak oxygen uptake ((Equation is included in full-text article.) O_2 peak; $P = .005$), peak heart rate ($P = .007$), exercise tolerance test duration ($P = .005$), and K-MBI ($P = .008$). The LBE group showed a significant improvement only in K-MBI ($P = .012$). In addition, improvement in (Equation is included in full-text article.) O_2 peak was greater in the ATE than in the LBE group.

Conclusion

This preliminary study showed that a 6-week ATE program improved peak aerobic capacity and walking endurance in patients with subacute stroke. The improvement in (Equation is included in full-text article.) O_2 peak after an ATE exercise program was greater than that observed after an LBE program. Therefore, ATE effectively improves cardiopulmonary fitness in patients with subacute stroke.



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18- Acute aquatic treadmill exercise improves gait and pain in people with knee osteoarthritis.

Objective

To examine the acute effects of aquatic and land treadmill exercise on gait kinematics as well as the level of disease-specific and movement-related pain for individuals with osteoarthritis.

Design

Quasi-experimental crossover design.

Setting

Biomechanics laboratory.

Participants

Participants (N=14; age, 43-64y) diagnosed with osteoarthritis at the knee (n=12), osteoarthritis at the knee and ankle (n=1), or osteoarthritis at the knee and hip (n=1).

Interventions

Participants performed 3 exercise sessions separated by at least 24 hours in 1 week for each mode of exercise (aquatic treadmill and land treadmill).

Main outcome measures

Gait kinematics and pain were measured before and after each intervention.

Results

The angular velocity gain score during stance for left knee extension was improved by 38% after aquatic treadmill exercise ($P=.004$). Similarly, during swing, the gain scores for angular velocity were also greater for left knee internal rotation and extension by 65% and 20%, respectively ($P=.004$, $P=.008$, respectively). During stance, the joint angle gain score for left hip flexion was 7.23% greater after land exercise ($P=.007$). During swing, the angular velocity gain score for right hip extension was significantly greater for aquatic exercise by 28% ($P=.01$). Only the joint angle gain score for left ankle abduction during stance was significantly higher after land exercise (4.72%, $P=.003$). No other joint angle gain scores for either stance or swing were significantly different for either condition ($P=.06-.96$). Perceived pain was 100% greater after land than aquatic treadmill exercise ($P=.02$). Step rate and step length were not different between conditions ($P=.31-.92$).

Conclusions

An acute training period on an aquatic treadmill positively influenced joint angular velocity and arthritis-related joint pain. Acute aquatic treadmill exercise may be useful as a conservative treatment to improve angular speed of the lower-extremity joints and pain related to osteoarthritis.

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