Aquatic Exercise Interventions for People with Osteoarthritis

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Role of Exercise in OA

- Reverse muscle sensorimotor dysfunction (weakness, fatigue, poor control)
  - Prevent abnormal movement and restore normal biomechanics
  - Normalize gait, relieve pain and improve function
Mechanical effects of water immersion

Louder et al. (in press)

Wt ≈ 164 lbs
100% of body wt

Wt ≈ 100 lbs
39% unloaded

Wt ≈ 53 lbs
68% unloaded
Bressel et al. (2012)

Walking at 2.3 mph

Mechanical and physiological effects of water immersion

\[ y = 0.0271x^3 - 0.3077x^2 + 1.982x + 9.4869 \]

\[ R^2 = 0.9937 \]
Targeted zone

5 x week; 30-60 min/session (ACSM)
Aerobic Interval Training (HIT)

3 x week; 20 min/session (ACSM)

Rating of Perceived Exertion (RPE)

Warm-up (5 min)

HIT (total duration = 5-15 min)

~ 90% aerobic capacity

Recovery (5 min)

Training zone
Aerobic Interval Training

- Compared to Traditional Training:
  - Superior VO$_2$ max after 12 weeks of training
    - Healthy adults (Nybo et al. 2010)
    - Heart failure patients (Wisloff et al. 2007)
  - Researchers examining optimal training techniques for improved balance in the elderly argue the need for “perturbation-based” training and exercises that promote muscle power production such as HIT (Granacher et al. 2008)
Purpose of Research Study

Develop and test the effectiveness of an aquatic aerobic interval training program on measures of balance and function in patients with osteoarthritis.

Bressel et al. (in press). *Journal of Strength and Conditioning Research*
Methods

Patients diagnosed with osteoarthritis

- n = 18
- Age = 64.5 ± 10.2 yrs.
- Body mass = 79.7 ± 11.6 kg
- Involved limb = 1 or both knees = 100%, knee and hip = 42%
- Duration of arthritis = 6.8 ± 11.6 yrs
Procedures

Key features of training program
- Applies interval training concept (HIT)
- Walking on an underwater treadmill
- Applies balance specific training with jets
Training Session

Rating of Perceived Exertion (RPE)

- Warm-up (5 min)
- Perturbation training (5 min)
- HIT (total duration = 5-15 min)
  - Interval duration = 30 s to 3 min
  - Rest duration = 1-2 min
- Recovery (5 min)

~ 90% aerobic capacity

Training zone
Balance training

Jet Force

Jet Force
Water Jet velocity:
20% = 0.4 m/s
40% = 0.7 m/s
60% = 1.0 m/s

Aquatic Balance

Water proof force plate
(AMTI, model OR6-WP)

Training Session

- Warm-up (5 min)
- Perturbation training (5 min)
- HIT (total duration = 5-15 min)
  - Interval duration = 30 s to 3 min
  - Rest duration = 1-2 min
- Recovery (5 min)

Rating of Perceived Exertion (RPE)

- ~ 90% aerobic capacity
- Training zone
HIT Statistics

- Walking speed = 1.8 ± 0.32 MPH (0.81 m/s)
- Jet intensity-intervals = 74 ± 37.7%
- RPE-intervals = 17.5 ± 0.5
Assessments

- Sensory organization test (SOT)
Assessments

- Limits of stability

Max distance a person can intentionally displace their COG
Assessments

- Functional limitation tests

Sit-to-stand

Forward lunge
Sensory Organization Test

Stability (%)

ES = 0.64; p = 0.01;

0% = no stability
Normative value = 68%
Limits of Stability Test

Max excursion = % of max distance possible

ES = .80; p = 0.04
Sit-to-Stand Test

Weight transfer = time required to shift COG

ES = 0.70; $p = 0.01$
10-M Walk Test

ES = 0.58; p = 0.01

Walk time: Time to cover 10-m using preferred pace
Normative values = 9.3 s
KOOS Scores

100 indicates no problems and 0 indicates extreme problems

Mean KOOS score
KOOS subscales
Pretest 1 Pretest 2 Posttest

KOOS subscales
0 10 20 30 40 50 60 70 80 90

0 10 20 30 40 50 60 70 80 90

100 indicates no problems and 0 indicates extreme problems
Subjective Comments

“Going up and down stairs is noticeably easier”

“I can alternate feet when going up and down stairs, whereas before I had to go one foot at a time” (other subjects gave similar feedback)

“I have less pain throughout the day after I come in for aquatic therapy, it greases my joints” (others gave similar feedback)
Select balance, pain, and functional measurements tend to improve after 6 weeks of aquatic interval training.

The interval training protocol was well tolerated. All participants raved about the protocol and desire to keep training in the pool.