Aquatic Therapy for Individuals with Neurological Disorders

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American Physical Therapy Association
San Antonio, TX,

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University of North Texas Health Science Center

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Long Island University

Course Objectives
In this course participants will be able to:
• Identify the unique aspects and benefits of aquatic therapy for patients with neurological disorders
• Overview current evidence that supports the use of aquatic therapy for rehabilitation of patients with neurological disorders
• Present general guidelines for effective aquatic therapy for patients with neurological disorders
• Describe the aquatic exercise precautions, implications, and concerns for patients with neurological disorders
• Presents examples of aquatic intervention strategies for treatment of balance and gait in patients with neurological disorders

Course Outline
• Introduction
• Common impairments seen in patients with neurological disorders
• Unique aspects of aquatic therapy as a rehabilitation approach
• Review of current evidence
• General guideline for treatment design
• Special considerations
• Discuss examples of aquatic intervention for balance and gait
• Summary of the topic and final thoughts

Common Impairments Seen In People With Neuromuscular Disorders

Parkinson Disease

<table>
<thead>
<tr>
<th>Bradykinesia / Akinesia</th>
<th>A decrease in motion or inability to initiate motion, alter speed and stop motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Festinating Gait</td>
<td>Decreased stride length, decreased velocity, short shuffling steps</td>
</tr>
<tr>
<td>Rigidity</td>
<td>Resistance to movement Lead pipe or cog wheel</td>
</tr>
<tr>
<td>Tremor</td>
<td>Present at rest 4-7 beats/sec, subsides with movement</td>
</tr>
</tbody>
</table>

Parkinson Disease
### Parkinson Disease

<table>
<thead>
<tr>
<th>Impaired posture / postural instability</th>
<th>Stooped or crouch posture, frequent falls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception, attention, cognitive deficits</td>
<td>Difficulty with visual spatial perception and discrimination, difficulty shifting attention, processing speed</td>
</tr>
<tr>
<td>Sleep disturbance, Autonomic Dysfunction</td>
<td>Daytime drowsiness, lack of right sleep, constipation, urinary frequency</td>
</tr>
</tbody>
</table>

### Hemiplegia Post Stroke

<table>
<thead>
<tr>
<th>Hypotonicity (early)</th>
<th>Low muscle tone, flaccidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td>Inability to move against gravity</td>
</tr>
<tr>
<td>Spasticity</td>
<td>Velocity dependent increased resistance to passive movement</td>
</tr>
<tr>
<td>Dystonia</td>
<td>Abnormal movements characterized by sustained muscle contractions causing abnormal postures, twisting, repetitive movements</td>
</tr>
</tbody>
</table>

### Hemiplegia Post Stroke

<table>
<thead>
<tr>
<th>Loss of selective motor control</th>
<th>Inability to isolate movement for function use of synergy patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait Abnormalities</td>
<td>Genu recurvatum, circumduction, toe drag, UE posturing</td>
</tr>
<tr>
<td>Balance Deficits</td>
<td>Varies according to severity, seen with weakness, spasticity, sensory loss</td>
</tr>
<tr>
<td>Loss of ROM or Contracture formation</td>
<td>Flexion contractures of UE, plantar flexion contracture LE</td>
</tr>
<tr>
<td>Pain</td>
<td>I.e. from shoulder subluxation</td>
</tr>
</tbody>
</table>

### Multiple Sclerosis

<table>
<thead>
<tr>
<th>Fatigue</th>
<th>Feeling exhausted “wiped out”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness or Paralysis</td>
<td>Varies according to severity, can cause gait deviation</td>
</tr>
<tr>
<td>Spasticity</td>
<td>Velocity dependent increased resistance to passive movement</td>
</tr>
<tr>
<td>Ataxia and Cerebellar dysfunction</td>
<td>Abnormal movement, Lack of control, dysmetria, tremor</td>
</tr>
</tbody>
</table>

### Multiple Sclerosis

<table>
<thead>
<tr>
<th>Pain</th>
<th>Neurogenic or Orthogenic, present in over 50% of Pt w MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of Balance</td>
<td>Varies according to severity, seen with weakness, spasticity, sensory loss &amp; ataxia</td>
</tr>
<tr>
<td>Sensory Deficits</td>
<td>Numbness, paresthesias, dysesthesia, hypoaesthesia</td>
</tr>
<tr>
<td>Heat Sensitivity</td>
<td>Worsening of MS symptoms when overheated</td>
</tr>
<tr>
<td>Behavioral / emotional changes</td>
<td>Memory, attention, problem solving, irritability, depression</td>
</tr>
</tbody>
</table>

### Traumatic Brain Injury

<table>
<thead>
<tr>
<th>Paralysis or Paresis</th>
<th>Often Hemiplegia, monoplegia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal reflexes</td>
<td>I.e. tonic neck reflexes, startle</td>
</tr>
<tr>
<td>Abnormal muscle tone</td>
<td>Spasticity, rigidity</td>
</tr>
<tr>
<td>Ataxia and Cerebellar dysfunction</td>
<td>Abnormal movement, Lack of control, dysmetria, tremor</td>
</tr>
</tbody>
</table>
### Traumatic Brain Injury

<table>
<thead>
<tr>
<th>Loss of Selective motor control</th>
<th>Inability to isolate movement for function - use of synergy patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Balance</td>
<td>Seen with weakness, spasticity, sensory loss &amp; ataxia Results in gait difficulty</td>
</tr>
<tr>
<td>Dizziness of Vertigo</td>
<td>Common with vestibular dysfunction</td>
</tr>
<tr>
<td>Behavioral Changes</td>
<td>Emotional lability, irritability, short attention span, problem solving skills</td>
</tr>
</tbody>
</table>

### Spinal Cord Injury

<table>
<thead>
<tr>
<th>Flaccidity</th>
<th>Based on level and completeness of injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spasticity</td>
<td>More common in incomplete lesions Velocity Dependent Increased resistance to passive movement</td>
</tr>
<tr>
<td>Autonomic Dysreflexia</td>
<td>Triggering of an uncontrolled hyperactive response from the sympathetic nervous system by a noxious stimulus</td>
</tr>
<tr>
<td>Bowel / Bladder Dysfunction</td>
<td>Neurogenic bowel Flaccid or spastic bladder</td>
</tr>
</tbody>
</table>

### Spinal Cord Injury

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<thead>
<tr>
<th>Loss of ROM / Contracture formation</th>
<th>Dependent on level and type of lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heterotropic Ossification</td>
<td>Spontaneous formation of bone into tissue (muscle) typically at larger joints</td>
</tr>
<tr>
<td>Orthostatic Hypotension</td>
<td>Dramatic fall in blood pressure when pt assumes an upright position usually due to decreased vasomotor control</td>
</tr>
<tr>
<td>Deep Vein Thrombosis</td>
<td>Blood clot within a deep vein</td>
</tr>
</tbody>
</table>

### Cerebral Palsy

<table>
<thead>
<tr>
<th>Hypotonicity</th>
<th>Low muscle tone, Often seen as poor postural / trunk tone.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td>Limited ability to move against gravity produce force</td>
</tr>
<tr>
<td>Spasticity</td>
<td>Velocity Dependent Increased resistance to passive movement Most common presentation in CP</td>
</tr>
<tr>
<td>Dystonia</td>
<td>Abnormal movements characterized by sustained muscle contractions causing abnormal postures, twisting, repetitive movements</td>
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### Cerebral Palsy

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<td>Gait Abnormalities</td>
<td>Toe Walking, Crouch Gait, Stiff Knee Gait, Scissoring, toe drag, UE posturing</td>
</tr>
<tr>
<td>Balance Deficits</td>
<td>Varies according to severity Seen with weakness, spasticity,</td>
</tr>
<tr>
<td>Loss of ROM or Contracture formation</td>
<td>Flexion contractures of UE Plantar flexion, knee and hip flexion, adductor contracture LE</td>
</tr>
<tr>
<td>Pain</td>
<td>Most often in older adolescents and young adults, LBP, Patello-femoral pain</td>
</tr>
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### Unique Aspects of Aquatic Therapy as A Rehabilitation Approach
**Aquatic Therapy for Individuals with Neurological Disorders**

- Aquatic therapy is a well-tolerated form of integrated exercise for individuals neurological disorders
- Recommended by clinicians on an increasing basis as a valuable adjunct to traditional treatment
- Often used to augment rehabilitation of individuals with neurological disorders

**Global Effects of Aquatic Therapy**

- Decreases joint stiffness and improve range of motion
- Facilitates resistance training and improves strength
- Enhances cardiovascular function
- Improves balance
- Edema control and increases peripheral venous return
- Relieves pain and muscle spasm
- General muscle relaxation
- Improves endurance
- Easier progression of weight bearing status
- Enhances quality of life and well-being

**Precautions and Contraindications**

**Contraindications**

- Unstable cardiac conditions
- Unstable vital signs
- Uncontrolled hypertension
- Uncontrolled seizures
- Open wounds/infect ed wounds
- Unstable respiratory dysfunction
- Severe peripheral vascular disease
- Fever
- Danger of bleeding or hemorrhage
- Severe kidney diseases
- Uncontrolled bowel or bladder dysfunctions
- Water and airborne infections
- Tracheotomy—until healed

**Precautions and Contraindications**

**Precautions**

- Fear of water
- Patients with heat sensitivity
- Seizures
- Cardiac dysfunction
- Patients with limited chest expansion
- Uncontrolled diabetes
- Autonomic dysreflexia
- Cognitive and behavioral disorders
- Severe disability

**Why an Aquatic Environment**

- The aquatic environment has broad rehabilitative potential, extending from the treatment of acute injuries through health maintenance in chronic diseases

**Why an Aquatic Environment**

- Aquatic therapy provides an alternate therapeutic environment that allows for the use of traditional therapeutic approaches as well as new intervention strategies
- Allows initiation of rehabilitation sooner than on land in many instances
  - Allows initiation of upright posture
  - Allows patients to move easier in water than on land
  - Allows initiation of controlled active movements earlier than on land
  - The support of the water allows patients to initiate functional activities earlier than on land
- Good environment to dissipate body heat generated during exercise
- Can easily modify degree of difficulty and progress activities
## Additional Rationales for Individuals with Neurological Disorders

- The natural properties of the water; including buoyancy, viscosity, pressure, and cohesion offer an appropriate therapeutic environment that can be used to augment rehabilitation of individuals with neurological disorders

## CLINICAL BOTTOM LINE

- Aquatic environment provides a safe environment to encourage individuals to begin practicing movements and functional activities in upright postural against gravity before being able to achieve these activities on land

## CLINICAL BOTTOM LINE

- Aquatic environment provides a variety of activities that can be easily modified to accommodate the wide range of motor abilities

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<tr>
<td>• The relaxing effects of the water along with neutral warmth may reduce muscle tone and spasticity</td>
<td></td>
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<tr>
<td>• Less pain with movement than on land</td>
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<tr>
<td>• Allows patients to explore movement strategies and patterns against gravity without anxiety or fear of falling</td>
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<tr>
<td>• Facilitates ability to begin practicing independent upright postural activities against gravity before being able to achieve these activities on land</td>
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<tr>
<td>• Reduction in proprioceptive feedback from the buoyancy effects creates a sensory conflict and may stimulate the sensory systems involved in balance</td>
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<tr>
<td>• Relative density, viscosity, and resistance provide multiple sensory stimuli that may contribute to sensory awareness</td>
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<td>• Good environment to dissipate body heat generated during exercise</td>
<td></td>
</tr>
<tr>
<td>— Aquatic exercise is one method of cooling the body during exercises</td>
<td></td>
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<tr>
<td>— Helps to keep core body temperature low, reducing the changes of overheating and fatigue</td>
<td></td>
</tr>
<tr>
<td>• Reduce the risk of fatigue during exercises</td>
<td></td>
</tr>
<tr>
<td>— A cool exercise environment which can increase endurance with activity</td>
<td></td>
</tr>
<tr>
<td>— Facilitate ability to perform movements and increase muscle force and activities without increase in fatigue</td>
<td></td>
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<tr>
<td>• Positive psychological benefits of being able to do more in water than on land</td>
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<tr>
<td>• Studies showing improvements in</td>
<td></td>
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<tr>
<td>— Motor skills – physical functioning</td>
<td></td>
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<tr>
<td>— Social skills</td>
<td></td>
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<tr>
<td>— Well-being and quality of life</td>
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</table>
What Is the Evidence?

- The efficacy of aquatic therapy for improving functions in individuals with neurological disorders has received attention in recent years.
- Although there is a limited number of studies evaluating the effectiveness of aquatic exercise for individuals with neurological disorders, those that have been conducted consistently demonstrate positive outcomes.

What Is the Evidence?

**Traumatic Brain Injury**

**Driver et al. (2004)**
- **Design**: Randomized controlled trial
- **Participants**: 16 participants with TBI at least level 6 or more on the Ranchos Los Amigos Scale of Cognitive Functioning - assigned randomly to aquatic group (n=8) and control group (n=8)
- **Intervention**: 8-week aquatic exercise program, 3/week for 60 minutes
- **Outcome Measures**: Cardiovascular endurance, body composition, muscular strength and endurance, and flexibility
- **Results**: Increase in components of physical fitness for the experimental group but not the control group.

What Is the Evidence?

**Parkinson's Disease**

**Driver et al. (2006)**
- **Design**: Randomized controlled trial
- **Participants**: 18 participants with TBI - outpatient with level 6 or more on the Ranchos Los Amigos Scale of Cognitive Functioning - assigned randomly to aquatic group (n=9) or control group (n=9)
- **Intervention**: 8-week aquatic exercise program, 3/week for 60 minutes
- **Outcome Measures**: Health Promoting Life Style Profile and Physical Self-Description Questionnaire
- **Results**: Significant improvements in health promoting behaviors, physical self-concept and self-esteem in the training group as compared to the control group.
What Is the Evidence?

- **Vivas et al. (2011)**
  - **Design:** Randomized controlled trial
  - **Participants:** 11 participants with PD – Hoehn and Yahr stage 2 or 3 - assigned randomly to aquatic group (n=5) or land-based group (n=6)
  - **Intervention:** 4-week aquatic program– individual sessions, 2/week for 45 minutes
  - **Outcome Measures:** Functional Reach Test (FRT), the Berg Balance Scale (BBS), the UPDRS, the 5-m walk test, and the Timed "Up and Go" test (TUG)
  - **Results:** A main effect of both therapies was seen for the FRT. Only the aquatic therapy group improved in the BBS and the UPDRS

What Is the Evidence?

- **Chu et al. (2004)**
  - **Design:** Randomized controlled trial
  - **Participants:** 12 community-dwelling patients with mild to moderate stroke
  - **Intervention:** 8-week group aquatic program, 3/week for 60 minutes
  - **Outcome Measures:** Cardiovascular fitness ($V_{O2,max}$), workload, strength, gait speed, and BBS
  - **Results:** The aquatic group attained significant improvements over the control group in the cardiovascular fitness, workload, paretic leg strength, and gait speed

What Is the Evidence?

- **Noh et al. (2008)**
  - **Design:** Randomized controlled trial
  - **Participants:** 25 ambulatory patients with chronic stroke – aquatic group (n=13) and control group (n=12)
  - **Intervention:** 8-week aquatic program (Ai Chi and Halliwick methods – focused on balance and weight bearing), 3/week for 60 minutes
  - **Outcome Measures:** BBS and GRF measured during four standing tasks – Secondary outcomes: Gait and Strength
  - **Results:** Significant improvements in BBS, GRF and knee flexor strength in the aquatic group as compared to the control group

What Is the Evidence?

- **Chon et al. (2009)**
  - **Design:** Case study
  - **Participants:** 3 ambulatory patients with chronic stroke
  - **Intervention:** 8-week Watsu approach, 5/week for 40 minutes
  - **Outcome Measures:** Tone Assessment Scale (TAS), Rivermead Visual Gait Assessment (RVGA)
  - **Results:** Improved TAS and RVGA scores

What Is the Evidence?

- **Santos et al. (2011)**
  - **Design:** Single subject design
  - **Participants:** 10 ambulatory patients with chronic stroke
  - **Intervention:** 12 treatment session
  - **Outcome Measures:** Timed "Up and Go" test (TUG)
  - **Results:** Significant improvements in TUG scores

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**Stroke**

- **Chon et al. (2009)**
  - **Design:** Case study
  - **Participants:** 3 ambulatory patients with chronic stroke
  - **Intervention:** 8-week Watsu approach, 5/week for 40 minutes
  - **Outcome Measures:** Tone Assessment Scale (TAS), Rivermead Visual Gait Assessment (RVGA)
  - **Results:** Improved TAS and RVGA scores
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<thead>
<tr>
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<tbody>
<tr>
<td><strong>Tripp F &amp; Krakow K et (2014)</strong></td>
<td><strong>Kim et al. (2016)</strong></td>
</tr>
<tr>
<td>- Design: Randomized Control Trial</td>
<td>- Design: Randomized Control Trial</td>
</tr>
<tr>
<td>- Participants: 30 2 weeks post-stroke in sub acute setting</td>
<td>- Participants: 20 ambulatory patients with chronic stroke</td>
</tr>
<tr>
<td>- Intervention: 3x a week for 2 weeks Halliwick treatment sessions</td>
<td>- Intervention: 30min x 5 days x 6 weeks, Aquatic Dual Task Training treatment sessions</td>
</tr>
<tr>
<td>- Outcome Measures: Berg Balance Scale, Functional Gait Ability</td>
<td>- Outcome Measures: Berg, 5x sit to stand, Functional Reach, Timed &quot;Up and Go&quot; test (TUG), 10MWT</td>
</tr>
<tr>
<td>- Results: Significant improvements in Berg scores, Modest improvement in Functional Gait</td>
<td>- Results: Significant improvements all measures, in experimental group</td>
</tr>
</tbody>
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<tr>
<td><strong>Zhu et al. (2016)</strong></td>
<td><strong>Spinal Cord Injury</strong></td>
</tr>
<tr>
<td>- Design: Single blind Randomized Control Pilot</td>
<td></td>
</tr>
<tr>
<td>- Participants: 28 ambulatory patients with chronic stroke</td>
<td></td>
</tr>
<tr>
<td>- Intervention: 45 min treatment sessions x 5 days x 4 weeks, Including Treadmill and Aquatic Treadmill training</td>
<td></td>
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<tr>
<td>- Outcome Measures: Berg, Functional Reach Test, 2MWT, Timed &quot;Up and Go&quot; test (TUG)</td>
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<tr>
<td>- Results: Significant improvements all scores both groups, Functional Reach and 2MWT Greater in Aquatic group</td>
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<tr>
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<tr>
<td><strong>Keşiktas et al. (2004)</strong></td>
<td><strong>Patients with poilo</strong></td>
</tr>
<tr>
<td>- Design: A case controlled matched study</td>
<td></td>
</tr>
<tr>
<td>- Participants: 20 individuals with SCI – aquatic group and control group</td>
<td></td>
</tr>
<tr>
<td>- Intervention: Water exercises, 10 weeks, 3/week for 20 minutes</td>
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</tr>
<tr>
<td>- Outcome Measures: FIM scores, spasm severity, oral baclofen intake and MAS</td>
<td></td>
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<tr>
<td>- Results: The water group demonstrated significant improvements as compared to the control group</td>
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<td>What Is the Evidence?</td>
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<tr>
<td><strong>Willén et al. (2002)</strong></td>
<td><strong>Multiple Sclerosis</strong></td>
</tr>
<tr>
<td></td>
<td>Design: Retrospective</td>
</tr>
<tr>
<td></td>
<td>Participants: 15 adults with polio</td>
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<tr>
<td></td>
<td>Intervention: Group water training – three years prior to the study – 45 minutes/session</td>
</tr>
<tr>
<td></td>
<td>Outcomes Measures: Semi-structured interview</td>
</tr>
<tr>
<td></td>
<td>Results: Participants reported that aquatic training improved their physical functions and quality of life</td>
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<td><strong>Gehlsen et al. (1984)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design: Single subject design</td>
</tr>
<tr>
<td></td>
<td>Participants: 10 ambulatory subjects with multiple sclerosis</td>
</tr>
<tr>
<td></td>
<td>Intervention: 10 weeks of water aerobics, 3/week for 60 minutes</td>
</tr>
<tr>
<td></td>
<td>Outcome Measures: Muscle strength, endurance, work and power</td>
</tr>
<tr>
<td></td>
<td>Results: Aquatic training increased work capacity and fatigue resistance of the knee flexor and extensor muscles, and improved upper extremity work, force, and power</td>
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<td></td>
<td>Design: Single subject design</td>
</tr>
<tr>
<td></td>
<td>Participants: 11 ambulatory subjects with multiple sclerosis</td>
</tr>
<tr>
<td></td>
<td>Intervention: 10 weeks of water aerobics 3/week for 60 minutes</td>
</tr>
<tr>
<td></td>
<td>Outcome Measures: Cadence, stride length and joint excursion during gait</td>
</tr>
<tr>
<td></td>
<td>Results: No changes in gait parameters</td>
</tr>
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<td><strong>Stuifbergen (1997)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design: Case study</td>
</tr>
<tr>
<td></td>
<td>Participants: 4 women with multiple sclerosis</td>
</tr>
<tr>
<td></td>
<td>Intervention: 6-week aquatic exercise class – 2/week</td>
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<tr>
<td></td>
<td>Outcome Measures: SF-36 and Human Activity Profile</td>
</tr>
<tr>
<td></td>
<td>Results: Improvements in self-reported QoL and Human Activity Profile in the four women with MS</td>
</tr>
</tbody>
</table>

<p>| What Is the Evidence? |  |
|----------------------|  |
| <strong>Sutherland et al. (2001)</strong> |  |
|  | Design: Randomized controlled trial |
|  | Participants: 22 individuals with multiple sclerosis - training group (n=11) and control group (n=11) |
|  | Intervention: 10-week water aerobic exercises, 3/week |
|  | Outcome Measures: Health Related Quality of Life (HRQOL) and the Profile of Mood Status |
|  | Results: Significant improvements in quality of life and psychological well-being in the training group as compared to the control group |</p>
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<tr>
<td>- Design: Single subject design</td>
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<tr>
<td>- Participants: 19 individuals with <em>multiple sclerosis</em></td>
<td>- Participants: 10 participants with <em>multiple sclerosis</em></td>
</tr>
<tr>
<td>- Intervention: 12-week aquatic exercise program, 2/week for 60 minutes</td>
<td>- Intervention: 10-week aquatic program, 2/week for 60 minutes</td>
</tr>
<tr>
<td>- Outcome Measures: SF-36 and MSQOL</td>
<td>- Outcome Measures: the 10-Meter Walk Test, Berg Balance Scale (BBS), the &quot;Timed Up and Go&quot; (TUG) test, grip strength and the Modified Fatigue Impact Scale (MFIS)</td>
</tr>
<tr>
<td>- Results: Significant improvements in the QoL domains of social functioning and fatigue</td>
<td>- Results: Significant improvements in all outcome measures were observed. All participants reported that they enjoyed the program and had improved after the training</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What Is the Evidence?</th>
<th>What Is the Evidence?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pariser et al. (2006)</strong></td>
<td><strong>Salem et al., – 2013</strong></td>
</tr>
<tr>
<td>- Design: Case report</td>
<td>- Design: Randomized controlled trial</td>
</tr>
<tr>
<td>- Participants: Two individuals with <em>multiple sclerosis</em></td>
<td>- Participants: 20 individuals with <em>multiple sclerosis</em> – assigned randomly to aquatic group (n=10) and control group (n=10)</td>
</tr>
<tr>
<td>- Intervention: 8-week aquatic training program, 2/week</td>
<td>- Intervention: 10-week aquatic program, 1/week for 60 minutes</td>
</tr>
<tr>
<td>- Outcome Measures: Cardiovascular fitness (VO2peak) and Fatigue Severity Scale</td>
<td>- Outcome Measures: Gait speed (10-MWT), BBS, TUG, grip strength, MFIS, and MSQOL-S4</td>
</tr>
<tr>
<td>- Results: Improvements in cardiovascular fitness - changes in fatigue were equivocal for participants</td>
<td>- Results: Significant improvements in strength, mobility function and quality of life</td>
</tr>
</tbody>
</table>

**Abstract**

Subjective and objective improvements were observed in a group of individuals with multiple sclerosis. Specifically, improvements in cardiovascular fitness and a reduction in fatigue were observed. These findings support the use of aquatic exercise as an adjunct evidence-based method to augment rehabilitation for individuals with multiple sclerosis.
What Is the Evidence?

- **Kalron et al. (2015)**
  - **Design:** Retrospective Cohort Review
  - **Participants:** 312 subjects with multiple sclerosis grouped by level of disability, Mild Mod, Severe
  - **Intervention:** Combination of Goal Directed PT, Aquatics, Aerobic Training
  - **Outcome Measures:** TUG, 10 and 20 M walk tests (speed) 2MWT (Distance)
  - **Results:** All measures improved only 2MWT reached clinically significant distance

What Is the Evidence?

- **Cerebral Palsy**

What Is the Evidence?

- **Ballaz et al. (2011)**
  - **Design:** Single Group Pre-Post Test Design
  - **Participants:** 12 Adolescents with Cerebral Palsy GMFCS Levels I-IV
  - **Intervention:** Aquatic Swimming Training Program 20 group training sessions 45 min, 2 x a week
  - **Outcome Measures:** EEI (energy expenditure index), 3-D Gait Analysis GMFM D & E
  - **Results:** Significant Improvement in EEI (decrease), some improvement in gait (single limb stance) GMFM E in GMFCS level IV

What Is the Evidence?

- **Fragala-Pinkham et al. (2014)**
  - **Design:** Prospective Time Series Group Design (pilot)
  - **Participants:** 8 ambulatory children with Cerebral Palsy GMFCS Level I & III
  - **Intervention:** Individual 60 min sessions 2 x a week x 14 weeks. Aerobic Activity based on HR
  - **Outcome Measures:** GMFM D & E, 6MWT
  - **Results:** Significant Improvement in all measures p < 0.001, Improvements maintained 1 month after intervention ended

What Is the Evidence?

- **Lai et al. (2015)**
  - **Design:** Prospective Single Blind Quasi-Experimental
  - **Participants:** 24 Children with Cerebral Palsy GMFCS Level I - IV
  - **Intervention:** Halliwick Method, 60 min sessions 2 x a week x 12 weeks
  - **Outcome Measures:** Modified Ashworth Scale, GMFM, Physical Activity Enjoyment Scale
  - **Results:** Significant & Greater Change in Aquatic Group in GMFM, No Change in MAS, Higher Enjoyment levels in Aquatic Group

What Is the Evidence?

- **Declerck et al. (2016)**
  - **Design:** Randomized Control Trial
  - **Participants:** 14 youth with Cerebral Palsy GMFCS Level I-III
  - **Intervention:** 10 week 2 x a week Swimming program in the community
  - **Outcome Measures:** Perceived Enjoyment, Pain Scales, 1 min fast walk test, PedsQL fatigue scale, WOTA water orientation scale
  - **Results:** All reported high levels of enjoyment, Significant increase in distance as max walking speed and swim skills in aquatic group, No increase in pain, Increase in fatigue in control
What Is the Evidence?
Summary of the Evidence

<table>
<thead>
<tr>
<th>Patient Population</th>
<th>Number of Studies</th>
<th>Level of Evidence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCI</td>
<td>1</td>
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<tr>
<td>PD</td>
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<td>1</td>
</tr>
<tr>
<td>Polio</td>
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<td>1</td>
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<tr>
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<td>2</td>
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<td>1</td>
</tr>
<tr>
<td>CP</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

*Level of evidence
- Level 1: RCT, systematic review of RCTs
- Level 2: Cohort study/low quality RCT, systematic review of cohort study
- Level 3: Case controlled study
- Level 4: Case series, case report
- Level 5: Expert opinion

What Is the Evidence?
What we learned

- Aquatic exercise programs are beneficial for individuals with neurological disorders to improve physical functions such as strength, balance and walking
- Aquatic programs can be beneficial to improve quality of life and well-being
- Aquatic programs can be used to augment the rehabilitation of individuals with neurological disorders

What Is the Evidence?
What we learned

- There is limited number of studies that examined the effectiveness of aquatic therapy in multiple sclerosis
- The available literature suggests the beneficial effects of aquatic exercises and support its use as a reasonable treatment option for individuals with neurological disorders to improve:
  - Flexibility and range of motion
  - Muscle tone
  - Cardiovascular endurance
  - Muscular strength and endurance
  - Mobility function – gait and balance
  - Fatigue level
  - Quality of life and well-being

CLINICAL BOTTOM LINE

- Aquatic training holds promise as an effective treatment strategy to minimize detrimental affect and maximize function in persons with neurological disorders
- Aquatic exercise is a safe, and effective therapeutic option to augment the rehabilitation of individuals with neurological disorders

General Guidelines of Treatment Design
General Guidelines of Treatment Design

**Warm Up**
- 5-10 minutes of light activity that prepares body for exercise
- Gradually increase heart rate and blood flow

**Aerobic Training**
- Improves cardiovascular fitness
- Decrease risk of prevent many chronic diseases
- Aerobic/cardiovascular conditioning activities include deep water walking, jogging, swimming strokes, immersed cycling and immersed treadmill

**Training Activities**
- Exercise targeted at achieving needs and goals of the patient
- Slow movements that elongate muscles
- Decrease chance of injury
- Improve posture
- Stretching exercises

**Stretching**
- 5-10 minutes of light activity to assist in returning body to rest
- Reduced risk of muscle soreness
- Reduce risk of abnormal HR and low post-exercise blood pressure

**Coast Down**
- Low intensity aerobic exercises
- Breathing exercises
- Flexibility
- Neck, arms, and legs movements such as arm circles

**Warm Up**
- 5-10 minutes of light activity that prepares body for exercise
- Gradually increase heart rate and blood flow

**Aerobic Training**
- Exercise targeted at achieving needs and goals of the patient
- Stretching exercises
- Strengthening exercises
- Balance training
- Gait training
- Exercises targeting specific impairments – spasticity, fatigue, pain, sensory deficits, etc.
- Functional activities – function, function, function

**Training Activities**
- Stretching exercises
- Gait training

**Stretching**
- 5-10 minutes of light activity to assist in returning body to rest
- Reduced risk of muscle soreness
- Reduce risk of abnormal HR and low post-exercise blood pressure

**Cool Down**
- Low intensity aerobic exercises
- Breathing exercises
- Flexibility
- Neck, arms, and legs movements such as arm circles
General Guidelines of Treatment Design

• Other factors should be considered when designing and implementing aquatic exercise programs for individuals with neurological disorders:
  – Identifying appropriate participants
  – Structuring meaningful training activities
  – Intensity, frequency, and duration
  – Group versus individual training
  – The ratio of participants to support staff
  – Suitability and safety of the training environment

Examples of Aquatic Intervention for Balance and Gait

Balance Activities

Planning Balance Activities

• Need to define and address impairments before designing aquatic program and know what system you are targeting
  • Motor system
  • Sensory system
  • Other impairments

• Work on trunk stability from upright position

Planning Balance Activities

• Work on developing strategies that move the COM relative to the BOS from sitting and standing
  – Appropriate lengthening and shortening of the trunk as the COM moves laterally
  – Ankle strategy
  – Hip strategy
  – Stepping strategy

• Work on activities to develop changing BOS strategies

Planning Balance Activities

• Design activities that focus on development of anticipatory postural control (such as manipulation tasks)

• Work on development of sensory strategies for balance
  – Visual system
  – Vestibular system
  – Somatosensory system
Examples of Balance Activities

- Sitting and standing with a neutral spine position
- Sitting – maintain balance while sitting on a flotation device
- Sitting – weight shifting activities
- Standing – maintain standing balance and progress to standing with narrow base of support
- Sitting or standing with a variety of upper extremity exercises
- Unilateral stance
- Practice sitting and standing activities with eyes open and progress to eyes closed

Examples of Balance Activities

- Standing – weight shifting activities
- Standing with predictable/unpredictable shifts
- Throwing a ball to different directions and heights
- Reaching in different directions to catch a ball
- Stepping activities such as stepping forward, backward, and sideways onto aqua step
- Picking up an object from the therapist’s hand in the water or placed on the floor of the pool

Gait Training Activities

Planning Gait Training Activities

- Work on treatment of underlying impairments
  - Muscle weakness, tightness, spasticity, balance deficits
- Work on strategies that focus on essential requirements of gait
  - Progression – limb advancement and foot placement
  - Postural control – postural support and stability - single limb support
  - Adaptation – functional adaptation

Examples of Gait Training Activities

- Step-up/step-down exercises
- Heel rise and lower
- Single leg stance activities
- Stepping activities such as stepping forward, backward, and sideways onto aqua step or blocks of various heights
Examples of Gait Training Activities

- Marching activities that focused on maintaining an upright trunk posture during single-leg stance, and strengthening of the hip and knee flexors and ankle-dorsiflexors during swing
- Walking activities including walking forward, backward, and sideways,
- Walking over an obstacle course

Examples of Gait Training Activities

- Walking against water turbulence
- Walking while holding a flotation noodle or walking while wearing flotation belt
- Underwater treadmill walking
- Change direction and speed while walking
- Consider various water depth

Progression of Aquatic Activities

- The difficulty level should be individualized and based on patient’s ability and goals
- Progression and difficulty level should be modified according to patient’s ability and based on the ongoing reevaluation

Ideas for Progression of Aquatic Activities

- Vary the depth of water
- Vary speed of movements
- Add time components to the task
- Create turbulence in the water
- Quick stops and changing directions
- Environmental conditions - obstacles and stairs
- Sensory conditions – vision, surface
- Use of equipment
- Feedback
- Dual tasks

Integrating Land and Aquatic Activities

- Begin to justify the need for aquatic intervention
  - Why treatment using aquatic intervention (properties of the water) is more effective and will achieve the patient’s goals more quickly than land-based intervention
  - Justify how aquatic intervention can be used to achieve land skills/goals
  - Remember that combining land-based and aquatic-based intervention allow the therapists to combine the best of both land and aquatic interventions and provide patients with several treatment options/strategies
Integrating Land and Aquatic Activities

- How much activities in water and how much activities on land?
  - Exact proportion is based on the condition, needs, and progression
  - Examples:

- Goals
  - Assess function on land
  - Establish goals for function on land
  - Establish goals for function in water that will enhance land function – aquatic goals and plan of care should reflect assisting patients to achieve

- Functional training
  - Incorporate functional training into an aquatic program

Special Considerations

- Most accidents involved in aquatic therapy occur while entering and exiting the pool. They are caused by lack of balance.
  - Special considerations to the entry ramp – hand railing, nonslip surface, organization of the pool side, locker areas
  - Check rubber tips of the canes and walkers as they lose their grip on wet surfaces
  - Adequate staffing (individual versus group, associated impairments, functional abilities, etc.)

Special Considerations

- Fatigue and heat sensitivity
  - Monitor water temperature
  - Make sure that exercise environment is cool
  - Encourage clients to drink plenty of water
  - Avoid strenuous activities – especially during hot, humid weather – MS, PD
  - Allow more frequent periods of rest
  - Monitor fatigue
  - Consider using the 0 to 10 Rate of Perceived Exertion (PRE) scale or other fatigue scales

Special Considerations

- Remember that neurological signs and symptoms may change from day to day - be prepared – ongoing assessment

- Considering functional level
  - Activities should be altered to match functional abilities and treatment goals

- Quality of movement
  - Proper posture and neutral body alignment
  - Encourage efficient movement patterns

Special Considerations

- Equipment is not needed to perform exercises – but may be used to facilitate and alter treatment activities

- Breathing
  - Encourage normal breathing during exercises – discourage holding one’s breath

- Monitor, monitor, monitor ……………
  - Vital signs
  - Motor signs – fatigue, general weakness, increased spasticity, decreased balance
  - Other signs - blurred vision, rapid eye movements
Summary and Final Thoughts

- Aquatic therapy is beneficial for individuals with neurological disorders to improve physical functions such as strength, balance and walking.
- Aquatic programs can be beneficial to improve quality of life and well-being.
- Therapists have a lot to contribute to the development of treatment activities.

References


References


It’s QUESTION TIME

- Evidence is limited but increasing – need more research in this area of practice.
- Aquatic therapy offers many opportunities and strategies that can be used to augment the rehabilitation of individuals with neurological disorders.

References