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Aquatic Interventions to Promote Functional Gains for Older Adults

June 28, 2019

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Learning Outcomes

At the conclusion of this course, participants will be able to:

- Discriminate/discuss the use of sequential aquatic interventions to provide positive outcomes for five functional activities of older adults;
- Discriminate/discuss justifications for using aquatic treatment options with respect to functional activities commonly performed by older adults;
- Recognize those functional activities as well as specific older adult conditions that are not appropriately addressed/contraindicated with respect to aquatic interventions;
- Discuss/defend appropriate aquatic interventions for functional activities using current literature depicting positive results.

Physical Functional Independence vs. Decline

Physical Decline Associated with Age

- Age-related changes
- Other factors related to dependence

Maintenance of Functional independence

- Individual expectations regarding aging/functional decline

Exercise—specifically Aquatics– as a ticket to maintaining independence

Western Society: Living Longer with Increased Disability & Inactivity

Aging with increased disability

- 1 in 4 adults 65 yrs. old /older falls every year
- Every 11 sec an older adult is admitted to ED for a fall-related injury
- 29,668 older adults died resultant of fall (2016)

27% of adults 65-74 yrs. old + 35% of those 75yrs and older are sedentary

- 36% adults >50 yrs. old are considered morbidly obese

Inactivity IS #1 Risk Factor for DEPENDENCY

Self-reported sedentary lifestyle = functional dependency

- Greater risk than aging alone
- Faster decline at younger spectrum of older adult
- Increased predictor of early mortality

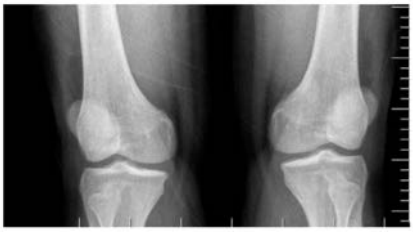
Cardiorespiratory fitness—gait speed--- is directly associated with functional independence for older adults

Immobility equates to increased frailty + fracture risk

Age-Related Changes Associated with Function

Musculoskeletal

- ↓ed Strength, power, muscle endurance
  - ↓ed Muscle Mass
  - ↑ed Time to peak muscle tension
  - ↓ed Skeletal muscle enzyme activity
  - Slow loss of bone mass begins at ≈ 40 yrs. –throughout lifespan
  - Onset of joint pain



Age-Related Changes Associated with Function

Neurological – Specific Motor Control Impairments

- Altered neural recruitment pattern
- Increased neural system activation time
- Altered visual acuity +sensory organ changes
- Perceptual deficits due to specific or multiple neural deficits
- Neuropathies/altered sensation

Age-Related Changes Associated with Function

- Cardiovascular: Directly correlated to gait speed
  - ↓ed Max heart rate (↓cardiac output)
  - ↓ed Max Skeletal Muscle Blood Flow
  - ↓ed Maximal Aerobic Capacity
  - ↑ed Blood pressure
- Pulmonary
  - ↓ed VO_2max
  - ↓ed Max flow Rate
  - ↓ed Respiratory muscle strength
  - ↑ed Respiratory Rate

↓Reduced exercise capacity/blunted exercise response

Associated Risk Factors that Affect Functional Independence

FUNCTION to FRAILTY

- Hospitalization
- ADL's + IADL's
- Cognitive Status and Social Interactions
- Health Co-morbidities
- Depression
- Environmental +financial resources

Functional Independence

- DEFINED: Complex interaction of various body systems—plus external considerations—that allow one to continue performing ADL's.
  - Interaction of tasks provides basis for independence
- ADAPTATION: component of successful aging
- GOAL: Optimize competency with specific tasks throughout lifespan

Components of Functional Tasks: Defining Independence

- Gait, specifically speed
- Dynamic Balance
  - Functional Reach
    - Core Strength required for functional reach
- Functional Upper/Lower Extremity Strength
    - Power Incorporated with strength tests/training

Independence requires coordination between muscle groups, motor systems + specificity of task

GAIT SPEED

- Best measurement of functional criteria for gait regardless of quality
- Gait speed indicative of survival in older adults[7]
- Integrates unrecognizable disturbances in multiple organ systems.

Gait SPEED
"the 6th Vital Sign"

Summary indicator of multiple physiologic system inputs—reflective of overall health[7-8]

- < .6 M/sec: Dependent ambulator with significant functional impairments;
- .6-1.0 M/sec: Limited community ambulator
- >1.0 M/sec: Functional community ambulator
- 1.4M/sec and >: crosses street safely; able to climb multiple flights of stairs

Physical Changes Occurring with Age that Affect GAIT SPEED

Decreased Speed results in ….

- Shorter stride lengths
- ↓ed medial/lateral trunk, hip and ankle rotation
- ↑ed anterior/posterior work expenditure from hip
- ↓ed plantar flexor power
- ↓ed ROM for spine, pelvis and LE's

How We Pick Gait Speed

- Individual's health
- Motor Controls
- Muscle Performance
- Sensory + Perceptual Functions
- Cognitive Status
- Motivation+ Mental health
- Characteristics of environment- land or water

Self-chosen speed requires selection of stride length + joint displacement + appropriate joint torque + power to maximize efficiency

Evaluating GAIT SPEED

PURPOSE: Measures endurance + community mobility using quantitative measures

STRENGTHS:

- Familiar functional activity
- Predictive morbidity/mortality
- Good reliability + validity

WEAKNESS:

- Cannot be used with non-ambulatory individuals
- Relies on patient motivation
- Limitations may not be related to endurance alone-pain
- Performance frequently improves with multiple trials

Gait Speed Tests

- 6-Minutes Walk Test: Most widely researched test of aerobic capacity for multiple patient populations
  - Measures distance with minimal turns —30meters
  - Validated for use of assistive device
- 2-Minutes Walk Test: Test of aerobic capacity, functional mobility + gait
  - Appropriate for amputees, frail + clients with
  - mod-severe cardiopulmonary disease
  - Assesses exercise capacity with same degree of accuracy as longer test

Gait Speed Tests (cont.)

400-Meter Walk Test: Effective tool to assess fitness of community dwelling older adults and predict mortality risk for those unable to perform 400-M

Addressing Gait Speed Using Water Exercise

Transitioning to Water Walking Consider…..

- Immersion level + Speed affects forces
- Resistance imposed on body-
  - Water is 800x denser than air
  - More conscious movement control
- Apparent decreased body weight due to buoyancy = decreased musculoskeletal stresses
  - Decreased muscle activation

Water Walking Considerations

- Depth alters ground reaction forces (GRF) + joint compressive forces
- Increased drag adjusts cyclic phases
  - Changes are more obvious as speed is adjusted
- Drag Force alters posture
  - Changes lower extremity (LE) muscle activation + timing
  - Internal net joint forces + torque are decreased affecting muscle activation

Consider Aquatic Interventions for….

Those individuals who present with

- Poor balance
- Decreased muscle and/or functional endurance
- Pain with ambulation
- Inconsistent gait sequencing
- Postural deviations, specifically trunk-flexed orientation

Note: There is a learning curve to achieving beneficial results with aquatic ambulation

Components of Water Walking Rx

- Increase speed with water at chest depth
- Work on increasing stride lengths
- Increase Upper Extremity (UE) involvement
- Designate sessions for strength training specifically for….
  - Gastroc/soleus complex
  - Trunk
  - Hip Flexors

Water Walking Rx Components

- Consider hip flexors "the driver" of forward motion—single fast/long stepping
  - Facilitates hip flexor stretch for back LE
  - Enhances toe-off for speed emphasis
- Power Drills
  - Running to destination, run with directional changes on command; run with metronome
  - QUICK-step-to-target or stepping on command
  - Directional Changes for time

Water Walking: Implications for Rx with Older Adults

Comparing older vs. young adult

- Significantly slower speeds, shorter stride lengths, increased stance period
- Stance originates from flat foot
- Increased knee flexion at initial contact, and persists throughout cycle but varied
- Increased hip flexion throughout sequence
- Decreased dorsiflexion + decreased plantar flexion power

Summary: Aquatic GAIT

Increased anterior force is required to overcome viscosity

- Increases effort for hip flexors
- Can strengthen hip flexors just walking
- Contralateral extremity use facilitates trunk flexion/balance

Multiple studies using water to enhance LE ROM, strength, balance also demonstrated improved gait speed

Water Exercise + Gait Speed Upgrades RESEARCH

Gait speed upgrades using resistive equipment

Purpose: Demonstrate aquatic exercise benefits.

- N: 18 using resistance equip; 12 without resistance
- Intervention: 90minute x 3x/wk. x 8wks
- Result: Significant improvement noted for 10-M walking speed.

Katsura Y. Yoshikawa T. Ueda S-Y. et al Effects of aquatic exercise training using water resistance equipment in elderly. Eur J Appl Phys. 2010; 108(5):957-964.

BALANCE

The Relationship Between AGE & Dynamic Balance

DYNAMIC BALANCE

"Process by which we control the body's Center of Mass (COM) with respect to the Base of Support (BOS), whether it is stationary or moving."

When the COM extends beyond the BOS,

- Step is required to prevent a fall
- Requires preparation + motor plan
  + strength to respond appropriately

Age-Related Changes of DYNAMIC BALANCE

Older adults demonstrate

- Decreased ability to anticipate task-specific demands:
  - Decline in information processing + manipulation of information
- Need for advanced stabilization due to weaker postural muscles and/or slower voluntary control system

Inability to stabilize with voluntary tasks

is a serious contributor to falls

Age-Related Changes of DYNAMIC BALANCE

DYNAMIC BALANCE depends on capacity of individual + demands of task + strategies used to accomplish control

- Postural Control requires attentional processing
- Amount of attention depends on degree of instability inherent in task
- Older individual requires more attention to perform dynamic tasks = Cognitive Component

Age-Related Changes of DYNAMIC BALANCE

- Evidence supports the notion that anxiety and/or fear of falling affects dynamic balance performance

  Fear of Falling = SIGNIFICANT FALL RISK

- Older adults modulate strategies for postural control based on level of postural threat

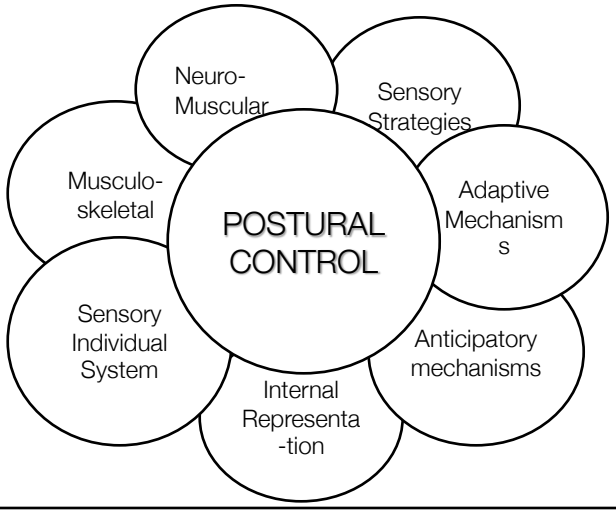
Balance in Elderly Deteriorates When……

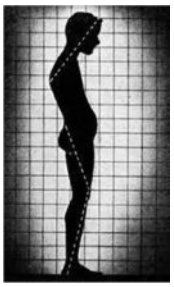
- Sensory inputs contributing to balance are altered
- Ability to process information is slowed/altered
- Motor programs are altered due to musculoskeletal deficits

ADDITIONALLY, ALTERED BALANCE… may represent non-specific presentation of an acute disease such as anemia, dehydration, infection

Postural Control of Quiet Stance

Interaction of musculoskeletal AND neural systems required for stability and orientation





Dynamic Balance Related to Posture

Stability requires

- Appropriate biomechanical alignment + environmental orientation
- Constant, active muscle contractions to counteract forces of gravity.
- Discrepancies in postural alignment drastically alters quiet stance
  - Older adult postural discrepancies disrupt spatial orientation + create altered balance

To Remain Upright Requires….

Motor: Organization of neuromuscular synergies

- Organized perceptual/sensory input
- Visual: movement + where we are in space
- Vestibular: determines whether we or the world moves
- Somatosensory Systems:
- Higher level processing
- Sensation to action

Ensure adaptive aspects of postural control

Postural Control
Anticipatory vs. Reactive

Anticipatory Postural Control: Adjustments made to stabilize the body prior to initiating voluntary movement.

- Feed forward Control: Response in anticipation of voluntary movements
- Requires sensory input + appropriate feedback loop
- Must activate postural muscles far enough ahead of prime movers or risk LOB
- Older Adults loose ability to anticipate task-specific demands due to:
  1. Decline in information processing speed AND/OR
  2. Altered storage/manipulation of information

Musculoskeletal Issues Affecting Anticipatory Postural Control

Alignment: Determines constellation of movement strategies available and effectiveness

- Abnormal alignment alters body position with reference to gravity + BOS

Constraining Factors: Lost AROM +flexibility limit movement possibilities for maintaining postural control

Neurological Issues Affecting Anticipatory Postural Control

Sensory input affects organization + coordination of information

- Affects adaptation of sensory inputs to changes in task or environmental demands
- Alters development of internal models of posture + orientation cues
- Alters other senses' abilities to detect body's position
- Changes interpretation/selection of sensory information

Reactive Postural Control

Response to unexpected perturbation requiring appropriately timed recognition of perturbation + adequate motor program to respond

- Decreased ability to process information creates problems with quick solution to balance perturbations
- Decline in muscle power between 50- 70 yrs. + muscle strength declines 10% per decade after 50 yrs.

Postural Control Requires….

1. Trunk Control: Require flexion/extension + lateral tilts
   Can you get into upright posture & do you have the strength to stay there?
2. Midline Orientation: Align mass over BoS
   Do you know where the middle is & can you stay there?
3. Weight Shift: Moving CoM over BoS
4. Head Control
5. Limb Function: Moving with ambulation

If 1-3 are altered/not possible, ambulation is non-functional.

Postural Control Strategies for Dynamic Balance

Three strategies used to control postural sway

1. ANKLE: body moves as an entity about the ankle
2. HIP: Upper and lower body move in opposite directions due to hip muscle activation
3. STEPPING: Occurs when COM is displaced beyond the maximal stability limits-requires establishment of new BoS

Dynamic Balance Tests

Timed Up & Go (TUG): Basic test of general mobility for lower functioning clients

- Performance influenced by functional independence
- Can be used for those with cognitive impairments
- Ceiling effect

4-Square Step Test: Quantifies balance in 4 directions

- Can use assistive
- Accurate for predicting falls in community dwelling older adults
- Requires stepping-over + ant/post + med/lat stepping

Functional Reach: Measures anterior/posterior stability

- Norms established are gender/age-related
- Describes fall risk + frailty
- Moderate correlates to gait speed

Tasks Where Dynamic Balance is Critical

Stair-Walking

- Ascent Stance: Weight acceptance –Pull up- Forward continuance
- Ascent Swing: Foot Clearance/placement
- Descent Stance: Weight acceptance – Controlled Lowering
- Descent Swing: Leg pull through/ preparation for foot placement

Transitional Movements

- Sit to Stand
- Stand to begin Walking
- Bed Mobility Skills

INTERVENTIONS

"Interventions that target the source(es) of balance related problems and repeatedly expose one to changing task demands and environmental constraints are particularly effective… in addressing balance deficits. "(Shumway-Cook [23])

General Balance Progressions

Treat Center of Gravity (CoG) control + head/neck alignment

- Find Midline and become stable in sitting + standing
- Perform small weight shifts to challenge CoG
- Increase limits of stability
  - Increase speed of weight shift
  - Increase directional changes by practicing functional tasks
  - Narrow BoS
  - Add resistance + medio-lateral directional changes
  - Add perturbational challenges-various surfaces

Benefits of Water Therapy with Balance Disorders

- Decreased fear of falling allows one to challenge balance strategies
  - Water slows falling speed + increased time to detect postural errors
- Can work out of CoM to learn boundaries
- Practice balance strategies, discarding those that do not work
- Provides constantly changing perturbations
- Can breakdown/practice transitional skills

Aquatic Balance Exercises
Stepping Strategies and Muscle Activation

- Facilitates practice of appropriate stepping sequences.
- Facilitates improved muscle strength + power with water exercises
  - Allow the practice of various strategies with movement sequences that places client at risk for falls on land
- Refine closed chain movement sequences without risk of pain due to unloading

Timing is modified for water vs. land muscle synergies

Aquatic Balance Exercises
Ankle Strategies + Muscle Activation

- Appropriate upright posture with ankle mobility
- Provides ankle/foot activation with CKC weight-bearing
- Can increase ankle strength + range of motion
  - Provides closed chain intervention for those with joint pathologies as functional positions well-tolerated

BUT: Postural support is increased by water eliciting altered muscle activation requirements

Aquatic Balance Exercise Progression

- Increase stability by increasing speed/change direction of weight shifts
- Directional changes
  - Predictable/unpredictable
  - Spatial challenges
  - Avoidance of obstacles
- BOS Changes
  - Bilateral stance →Unilateral challenges emphasizing toes involvement
- Add Resistance
  - LE closed chain exercises for speed
  - Alter buoyancy of lower extremities
  - Provide exercises to challenge trunk

The Exercises for
BALANCE

STATIC ⇨ DYNAMIC ⇨ UNPREDICTABLE

What the Literature Says

Evidence-Based Aquatic Interventions that Address Balance Deficits

Aquatics + Mental Training for Balance in Elderly Males

Purpose: Investigate the effects of aquatic exercise + mental training on balance in elderly males.

Subjects: 120 males, classified into 4 groups: aquatic balance training n =30; mental training n = 30; aquatic + mental training n = 30; control n = 30.

Method: Aquatics balance = 3x/wk x 6wks x 60 min/session of balance related exercises; mental training = 3x/wk x 6wks x 15 min/session visualization ; Mental/Aquatics Group = 3x/wk x6 wks x 1.5 hours/session aquatics + balance training

Aquatics and Mental Training on Balance in Elderly Males continued

Results: Improvement in post-test results noted for all test groups for all (3) reach positions. Results listed greatest to least, excluding control.

Anterior: Aquatic + mental training; aquatic training only; Mental training only

Posteromedial: Aquatic + mental training; mental training only; aquatic training only.

Posterolateral: Aquatic + mental training; mental training only; aquatic training only.

Hosseinin SS. The effects of aquatic and mental training on balance in elderly males. Middle-East J of Scientific Research. 2011;7(3):296-302.

Comparison of Static and Dynamic Balance in Aquatic and Land Environments [31]

Purpose: To compare the effects balance training in aquatic and land environments.

Subjects: 24 subjects 19-23 yrs old. Aquatic n =8, Land n =10, Control n = 6.

Method: 3x/wk x 4 wks for both interventions. Aquatic and land interventions used single leg stance on/off wobble board. Dynamic balance included step-ups, balance & reach, ant/post tilt and med/lat tilt on wobble board.

Results: No significant therapeutic benefit using one environment over the other for balance training. Healthy subjects respond equally to either environment.

Roth AE, Miller MG, Ricard M, et al. Comparison of static and dynamic balance following training in aquatic and land environments.J Sports Rehabil.2006;15:299-311.

Effects of Water-Based Training on Older Women- RCT[32]

Purpose: To assess the effects of water-based exercise and self-management program on balance, fear of falling and quality of life in community-dwelling women 65/older with osteoporosis.

Subjects: 50 women (average age = 73.3 yrs)

Method: 2x/wk x 10wks x 1 hr/session of water-based exercises performed in a group setting, instructed by a physical therapist.

Results: Significant improvement on the step-test for the intervention group, indicative of improved dynamic balance. No statistical difference between groups for Modified Falls Efficacy Scale. Significant differences noted in physical functioning + mental health domains of Short Form 36.

Devereux K, Robertson D, Briffa NK. Effects of water-based program on women 65 years and over: A randomized controlled trial. Aus J Physiotherapy. 2005, 51:102-108.

Fall Prevention Using Hydrotherapy with Elderly Women

Purpose: Demonstrate benefits of hydrotherapy in fall prevention for elderly women

Subjects: N =24 mean age 72 $\pm$ 7 yrs. (no control)

Method: Aquatic Exercise comprised of warm-up, adaptive stretching, dynamic balance exercises, cool-down. 40min x2x/wk x12 wks

Results: Berg Balance Scores improved 7 points $\pm$ 3; TUG scores decreased 5 sec.$\pm$2 sec.

Risende SM. Rassi CM. Viana FP. Effects of hydrotherapy in balance and prevention of falls among elderly women. Brazilian J Phys Ther. 2008;12(1):57-63.

Effects of Hydrotherapy on Static & Dynamic Balance of Elderly Men

Purpose: Demonstrate effect on static & dynamic balance on healthy, sedentary elderly men.

Subjects: N= 14 Control = 14

Method: Performed a series of static and dynamic exercises for 1hr x 3x/wk x 8wks.

Results: TUG scores improved by 3 seconds; Romberg Eyes Open/Closed time ≈ doubled

Alikhjeh Y. Hosseine SRH, Moghaddam A. Effects of hydrotherapy on static and dynamic balances among elderly men. Social and Behavioral Sciences. 2012;46:2220-2224.

Executing BALANCE TRAINING

Requires Planning for both

DIRECTIONAL CHANGES +
UNPREDICTABLE
FUNCTIONAL BALANCE CHALLENGES

STRENGTH + AGING
ITS RELATIONSHIP TO FUNCTION

Review: Age-Related Musculoskeletal Changes

- ⇩ Size of fast twitch greater than slow twitch fibers
- ⇩ Peak Anaerobic power
- ⇩ Elasticity of tissue
- ⇩ Bone Mineral density/increased osteoclastic activity
- ⇩ Muscle mass = decreased strength, power, endurance
- ⇧ Increased muscle fat + connective tissue

Functional Implications of Musculoskeletal Changes

Decreased strength, power, speed of contraction….

- Increases energy expenditure to perform ADL's
- Renders one unable to generate sufficient muscle tension to react to perturbations
- Transitional movements become difficult/untimely

Functional Implications of Musculoskeletal Changes

- Increased time to peak muscle tension = difficulty with ADL's
- Increased osteoclastic activity = increased fracture risk
- Decreased muscle strength = postural changes
  - Forward Head
  - Increased kyphosis
  - Increased hip/knee flexion
- Postural changes = increased fall risk
- Onset of painful movement due to musculoskeletal changes

Equates to the onset of Sedentary Lifestyle

SEDENTARY LIFESTYLE
Effects of Sarcopenia & Low BMD

Study: Comparing sitting time and decreased lean mass in community dwelling older adults

- Every hour sitting/day associated with lower muscle mass.
- Frequent breaks in sitting associated with decreased pre-sarcopenia risk
  - Each 10 sit→stand transitions/day associated with 45% lower odds of pre-sarcopenia

Sarcopenia and Its Relationship to Decreased Function

Decreased strength related to decreased function = IMPAIRED MOBILITY

- Multi-factorial mechanism driving sarcopenia BUT physical activity has been proven to be an important factor to reverse/modify this condition.
- Profound benefits associated with strength-building activities

Functional Strength Tests

Sit to Stand: Functionally important test for LE strength
- Weakness: Many older adults cannot complete 1 rep
- 5 Rep Sit to Stand discriminates between older women with/without risk of frailty + recurrent fallers

Heel Rise: endurance, strength, function incl gait
- Weakness: Performed barefoot recognize related pain-related weakness

Arm Curl: To assess UE strength required for household tasks involving carrying/lifting
- Greater measure of endurance vs. strength

Considerations of Aquatics & Strength Training

- Exponential relationship between velocity and movement
  - The faster the movement the greater the resistance
- Constant movement provides cardiovascular + muscle strength effects
- Muscle activity is greater in water performing same activity at the same speed
- Must overcome wave, shape + friction to move through the water

Practical AQUATIC CONSIDERATIONS for Strength Training

BENEFITS

- Decreased joint compression forces and mechanical stress for CKC activities
- Hydrostatic pressure facilitates circulation, decreasing potential for edema
- Resistance provided in direct response to applied force: the greater the speed the greater the resistance.
- Multi-directional movements = functional adaptation
- Viscosity protects against injury with fast movements

Practical AQUATIC CONSIDERATIONS for Strength Training

CONCERNS

- Inverse proportion between water depth + muscle activation
  - The greater the depth, less LE fiber activation
- Increasing movement speed to 45-60°/sec has muscles working harder than they do on land
- Increasing speed of CKC activities increases weight bearing
  - Up to 76% increase in weight bearing at specific depth
  - Difficult to generate sufficient speed for some functional activities
- Difficult to effect eccentric training

Aquatic Interventions for UE Strength

Considerations:

- How joint mobility is affected throughout the chain
- Increasing the speed make joints work harder than same activity on land
- Increased forces with longer lever arm and the impact on shoulder function
- Specificity of Movement
- Increased surface area and/or speed increases work

Upper Extremity Strength Training

Using speed +equipment to change intensity

Practical Aquatic Interventions for LE Strength

Incorporate Power and Endurance Moves

CKC Activities Predominate

- Squats/Sit-to-Stands
- Step-ups/downs
- Lunges-single or repetitive/line
- Jumps
- Fast Walking

Equipment Choices

- Increased surface area increases resistance but may limit speed
- Multi-directional resistance equipment
- Equipment resisting forward/lateral advancement: belts/bands

Depth is always a consideration

Executing Exercises to Improve Strength Requires Appropriate……

DOSE

FREQUENCY

INTENSITY

DURATION

Strength Training Using Deep Water Interventions with Elderly Men

Purpose: Investigate the effects of two deep water training programs on cardiorespiratory function + strength of sedentary elderly men.

Subjects: N = 1st 16 subjects for endurance training only
2nd 18 subjects using strength training followed by endurance training

Methods: 1st Group: performed deep water cardio-training only; 2nd group performed strength exercises followed by cardio.

Bouts = 45 minutes x 3x/wk x 12 wks

Strength Training Using Deep Water Interventions with Elderly Men

Results:

	Pre-test	Post-Test
Endurance Training Group		
Knee Flex IRM	21.0 ± 5.8 Kg	21.4 ± 5.3Kg
Knee Ext 1RM	53.6 ± 6.4 Kg	57.8 ± 8.6 Kg.
Concurrent Training Group (strength+ cardio)		
Knee Flex 1RM	18.4 ± 3.8 Kg	19.5 ± 4.6 Kg
Knee Ext 1RM	51.4 ± 10.6 Kg	54.6 ± 12.8 Kg

Kanitz AC. Delevatti RS. Reichert T. et al. Effects of two deep water training programs on cardiorespiratory and muscular strength responses in older adults. Experimental Gerentology.2015; 64:55-61.

Aquatic-Based Strength Training of Elderly Adults

Purpose: Analyze effects of aquatic training on strength + peak torque for LE muscles + functionality for elderly adults

Subjects: N = 18 Control =16

Methods: Aquatic exercise training emphasizing hip, knee and ankle muscle involvement. 45 minutes x 3d/wk x 12wks

Results: Peak torque increased for the hip flexors (18%) and extensors (40%); the plantar-flexors (42%)

Bento PCB. Pereira G. Ugrinowitsch C. Rodacki ALF. The effects of a water-based program on the strength and functionality of older adults. J Aging Phys Act. 2012;20(4):469-473.

Upper Quadrant Aquatic-Based Training Elderly Women

Purpose: Compare the effects of a water resistance program with a water exercise program.

Subjects: Water Resistance Group: 10

Water Exercise Group: 10

Control: 7

Methods: Resistance group performed 4 mesocycles of multiple sets of various upper quadrant exercises. Using resistance equipment. Water group performed various exercises in water, non-resistance based.

Bouts: 50 minutes x 2d/wk x12 wks

Upper Quadrant Aquatic-Based Training Elderly Women (continued)

Results: Used 1RM for pectoral fly machine

Resistance Water Exercise Group

Pre-Test:	Post-Test
16.5 ± 2.9 Kg	18.3 ± 3.1 Kg

Water Exercise Only Group

Pre-Test	Post-Test
18.4 ± 1.9 Kg	18.4 ± 2.1 Kg.

Graf FI. Pinto RS. Alberton CL. et al. The effects of resistance training performed in water on muscle strength in the elderly. J Strength Conditioning.2010;24(11):3150-3156.

Aquatic Exercise: Its Effect on Bone

PURPOSE: Explore water-based exercise effectiveness in preventing age-related bone deterioration.

METHOD: Search of relevant data bases revealed (11) studies involving (629) participants.

RESULTS: Studies reporting significant increase in BMD for the following:

- (1) - lumbar spine
- (5) - femoral neck
- (3) - greater trochanter
- Non-significant changes noted for total femur, Ward's Triangle

Aquatic Exercise: Its Effect on Bone

RESULTS continued

- (2) studies noted increased biomarker formation
  - Osteocalcin
  - Procollagen type 1 amino-terminal propeptide (PINP) + biomarker of bone resporption
- (2) studies assess strength with (1) noting significantly improved quadriceps strength
- (2) studies demonstrated significant balance upgrades

Simas V. Hing W. Climstein M. Effetcs of water-based exercise on bone health of middle-aged and older adults: a systematic review and mate-analysis. Open Access J Sports Med. 2017; 8:39-60.

In Summary: The Benefits of Aquatics for Functional Upgrades in Older Adults

Systematic Review with Meta-Analysis by Waller et al

- Water exercise has moderate positive effect on function compared to land exercise.
- Water Exercise has moderate effect on
  - Muscle Power
  - Flexibility/Agility
  - Walking Function
- Aquatic Exercise could be more beneficial to older adult at lower functional level

CONTINUED

Thank you for your interest.
Our journey is not complete

CONTINUED

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