Run the Distance: Aquatic Based Augmented Training, Conditioning, and Return-to-Running
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Disclosures

• None

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Objectives

- Understand When, Why, and How to Apply Aquatic Training and Conditioning
- Analyze Shallow verse Deep Water Training Effects on the Body
- Determine how to Monitor and Change Intensity of Aquatic Exercises
- Examine Specific Visual Examples of Exercises for Run Specific Training
- Apply Return-to-Run Decision Making with Aquatic-based Methods

Considerations: Distance Runners in Water

- Level of expertise with regards to Running AND Water Exercises
- Running mileage, times, and environment
- Current running and cross training regiment
- Muscle strength and overall motor control
- Different effects land and water running have on the body
- **Most importantly**: Know what you want to train, why you want to train it, and how to use the water to accomplish your goal.
When, How, and Why 14,16-24

• **When** –
  – Preseason,
  – In-season,
  – Postseason,

• **How** –
  – Easily implementation in community pool settings
  – Combine your knowledge as a PT to the principles of water
  – Creativity is key
  – “**Practice Before You Prescribe**”
    • Make sure the water exercise is doing what you think it’s doing
When, How, and Why

• **Why** –
  – Cross training/conditioning
  – Help identify areas that need improvement
  – Builds strength in more proximal muscles like those of the “core,” hips, and gluts
  – Improve cardiovascular and pulmonary effects of the body
  – Reduce ground reaction force (GRF) and pain –
    • may depend on variables other than depth of immersion alone
  – Swelling Management
  – Can monitor intensity similarly to monitoring intensity on land
  – Can apply specificity of training in a varied environment to challenge the runner
Deep Water Effects 13,16,17,20-22,24-26

• Review by Kilgore (2012):

<table>
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<tr>
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<tbody>
<tr>
<td>State of Mind during Deep Water Running (DWR)</td>
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<tr>
<td>Buoyancy</td>
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1. Individual needs to be comfortable in water and given time to adapt to the environment
2. Need a good understanding of how to use the properties or water
   • Buoyancy, Drag, Density, Hydrostatic Pressure, etc.
3. Style of DWR matters
   • Specificity of Training verse Strengthening?
4. Muscle activation is “similar” but not all together the same due to no contact with the ground
5. Drag increases energy expenditure and can be manipulated
   • Changes in velocity of motion, lever arm, or adding resistance (shoes, paddles, etc.)
Deep Water Effects

6. Hydrostatic pressure of the water is proportional to depth and helps with venous return.
   • May help with active recovery by avoiding LE pooling of blood you can get with running on land

7. Max Target HR may be lower in DWR compared to shallow water and/or land based running while getting similar training effects (needs more research).

↑ Stroke Volume X ↓ Heart Rate = ↑ Cardiac Output
   • See Diagrams by Bruce Becker (2009).

8. Sub-Max effort may yield HR and VO2 more like land running values when compared to maximal effort in Deep Water.
   • Demand on the lungs increases in neck deep water

9. RPE may be similar or slightly higher in DWR compared to land running depending on the person.

10. For a training effect, sub-max effort can at least maintain cardiovascular fitness
    • more research is needed due to limitations of measuring max effort in most aquatic studies
Shallow Water Exercise Reasoning and Evidence

Shallow Water Effects $^{23,25,27-45}$

- New Review of Shallow Water Locomotion
  (Duke Student Capstone – currently unpublished)
Shallow Water Effects 23,25,27-45

• Working definition of shallow water locomotion used in their review:

  “Any upright locomotion in a body of water, neck deep or lower, in which the foot contacts the bottom surface to propel a person's body through water, or over a treadmill.”

Shallow Water Effects 23,25,27-45

• HR
  – Can achieve similar or higher HR in shallow water (compared to land)
  – HR can be higher in hip-deep water running compared to land but depends on speed
    • HR is highest in thigh deep water \( \rightarrow \) break surface tension
  – Backwards walking may yield higher HR than forwards walking
Shallow Water Effects

- **VO2**
  - Maximal VO2 in water can be similar or higher depending on speed, depth, and previous training (compared to land)
  - May have implications for improving VO2
  - VO2 is proportional to speed and depth of immersion
    - Thigh Deep water increases VO2 the most, then hip deep, and lastly at the xiphoid

- **RPE**
  - RPE is similar in water compared to land at Maximum efforts and is related to speed.
  - RPE is related to HR and may be a better measure in the water if water proof HR monitors are not easily available.

- **Stride Frequency**
  - Decreased compared to land due to drag,
  - Most studies looked at self selected speeds

- **Stride Length**
  - Decreased compared to land, may have implications for motor control and training

- **Ground Reaction Force (GRF)**
  - Vertical GRF (VGRF) decreased compared to land
    - Depends on depth of immersion, speed of exercise, and potentially other factors such as gender or body composition,
  - Horizontal GRF (HGRF)– decreased compared to land
    - Higher HGRF at higher speeds and lower water levels in order to overcome drag and surface tension.
**Shallow Water Effects** 23,25,27-45

- **Joint mechanics**
  - Overall similar to land with slight differences in peak ranges occurring at different times from decreased stopping force due to altered GRFs and increased resistance from drag
  - Hip –
  - Knee –
  - Ankle –

**Shallow Water Effects** 23,25,27-45

- **Limitations**
  - Significant Variability between studies
    - Depth of immersion (and other factors affecting unweighting)
    - Variability and reliability of monitoring outcome measures
    - Speed selected
    - Arms in vs arms out
    - Trained vs untrained individuals in the water
    - Sufficient intensity of the exercises?
Shallow Water Effects\textsuperscript{23,25,27-45}

- **Take Home Points:**
  - Shallow Water Running may be a good training or cross-training method for runners.
  - Physiologic effects (HR, VO2, RPE, etc.) are dependent on depth of immersion and speed.
  - Biomechanical effects include lessened force through the body, specificity of training in a new environment, and may improve running mechanics from a motor control/learning perspective.
  - More research on this topic should include looking at trained versus untrained individuals, muscle activation, and similar outcome measures across studies.
General Exercise Principles in Water

• Variety of Exercises can be performed in the water besides water running

• Areas of Training/Exercise
  – Strengthening
  – Flexibility
  – Balance
  – Endurance
  – Plyometrics

General Exercise Principles in Water

• Tools
  – Your Body
  – Resistance Devices
  – Buoyance Device
  – Water shoes
  – Resistance Bands
General Exercise Principles in Water

- Check for Contraindications or Precautions
- Is your athlete comfortable in water?
  - Does the athlete have access to a pool?
- Monitor and change intensity as appropriate
- Try the exercises before you give them.
- Specificity of Training is important! Make sure you are doing exercises to achieve a specific goal
- If doing shallow water exercises consider getting a pair of good water shoes
  - Can also be used as resistance in deep water

Intensity of Exercise in the Water

- Monitoring Intensity of Aquatic Exercise
  - RPE verses HR – either can be used depending on depth of immersion you are using and equipment you have readily available
    - Remember deeper water Target HR might need to be lower than on land (~5-7 bpm)
  - Body composition may matter
  - Trained verse untrained may matter
• **Changing Intensity** (when using resistance tools)

  Want the *max possible cadence* to complete the *targeted # of reps* with the *appropriately selected device* at the desired *exertion*.

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• **Changing Intensity** (when using resistance tools)
  – Important Variables to consider:
    1. Movement Pace or Cadence (Based on predetermined # of reps)
    2. Appropriately Sized Resistive Device (To achieve # of reps)
    3. Length of body part
    4. Position of body part/device as it moves through water
    5. Perception of Effort (To complete the predetermined # of reps)
Indications/application of plyometrics\textsuperscript{7,19,51-56}

• Waist deep water is recommended
• Aquatic training groups train with lower loads but faster transition times (short amortization phase).
• Force reduction depends on landing technique, water depth, as well as athlete’s height and body composition
• Plyometrics on land is better for strengthening, but muscle-power output may be better in the water.
  – Plyometrics may be appropriate in water before land
Exercises Used with Runners

- **Deep Water**
  - Deep water running (cross country, HS Curls, recumbent cycling or knees to chest, “Moonboot” running, etc.)
  - Deep Water Endurance Training
  - Deep water Hip ABD
  - Deep water core stability exercises
  - Treading water
- **Core Stability Exercises**
  - Wall squat with DB/KB depression,
  - Prone planks with UE movement
  - Walking with DB depression,
  - Resistance Bell punches
  - Lunge with KB push/pull
- **Flexibility/Stretches**
  - Hip flexor/quad/ITB
  - Gastroc
  - Lumbar spine
  - HS
  - Anterior Tib

- **Glut/LE stability**
  - Noodle stomps
  - Side steps with direction changes
  - Ice-skaters
  - Lunges with UE Resisted Movement
  - Stationary Running man/woman
  - Repeated forward step ups (Running man/woman)
  - Lateral step downs (with good hip-knee-foot alignment)
  - Lateral step up and overs

- **Gait Mechanics**
  - Resisted walking with push off (either by PT or by tethering to wall)
  - Side steps with direction changes
  - KB walking with direction changes and stopping
  - 4 square walking
  - Walk with randomized cutting (especially if trail runner)

- **Jump/Landing**
  - Toe taps soccer drill on steps
  - Wall Push offs
  - Feet on Wall Squats and jumps
  - Double leg jumping
  - Single Leg Jump, Hopping, Bounding, Skipping
  - Bound-Hop-Run

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Return-to-Run Progression

**Part 1 – Glut and Core stability**

- Floating Dumbbell and Kickboard Core Activation Exercises
- Prone Planks with Arm Movements or wall push ups
- Side steps with direction changes and/or Ice-skaters
- Squats
- Lunges with Arm Movement and resistance
- Step Ups (forward/lateral/up-and-overs)

**Part 2 – Jump/Landing and Running**

- Deep Water Running
- Running Man/Woman (with/without resistance or step)
- Resisted walking drills (all directions with switches)
- Toe tap soccer drill on steps
- Double leg jumps with soft landing
- Single leg jumps with soft landing
- Bound-Hop-Run Progression
- Obstacle Course
Video Resource:

• Link to videos on YouTube of these and more advanced aquatic exercises (Audio Removed):

https://youtu.be/GkRkQ4sV6X0
Variations of Deep Water Running

Recumbent LE and Core Exercises
Shallow Water

Gluts and Quad Activation
Gluts and Quad Activation

Core Stability Exercises
Core Stability Exercises

Lunging Exercises
Hill Training and Gait Mechanics

Lateral and Repeated Step Ups
Wall Resisted Running-man & Walking

Foot Work Drills
Jumps with Soft Landings

Bound, Hop, Run Drill
Bonus: Supine Wall Drills

Return-to-Run Progression

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• Double leg jumps with soft landing
• Single leg jumps with soft landing
• Bound-Hop-Run Progression
• Obstacle Course
**Conclusion:**

- Apply what you know as a PT/trainer with the properties of water.
- You can get similar or higher HR/RPE/VO2 etc. using the water. Therefore monitor your athlete carefully.
- Specificity of Training is important! Make sure you are doing exercises to achieve a specific goal.
- Both Shallow and Deep water interventions can be used for augmented training or returning an athlete to running but their effects on the body can be very different.
- Try the exercises before you give them.
References

References


Questions?

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YouTube: https://youtu.be/GkRkQ4sV6X0