Duke University School of Medicine
Doctor of Physical Therapy

BIOMECHANICAL AND PHYSIOLOGICAL EFFECTS OF SHALLOW WATER LOCOMOTION IN HEALTHY ADULTS

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BACKGROUND

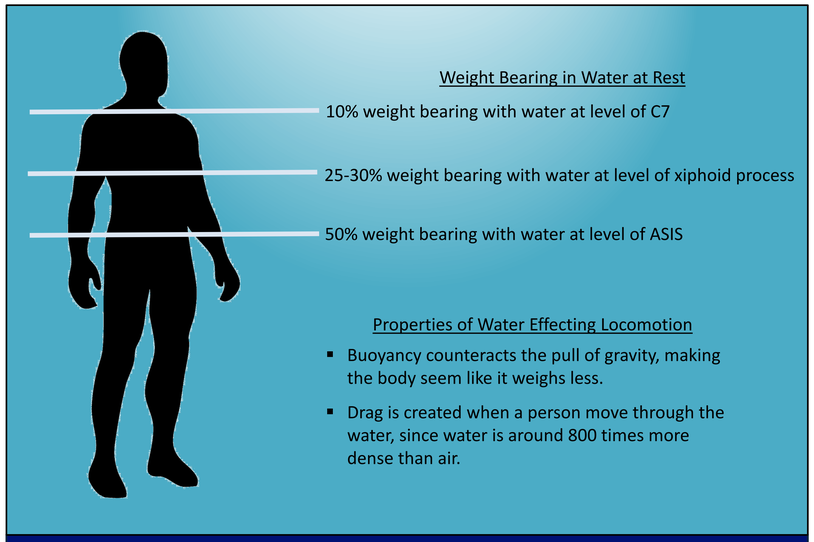
- Shallow water locomotion has become an increasingly popular intervention for rehabilitation of lower extremity injuries in healthy adults.
- There is a transfer of function when progressing from water to land based locomotion, despite there being a kinematical difference between the two environments.
- There are similar cardiovascular responses to shallow water locomotion when compared to land based locomotion.
- **Operational definition of shallow water locomotion:** 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.
- There is limited research exploring biomechanical and physiological effects of shallow water locomotion and how these variables may be interrelated.

PURPOSE

- To provide a review of the biomechanical and physiological effects of shallow water locomotion in healthy adults.

METHODS

- Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was used to identify articles to be reviewed.
- **Search Terms:** aquatic, hydrotherapy, shallow water, locomotion, running, exercise, treadmill, physiology, heart rate, oxygen consumption, physical exertion, biomechanics, ground reaction force, stride.
- **Eligibility Criteria:**
  - English full text manuscripts that examined biomechanical and/or physiological variables of shallow water locomotion of healthy adults.
  - Articles were excluded if subjects performed stationary movements or used a flotation device.



RESULTS

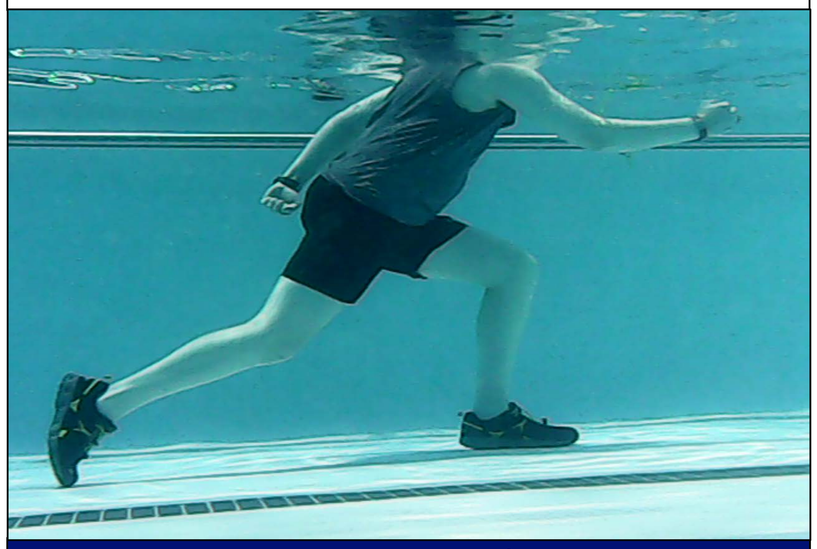
- 1836 articles were retrieved from PubMed, CINAHL, and Embase. 21 articles were acceptable for data extraction.
- **Stride Length and Stride Frequency**
  - Stride frequency and length both decreased leading to significantly lower self-selected walking speeds compared to land.
- **Ground Reaction Forces (GRF)**
  - Vertical GRF was decreased in water compared to land and decreased at higher levels of immersion.
  - Horizontal GRF decreased in water compared to land and increased with speed and lower water levels.
- **Joint Mechanics**
  - Hip flexion had similar total range of motion, but occurred in a more flexed trunk position.
  - The knee had decreased total range of motion and occurred in a more flexed positon.
  - The ankle had similar total range of motion, but occurred in a more dorsiflexed position.
- **Physiological Variables**
  - Heart rate had a linear response to increasing intensity in water.
  - Heart rate and VO2 had a similar relationship in water compared to land.
  - RPE and heart rate had a linear relationship in water and land.

CONCLUSIONS

- The evidence suggests that shallow water locomotion can be used to decrease the forces associated with locomotion while maintaining the physiological benefits of exercise.

CLINICAL RELEVANCE

- The properties of water decrease the forces on the body, while potentially increasing muscle power and speed.
- Training in an aquatic environment is a viable option to maintain or improve cardiovascular fitness if land based locomotion is contraindicated because of high biomechanical stress on the body.
- Community pools may serve as an accessible way to utilize the biomechanical and physiological benefits of shallow water locomotion.



ACKNOWLEDGEMENTS / REFERENCES

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