



# Comparing Aquatic Plyometric and Land Plyometric Training on Power and Agility Performance

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## ABSTRACT

**Purpose:** Plyometric training has been shown to enhance athletic performance in sports that require a high-level of speed, agility, and power. Plyometric training is traditionally performed in a weight room or on a land-based surface, but some evidence indicates that plyometric training underwater may limit the risk of exercise-induced injury without sacrificing performance results. Therefore, the purpose of this study is to compare 4-weeks of aquatic-based plyometric training to a traditional land-based plyometric program with respect to speed, power and agility performance in recreationally active young adults. We hypothesized that both programs will yield similar improvements in power and agility; therefore, aquatic plyometric training may be an effective alternative to traditional land-based plyometric training. **Methods:** Twenty-two subjects (16 males, 5 females) were randomly assigned to 4 weeks of an identical plyometric training program on land or in an aquatic setting (indoor pool). Exercise performance tests (i.e., vertical jump height, standing broad jump, medicine ball chest pass, agility T-test, 20 yard shuttle, and 40 yard sprint) were completed before and after plyometric training. **Results:** Land plyometric training increased T-Test and 20 yard shuttle significantly, while also showing a trending improvement in the 40 yard dash. Aquatic plyometric training showed a trending increase in 20 yard shuttle, but a decreasing trend in vertical jump and standing broad jump performance. **Conclusions:** We conclude that land based plyometric programs elicit significant improvements in power, speed, and agility compared to a similar aquatic based plyometric program over 4-weeks. However, aquatic plyometric exercise may minimize muscle and joint discomfort, enhance exercise recovery, and lower injury risk without significantly sacrificing performance gains.

## INTRODUCTION

- ◆ Traditional land-based plyometric programs are based on quick eccentric to concentric movements, utilizing the stretch reflex to increase force-generating capacity.
- ◆ Plyometric exercise training is used for its sport specific properties and its favorable effects on various aspects of sport performance, particularly explosive power, speed, and agility.
- ◆ The ground reaction force distributed throughout the human body has shown to play a large role in joint stress during high impact exercise training, particularly with land-based plyometrics.
- ◆ On the contrary it is well-known that the inherent properties of water, that is, the buoyancy and density, can be a very useful alternative to land exercise, especially for therapeutic and rehabilitative reasons.
- ◆ Therefore, aquatic-based plyometrics may be a useful alternative to land-based plyometrics while minimizing joint stress and discomfort.
- ◆ Currently, there is limited information concerning whether aquatic plyometrics is as good as land-based plyometrics with respect to exercise performance benefits.

## EXPERIMENTAL AIM

The aim of the present study was to compare 4-weeks of aquatic-based plyometric training to a traditional land-based plyometric program with respect to speed, power, and agility performance in recreationally active young adults.

## METHODS

### Subjects

- ◆ Twenty-two Caucasian subjects participated in this study (age range: 19-23 years; 17 men, 5 women).
- ◆ Subjects were included if they were considered recreationally active according to a health history questionnaire and physical assessments.

### Procedures

- ◆ Pre-Testing and Post-Testing included basic health related measures and sport specific variables such as vertical jump, standing broad jump, medicine ball chest pass, T-test, 20 yard shuttle, and 40 yard dash.
- ◆ 10 plyometric training sessions over a four week period lasting 30 to 45 minutes of high intensity exercise.



## EXERCISE PROTOCOL TABLE

### Land Plyometric Exercises

<p><i>Dynamic Warm-up:</i></p> <ul style="list-style-type: none"> <li>• Jog 400 m.</li> <li>• High Knees- 20 ft.</li> <li>• Butt-kicks-20 ft.</li> <li>• Lunges-20 ft.</li> </ul>
<ul style="list-style-type: none"> <li>• Shuttle Sprints-10 sec</li> <li>• MB Chest Pass- 10 sec</li> <li>• Tuck Jumps-10 sec</li> <li>• <b>2 minute rest</b></li> </ul>
<ul style="list-style-type: none"> <li>• Bounding R/L- 45ft each leg</li> <li>• Lateral Jumps-10 sec</li> <li>• Jumping Jack Pushup-10 sec</li> <li>• <b>2 minute rest</b></li> </ul>
<ul style="list-style-type: none"> <li>• Parachute Sprint-80 meters</li> <li>• 28" Depth Jumps-5</li> <li>• <b>1 minute rest</b></li> <li>• Partner Resisted Band Sprint Backward-80 m</li> <li>• 28" Depth Jumps-5</li> <li>• <b>1 minute rest</b></li> <li>• Partner Resisted Band Side Shuffle R/L-40 m</li> <li>• 28" Depth Jumps-5</li> <li>• <b>2 minute rest</b></li> </ul>
<ul style="list-style-type: none"> <li>• Sprinter Kicks-10 sec</li> <li>• Squat Jumps-10 sec</li> <li>• MB Side Twist- 10 sec each side</li> <li>• <b>2 minute rest</b></li> </ul>

### Aquatic Plyometric Exercises

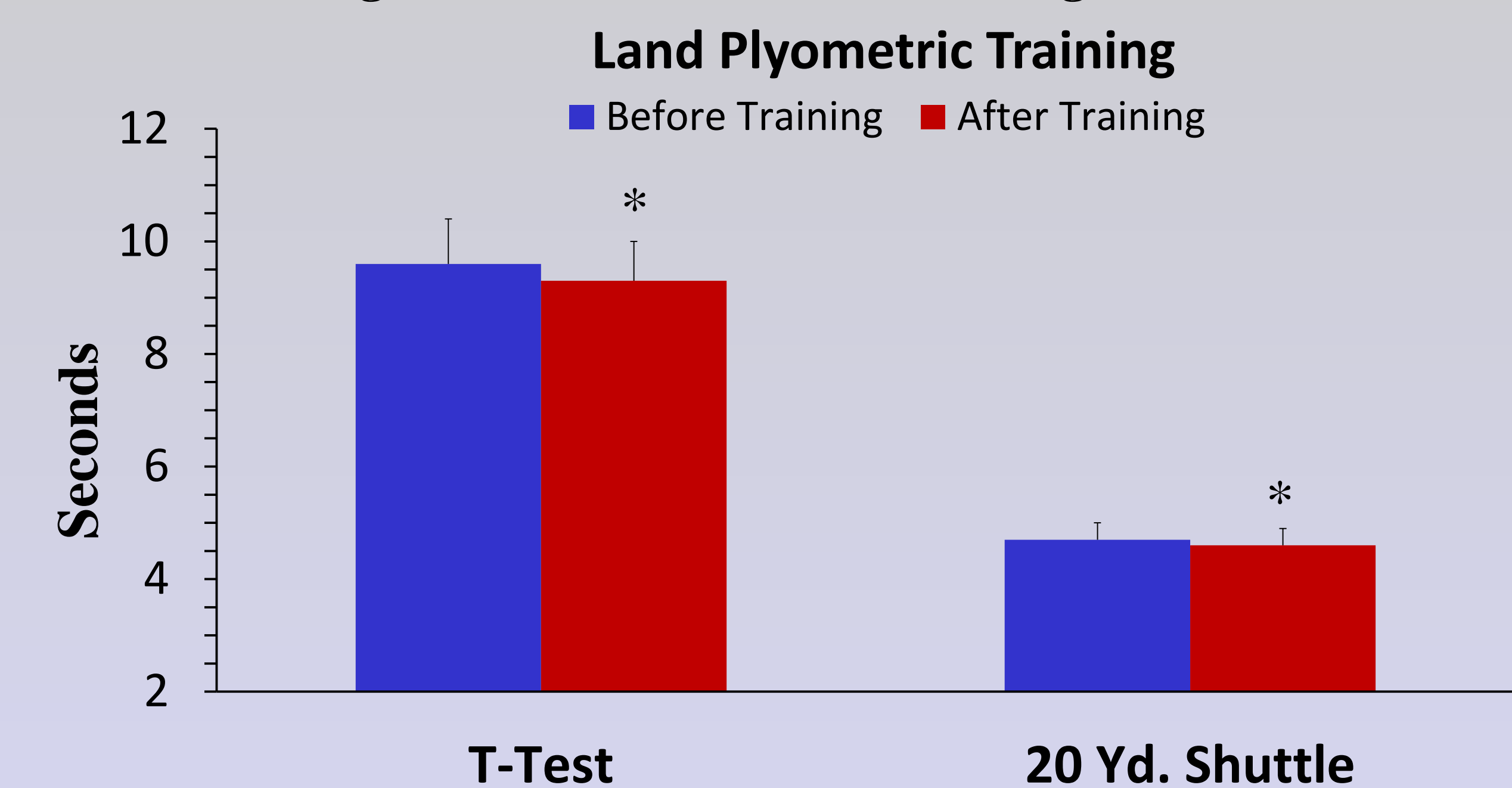
<p><i>Dynamic Warm-up:</i></p> <ul style="list-style-type: none"> <li>• Swim 50 m.</li> <li>• Tread Water for 1 min.</li> </ul>
<ul style="list-style-type: none"> <li>• High Knee Sprints- 10 m</li> <li>• Swim Board Push- 10 sec</li> <li>• Tuck Jumps- 10 sec</li> <li>• <b>2 minute rest</b></li> </ul>
<ul style="list-style-type: none"> <li>• Bounding R/L- 10 m each leg</li> <li>• Lateral Jumps- 10 sec</li> <li>• Chest Fly w/Foam DB's- 10 sec</li> <li>• <b>2 minute rest</b></li> </ul>
<ul style="list-style-type: none"> <li>• Partner Resisted Band Sprint-50 ft.</li> <li>• 28" Depth Jumps-5</li> <li>• <b>1 minute rest</b></li> <li>• Partner Resisted Band Sprint Backward-50 ft.</li> <li>• 28" Depth Jumps-5</li> <li>• <b>1 minute rest</b></li> <li>• Partner Resisted Band Side Shuffle R/L-25 ft.</li> <li>• 28" Depth Jumps-5</li> <li>• <b>2 minute rest</b></li> </ul>
<ul style="list-style-type: none"> <li>• Sprinter Kicks-10 sec</li> <li>• Squat Jumps-10 sec</li> <li>• Ab. Twist w/Foam DB's-10 sec</li> <li>• <b>2 minute rest</b></li> </ul>

## RESULTS

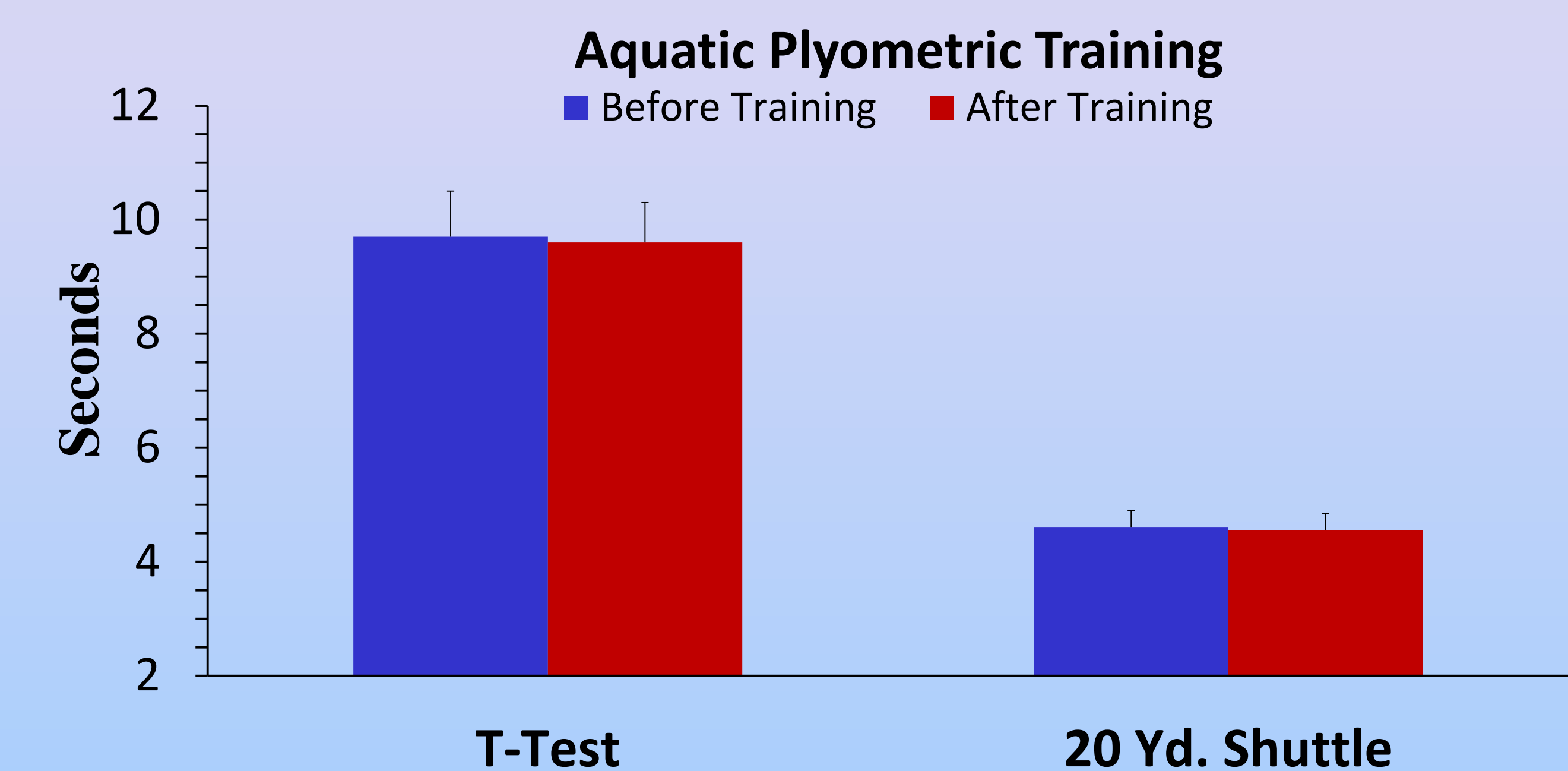
### I. Subject Characteristics for the entire study population and performance variables

Variable	Before land plyometrics	After land plyometrics	Before water plyometrics	After water plyometrics
Weight (kg)	72.2±16.1	72.4±16.3	78.6±15.7	79.3±15.6
BMI (kg/m <sup>2</sup> )	23±3	23±3	24±4	24±4
SBP (mmHg)	117±12	115±12	117±8	115±11
DBP (mmHg)	74±8	71±6	67±4	70±8
RHR (bpm)	79±20	74±20	69±11	68±10
Vertical Jump(cm)	61.0±15.9	61.1±14.1	61.1±5.1	59.1±5.4
MB Chest Pass (m)	5.4±0.9	5.7±1.0	5.8±1.1	5.9±1.0
Broad Jump (m)	2.4±0.3	2.5±0.3	2.3±0.3	2.3±0.2
40-yd Dash (sec)	5.5±0.5	5.4±0.5	5.5±0.4	5.4±0.4

### II. Indication of significant improvements in T-Test and 20 yd. shuttle pre and post land based training. \*P<0.05 versus before training.



### III. In contrast to land training, there was no significant improvements in T-test and 20 yard shuttle with aquatic based plyometric training.



## SUMMARY AND CONCLUSIONS

- ◆ Our study has shown that land plyometric training improved T-Test and 20 yard shuttle performance significantly, while also showing a trending improvement in the 40 yard dash.
- ◆ Aquatic plyometric training showed a trending increase in 20 yard shuttle, but a decreasing trend in vertical jump and standing broad jump performance.
- ◆ We conclude that land based plyometric programs elicit significant improvements in power, speed, and agility compared to a similar aquatic based plyometric program over 4-weeks.

## ACKNOWLEDGEMENTS

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