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Comparison of Dynamic Stability between Gymnast and Soccer Players Following a  
Counter-movement Jump on Land and in Water

By:

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of the requirements for the degree  
of  
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## Abstract

Gymnasts and Soccer players are faces with increasingly high injury rates and demanding impact landing forces during participation. The use of a water environment may provide some benefit by the reduced peak forces and lower impulses compared to land. The sport of gymnastics may provide specific training that promotes rapid postural stabilization upon landing a variety of jumps. The measure of Time to Stabilization (TTS) is a measure of dynamic stability and may be a method to differentiate between athletes in different sports. **Purpose:** This study was created to evaluate dynamic stability between soccer and gymnastics in two environments (land vs water) with varying external loads through the use of TTS. Each participant performed a series of countermovement jumps on land and in water submerged to xyphiod process. In each environment participants performed jumps with varying external loads (body weight (BW), and additional loads equal to 10%, 20%, and 30% BW). Vertical ground reaction forces from which TTS was determined were assessed using a waterproof force plate. A repeated measures ANOVA was used to determine if any significant main effects or interactions were present. **Result:** A significant main effect between land and water environments ( $p=.006$ ) was observed, where TTS in water was shorter than on land. There were no effect due to sport, load or any interaction among sport, load and environment. These results suggest a water environment may facilitate an index of postural stability when landing from a CMJ. The observation of no difference between gymnasts and soccer athletes may reflect a true similarity in landing technique or a measure that is not sensitive in differentiating subtle differences between well-trained female athletes.

## **Introduction**

Plyometrics are defined as “exercises that enable muscles to reach maximum strength in as short a time as possible” (Chu, 1998). Plyometric exercises use a combination of speed and strength to evolve an athlete to be able to jump higher and run faster, these results are known as power (Chu, 1998). Dynamic Stability is the ability to maintain balance while transitioning from a dynamic movement to a static movement over ones base of support (Liu & Heise, 2013). This is a functionally relevant measure to assess when performing these plyometric exercises. Fred Wilt (a track and field coach) was first to endorse the term “plyometric” when European Track and Field teams began having notably superior competitors (Chu, 1998). Soon plyometrics became an essential inclusion of training programs for athletes who jumped, lifted, or threw for sport (Chu, 1998), which resulted in increased stresses on the body. Performance enhancement factors in research include reports of; muscular contractile performance, hypertrophy, muscle geometry, neural adaptations, strength, power, agility, and jumping performance (Markovic & Mikulic, 2010). Assessing ones dynamic stability can provide insight into ankle instability, effectiveness of bracing, muscle fatigue, and differences between varying athletic populations (Liu & Heise, 2013).

Ground reaction force (GRF) in athletics is a crucial factor influencing performance and lower extremity injury rates in specific sports (McNitt-Gray, Yokoi & Millward 1994; Seegmiller & McCaw 2003). Gymnasts and soccer players are two of these competitive sports in which lower extremity injuries are frequent due to the forces placed upon the body during participation (Cowley, Ford, Myer, Kernozek, & Hewett 2006; Seegmiller & McCaw 2003). Soccer having the highest injury rate among young

athletes (21%) (Cowley, Ford, Myer, Kernozek, & Hewett 2006) and gymnastics ranking second in collegiate practice injury rates (Seegmiller & McCaw 2003), these are two activities that significantly vary in nature of physical demand, yet are related by high frequency of injury and have not been compared with impact forces of landing.

Gymnastics is a prime example, where the sport utilizes rapid and continuous changes in direction causing countless muscle contractions and GRF. Gymnastics has the 2<sup>nd</sup> highest rate of injury at 6.2 injuries per 1000 athlete-exposure when compared to other NCAA sports (Seegmiller & McCaw, 2003). In a sample of 509 injuries 49.51% of those injuries were lower extremity and 15.52% were lower back, majority of these injuries were caused by repetitive stress (Seegmiller & McCaw, 2003). Many injuries in gymnastics occur during landing of a routine, in which the athlete uses minimal absorption of energy by not flexing their hips, knees, and ankles (Seegmiller & McCaw, 2003). It is unclear if the landings are causing injury or the repetitive forces from training regimens are wearing the athletes to a breaking point when they land.

In the younger population soccer players have the highest rate of injury at 21%, just barely more than basketball (Cowley et al., 2006). Females are 4-6 times more likely to sustain a non-contact ACL injury due to body positioning, and movement patterns (Cowley et al., 2006). Young female soccer players are more frequently injured during a cutting movement as opposed to landing from a jump of some sort (Cowley et al., 2006). A comparison between gymnasts and soccer players is insightful as one athlete is presumed to be injured from landing forces and the other due to distinct movements. Due to the vast amount of measures that can be assessed through TTS and dynamic stability

collection of data on the TTS between athletes could reveal further information as to why some of the non-contact injuries occur.

There are several values that we can collect using a force platform to quantify different phases of a plyometric jump. First the ground reaction force (GRF) values can quantify and measure dynamic stability and landing forces of the plyometric jump (Searle, Louder & Bressel 2015). Dynamic stability is the ability to correct balance when there are disturbances in the environment (Ebben, Vanderzanden, Wurum, & Petushek, 2010; Liu & Heise, 2013; Ross & Guskiewicz, 2003). Dynamic stability can be evaluated using time to stabilization (TTS) on a force plate and is shown to be reliable. TTS can demonstrate how quickly the neuromuscular system can utilize sensory and mechanical systems to safely land from a jump and return to stability (Ebben et al., 2010; Fransz, Huurnink, de Boode, Kingma, & van Dieen, 2015; Liu & Heise, 2013; Ross & Guskiewicz, 2003; Ross, Guskiewicz, Prentice, Schneider, & Yu, 2004; Ross, Guskiewicz, & Yu, 2005; Wikstrom, Powers, & Tillman, 2004). These measures have yet to be tested between two of the most commonly injured female athletes, in different environments with varying loads.

Impact forces are reduced in an aquatic environment based on force platform measures (Colado, Garcia-Masso, Gonzalez, Triplett, Mayo & Merce 2010; Donoghue, Shimojo & Takagi 2011; Louder, Searle & Bressel 2015; Robinson, Devor, Merrick & Buckworth 2004; Searle, Louder & Bressel 2015; Stemm & Jacobson 2007; Triplett, Colado, Benavent, Alakhdar, Madera, Gonzalez & Tella 2009), making water an ideal environment for plyometric training to prevent overuse injuries by lessening forces. It is practical to investigate the difference in TTS between gymnast and soccer players in both

and aquatic and land environment to better understand the athlete's reaction to stabilization in varying environments. The usefulness of participating in an aquatic plyometric training program is evident by research demonstrating less soreness post-training and potential for decreased injury in a buoyant environment with decreased impact forces (Colado et al., 2010; Donoghue, Shimojo, & Takagi, 2011; Martel, Harmer, Logan, & Parker, 2005; Miller et al., 2007; Robinson et al., 2004).

The appeal of using water as an alternative form of training and rehabilitation is evident because of water's natural properties including buoyancy, fluid resistance, and hydrostatic pressure (Torres-Ronda and Scelling I del Alcazar, 2014). Aquatic plyometrics as a possible means of improving athletic performance has been a spotlight in recent research (Robinson *et al.*, 2004; Martel *et al.*, 2005; Miller *et al.*, 2007; Colado *et al.*, 2010; Ploeg *et al.*, 2010; Whitehill *et al.*, 2010; Arazi and Asadi, 2011; Jurado-Lavanant *et al.*, in press). The idea of lower impact forces and decreased injury rate appeals to athletic programs across the country and could easily be integrated into training as an aquatic recovery practice/session in an effort to prevent overtraining (Robinson et al., 2004). Having further insight as to why injuries occur and how GRF are affecting one's postural stability can allow researchers and clinicians to make evidence-based decisions. The effectiveness of lower extremity bracing or muscular fatigue programs can be evaluated and recommendations can be made to keep athletes performing at their optimal capacity.

Plyometric exercises have been performed in both land and water, and the benefits of an aquatic environment have been proven, however there is no measure for dynamic stability training (Martel *et al.*, 2005; Colado *et al.*, 2010; Whitehill *et al.*, 2010;

Arazi and Asadi, 2011). Soccer and Gymnastics are two of the most powerful and explosive female sports not yet having been examined side by side in any environment.

Therefore the purpose of this study is to determine the dynamic stability (TTS) of gymnasts and soccer players under varying conditions (environment and load) to determine if aquatic plyometric training is effective for reducing GRF and stability training. We hypothesis that: 1) gymnasts will obtain shorter TTS than soccer players in all conditions: 2) TTS in water will be shorter than land: 3) TTS will be longer as external load increases.

## **Methods**

### ***Participants***

This study recruited twenty-four healthy female athletes between the ages of 18-23 years. Subjects were Division 1 gymnasts and soccer players who volunteered to participate in the study. In order to be cleared for participation the subjects had to report that they were: 1) free from any orthopedic injury, and not had a recent surgery (within the last 3 months) that would prevent them from safely completing a countermovement jump with various loads. Subjects were informed of the general requirements and tasks involved in the study as well as given a letter on informed consent to read and sign before participation that has been approved by the university institutional review board.

### ***Procedures***

Subjects performed three countermovement jumps (CMJ) in 9 different conditions; for a total of 27 CMJ's. This study had 3 different environmental conditions (land, water hip height (HH), and water chest height (CH)), and 4 varying loads (body weight, 10%, 20%, and 30% bodyweight (BW)), which were measured in the land and

chest height environments. Only body weight was tested for the water hip height. The percentages listed above are the percentages of each subject's individual body weight added to the subject before performing the loaded CMJ's for specified condition.

All data collection jumps were performed on a waterproof force plate (AMTI, Model OR6-WP; Columbus, OH) that was positioned in the center of the floor of a height-adjustable underwater treadmill (Hyrdoworx 2000; Middletown, PA). Subjects had the option to warm-up and participate in 'practice jumps' prior to testing. The subject's weight was measured on a electronic scale before beginning the collection. When performing CMJs in CH conditions the subjects were submerged to their xyphoid process, for the HH condition subjects were submerged to greater trochanter of femur. For the jump, subjects were instructed to keep their hands on their hips and "jump as high as possible using your natural jumping method and stand still upon landing until instructed to move." The CMJ involved quick hip flexion, knee flexion, and dorsiflexion and than a rapid concentric contraction to propel their body into a jump and properly utilize the stretch shortening cycle. Subjects were able to choose the depth of their CMJ.

The additional load used for jumps was created using a weighted vest (MIR Vest Inc. San Jose, CA). Each weighted load was rounded to 1.4kg (3lbs) increments nearest the percentage of bodyweight required for each condition. The loads did not exceed 27.2kg (60lbs), which was the maximum capacity of the vest. Between each condition the subjects had 2-3 minutes of rest and the vest was removed and load was adjusted for next condition before properly re-securing the vest.

To be considered an acceptable trial the subject had to complete the CMJ, with hands staying on their hips during the entirety of the jump, then land with both feet on the

force plate simultaneously and wait to become stabilized. If the jump did not meet these requirements the protocol would be repeated.

### ***Data Collection and Analysis***

The data collection was triggered manually for each trial and collected using Netforce software (AMTI; Columbus, OH), at a duration of 20s (1000Hz) giving subjects enough time to complete a jump and have 10s of TTS data. Data Sampling began approximately 3 seconds prior to the subject initiation of the CMJ. Vertical ground reaction force (GRF, N) values were measured by the force plate and saved as raw data.

Data was filtered and initial landing was considered when an RFD of 10,000 Newtons per second between two consecutive data points was confirmed. This method was used because initial contact points are difficult to identify in water, as there are gradually increasing points before a more exponential increase. This method has been demonstrated to be accurate to 0.02 seconds when compared to video analysis (Donoghue et al., 2011). After determining a landing point 10,001 data points (10 seconds) were retrieved and analyzed in Microsoft Excel (Microsoft Corp., Redmond, WA) to determine TTS.

TTS was calculated from the dampening of GRF fluctuations over a period of time (10 seconds for this study). Procedures outlined by Liu and Heise (2013) were followed for the analysis of TTS using *figure 1, and equation 1* from the manuscript and then modified to fit our data. TTS is calculated when the time for sequential average is diminished within  $\frac{1}{4}$  the overall standard deviation (See Equation 1 below). Sequential averaging was performed using the Python (Python Software Foundation, Beaverton, OR) to expedite the process of converting raw data. Excel was then used to determine

the point where sequential average diminished to within one quarter of the overall standard deviation using logistical functions (Liu & Heise, 2013).

**Equation 1. Sequential averaging equation (Liu & Heise, 2013)**

$$SeqAvgx(n) = \frac{\sum_{n=1}^{10001} Fz}{n}$$

### ***Statistical Analysis***

The average of the 3 CMJ's for each trial was used for the TTS analysis. Independent variables included the environment (land, water), load (BW, 105, 20%, 30%), and athlete type (soccer or gymnast). The dependent variable was TTS. A 3-Way Repeated Measures ANOVA (SPSS 23, Chicago IL) was used to determine if any significant main effects or interactions were present. Sphericity for TTS was tested and if failed, the Greenhouse-Geisser adjustment was employed. When necessary post hoc comparisons were performed using Duncan's Least Significant Difference (LSD) test. The level of confidence was set at  $p < 0.05$ .

### **Results**

#### ***TTS***

A significant main effect was observed for environments (Land vs Water) regardless of load or sport interactions ( $p = .006$ ). Land resulted in significantly greater TTS than water (Figure 1). There was no significant main effects for Load, Sport, or the interaction effects for Environment vs Sport ( $p = .456$ ), Environment vs Load ( $p = .912$ ), or Environment vs Sport vs Load ( $p = .374$ ) (Figure 2). The average weights used for each

external load placed on participants were equal to;  $13.9 \pm 1.7$ lbs (10%),  $28.1 \pm 3.0$ lbs (20%), and  $41.9 \pm 4.2$ lbs (30%).

### **Discussion**

The purpose of this study was to assess dynamic stability of Division 1 athletes in land vs water conditions with varying loads through the use of TTS. This study is the first we know of comparing collegiate female athletes for TTS in an aquatic environment with varying external loads.

We initially hypothesized that gymnast would attain a shorter TTS in both environments under all load condition. This assumption was made based off the nature of gymnastics that a major objective in the sport is to “stick landings” and subsequently anticipated shorter TTS. Previous research in drop jump landings has reported significantly greater GRF in gymnasts over recreational athletes (Seegmiller & McCaw, 2003). This technique of landing would support that “sticking landings” is part of their sport technique and despite the potential increase in TTS with greater peak force is ignored by gymnasts. Unfortunately, the results of this study did not support our hypothesis. There was no significant difference ( $p = .456$ ) between gymnasts and soccer players when evaluating dynamic stability.

The comparable performance in TTS between athletes might be explained by the nature of the TTS calculation. TTS can demonstrate how quickly the neuromuscular system can utilize sensory and mechanical systems to safely land from a jump and return to stability. By convention TTS is a time dependent dampening of vertical ground reaction forces (Ross & Guskiewicz, 2004; Wickstrom, Powers & Tillman, 2004; Lui & Heise, 2013) It is a very specific calculation that perhaps is more sensitive to relatively

small landing vertical force perturbations than athletes are required to control in training and competition. For example, gymnasts focus on not taking any steps once landed or displaying observable sways in posture as the landing is more judged from a qualitative perspective as quantitative. Soccer players who land from any jump typically have to react and continue moving immediately. Therefore similar TTS values between sport teams may be more of a comparison between two well-trained athletic groups who display heightened neuromuscular capacity. The use of both environments plus added loads were assumed to provide adequate experimental conditions for these groups to discriminate themselves. Perhaps the magnitude of loads were not great enough or the water depth impacted both teams to a similar extent. It was assumed that both teams were inexperienced in performing CMJ's in the water. Perhaps if a drop jump were employed the greater skill requirement may have provided differences. In order to determine a significant difference between sports, future researchers may want to compare an upper extremity focused sport (softball, golf, or tennis) with gymnastics and assess TTS and GRF of landing together. Future research could also focus on male vs female athletes in either soccer or gymnastics to explore other possible differences in landing mechanics and dynamic stability.

When reviewing our result with other previous research of TTS on land (Fransz et al., 2015) and in aquatic environments, we found the values were comparable. Fransz et al., (2015) reported results similar to ours. The mean $\pm$ SD TTS in their study was 4.56 $\pm$ 0.30 when assessing vGRF. They had subjects perform one-legged drop landings of single leg hops, making it understandable to have a greater average than when landing on both feet. This is appropriate assuming that TTS will be greater when landing on a

single leg which is a less stable condition. Wikstrom et al., (2004) reported TTS before and after the subjects participated in an isokinetic and/or functional fatigue program. Subjects jumped by taking off of two feet and landing on a single leg. The mean TTS before partaking in the fatigue programs were; isokinetic group( $2.06\pm 0.57$ ), functional fatigue group ( $2.34\pm 0.59$ ), and combined group ( $2.20\pm 0.58$ ). After partaking in assigned fatigue protocol TTS there was a significant increase in TTS. Post participation TTS were; isokinetic ( $2.45\pm 0.39$ ), functional ( $2.47\pm 0.52$ ), combined ( $2.46\pm 0.43$ ). These results are quite shorter than the present study's perhaps due to the method used for data analysis and conversion from raw data to TTS (See Table 3). If the raw data were synthesized using the most recent recommendations it is possible the results would more closely match those in Fransz et al., (2015). Further evidence for this observation is presented in limitations of the present study below.

Perhaps some of the properties of water may actually aid in shortening TTS. We originally hypothesized that TTS would be longer in water due do the subjects lack of experience in an aquatic environment plus the role of buoyancy creating a "lightening" of ground support. Louder (2014) reported that static stability in chest height water is influenced by some of the properties of water. These results do not follow the principle of specificity stating that an athletes training should be relevant to the sport in order to produce a training effect. If the results did support our hypothesis then this would better apply to the specificity principle. It is assumed that a lower peak force may be easier for the athletes to stabilize from, yet Searle et al., (2015) reports that there is no significant relationship between peak force and TTS. Another possible explanation for lower TTS

could be the body has a heightened proprioceptive capacity from the hydrostatic pressure and viscosity of water (Roth, Miller, Richard, Ritenour, & Chapman, 2006).

Our final hypothesis was that TTS would become longer as the external load placed on the participants was increased. Our results did not support our hypothesis; there was no significant difference ( $p = .912$ ) in TTS when the external load was modified. Additional weight may not be a beneficial or harmful modification to a training program when evaluating or focusing on dynamic stability. The effect and interactions were not significant to determine if it should be included in a training progression.

Insights that can be gained from this study apply strongly to rehabilitation specialists, training professionals, and the athletic population. Aquatic based training/rehabilitative programs can be used as a progression for athletes who have sustained previous injury. As earlier stated the hydrostatic pressure and viscous properties of water assist in improving proprioceptive capacity (Roth, Miller, Richard, Ritenour, & Chapman, 2006), which is one of the initial steps in rehabilitating and injury. When returning from a more severe proprioceptive deficit beginning in water and progressing to land is beneficial for patients. Another use for aquatic training is with the elderly population, where they may have just decreased their dynamic stability over time and are more comfortable in water than on land due to fear of falling and risking injury (Searle, Louder & Bressel 2015).

Markovic and Mikulic (2010) showed similar improvements in strength, power, and neural adaptations when training in land and water, however the aquatic based programs resulted in less muscle soreness and lower GRF upon landing. Aquatic plyometrics can be used as a safe environment to rehabilitate and recondition athletes

when returning to regular activities. Allowing athletes to re-gain muscular power while avoiding hazardous activities are a key component when creating training programs for post-surgical patients. Healthy athletes may also be inclined use train aquatically for cross training purposes.

This study included several limitations. First, the analysis of TTS was based off a previous study (Searle, Louder & Bressel 2015) where TTS was analyzed off vertical axis. The alternative would be to measure in a mediolateral or anterioposterior axis, though the pilot testing in that study revealed no significant variations in either measures. Searle (2015) reported TTS measures about  $\frac{1}{2}$  the time of our study with an almost identical protocol. The results still held true that water resulted in a shorter TTS than on land. After Further examination we found that averages were taken from the raw data and then converted into TTS. The recommendations for calculating TTS were changed between the Searle (2015) and our data analysis. When reanalyzing the data from the Searle (2015) study we observed that if each raw data point was converted to TTS then averaged the numbers were quite similar to our results. Mean TTS from the Searle et al. study were: land ( $2.92 \pm 0.43$ ) and water  $2.87 \pm 0.54$ . Second, the weights used in the vest for external loads were not exact body weight percentages, they were estimated in 3lb increments. The vest also did not allow for even distribution of the weight in the vest, which could cause the subject to feel “uneven” when partaking in the countermovement jumps. The drag forces of the vest being added to the surface area of the body likely influenced jumping mechanics. The vest makes the participant “top heavy” and could influence the protocol. Alternatively there have been studies that used a barbell above water resting on participants shoulders (Baker et al., 2001; Cormie et al. 2007; Taylor &

Taylor, 2014; Stone et al., 2003). Third, the participants were able to select their own range of motion for each countermovement jump, which creates variation in the possible peak power, landing forces and TTS. The amount of effort that each participant exerted on each jump was also subjective and could influence the outcomes of the results. Often times a participant would squat low enough in their countermovement that their head would become very close to the water and could have altered their “natural jumping form” as they attempt to keep their face above water. Finally, subjects had the option to take practice jumps in each new condition but were not required to. Some participants took advantage of these practice jumps while others did not.

### **Conclusion**

Our findings illustrate the disparity of dynamic stability between land and aquatic landings in female Division 1 athletes. The measure of dynamic stability (TTS) was shorter in water than on land regardless of sport or external load. Through this we concluded that aquatic training for dynamic stability could be a respectable step for rehabilitation, reconditioning, or cross training of athletes. An important factor in this decision is also the known decrease in landing forces when in an aquatic environment making it a suitable alternative for low impact neuromuscular training.

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## Appendix

Table 1. Descriptive Statistics (Mean  $\pm$  SD) of Subjects

<b>SPORT</b>	<b>AGE (Years)</b>	<b>HEIGHT (CM)</b>	<b>WEIGHT (Kg)</b>	<b>YEARS EXPERIENCE</b>
Gymnastics (n=12)	19.91 $\pm$ 1.24	148.4 $\pm$ 6.86	62.16 $\pm$ 5.99	1.33 $\pm$ 1.15
Soccer (n=12)	19.91 $\pm$ 1.0	153.06 $\pm$ 4.63	64.62 $\pm$ 7.28	1.33 $\pm$ 0.78
Total	19.92 $\pm$ 1.10	150.74 $\pm$ 6.2	63.39 $\pm$ 6.64	1.33 $\pm$ 0.96

Table 2. Descriptive Statistics (Mean  $\pm$  SD) of Conditions

<b>Sport</b>	<b>Load</b>	<b>Mean TTS Land</b>	<b>Mean TTS Water</b>
Gymnasts	BW	2.9 $\pm$ .65	2.97 $\pm$ .45
	10 Percent	3.1 $\pm$ .24	2.98 $\pm$ .60
	20 Percent	3.24 $\pm$ .35	3.07 $\pm$ .58
	30 Percent	3.18 $\pm$ .23	2.84 $\pm$ .57
	Total	3.11 $\pm$ .41	2.97 $\pm$ .54
Soccer	BW	3.07 $\pm$ .24	2.67 $\pm$ .63
	10 Percent	3.02 $\pm$ .58	2.88 $\pm$ .53
	20 Percent	3.01 $\pm$ .64	2.78 $\pm$ .64
	30 Percent	3.11 $\pm$ .67	2.92 $\pm$ .29
	Total	3.05 $\pm$ .54	2.81 $\pm$ .53
Total	BW	2.99 $\pm$ .49	2.82 $\pm$ .56
	10 Percent	3.06 $\pm$ .44	2.93 $\pm$ .56
	20 Percent	3.12 $\pm$ .52	2.93 $\pm$ .62
	30 Percent	3.14 $\pm$ .49	2.88 $\pm$ .45
	Total	3.08 $\pm$ .48	2.89 $\pm$ .54

Table 3. Comparison of TTS Values in Literature

	<b>TIME TO STABILIZATION (s)</b>		
	<b>Land</b>	<b>Water</b>	<b>SL Land</b>
<b>Dwyer</b>	2.99 ± .49	2.82 ± .56	NA
<b>Searle</b>	2.92± 0.43	2.87±0.54	NA
<b>Franzs</b>	NA	NA	4.56±0.30
<b>Wikstrom</b>	NA	NA	2.20±0.58

\*The numbers reported for Dwyer were only body weight averages. Searle's data represents re-analysis of original data. Franz's single leg landings on land. Wikstrom is the average of all 3 trial groups before participation in training regimen.

Figure 1. TTS (Mean  $\pm$  SD) in Land vs. Water across external loads

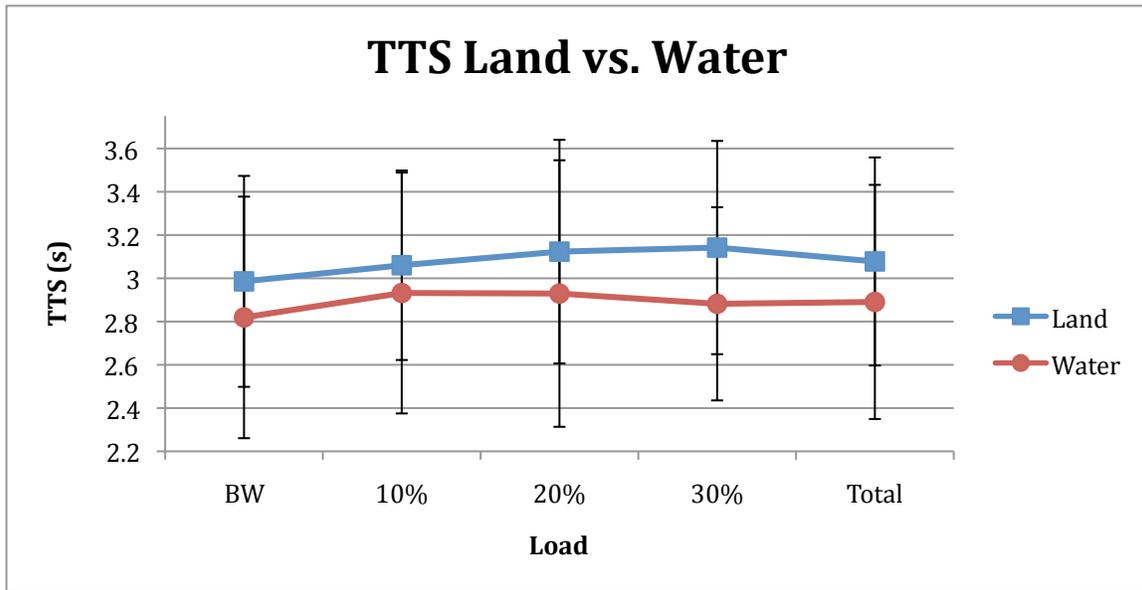


Figure 2. TTS (Mean  $\pm$  SD) for Gymnastics vs. Soccer athletes across all conditions

