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# Coaches Perspective: Changes in Swim Performance and Perceived Stress and Recovery in Female Collegiate Swimmers Across a Competitive Season

Jacquelyn N Zera, *John Carroll University*  
James L. McMillan, *Georgia Southern University*  
Barry A. Munkasy, *Georgia Southern University*  
A. Barry Joyner, *Georgia Southern University*  
Stephen J. Rossi, *Georgia Southern University*



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## *Coaching Applications*

# **Changes in Swim Performance and Perceived Stress and Recovery in Female Collegiate Swimmers Across a Competitive Season**

**Jacquelyn A. Nagle<sup>1</sup>, James L. McMillan<sup>2</sup>, Barry A. Munkasy<sup>2</sup>, A. Barry Joyner<sup>2</sup>, Alexander Roorda, Mindy K. Scott, and Stephen J. Rossi<sup>2</sup>**

<sup>1</sup>Department of Sports Medicine and Nutrition  
Neuromuscular Research Laboratory  
The University of Pittsburgh  
3830 S Water Street  
Pittsburgh, PA 15203

<sup>2</sup>Department of Health and Kinesiology  
Georgia Southern University  
1332 Southern Drive  
Statesboro, GA 30458

### **Abstract**

*Optimal sport performance involves balancing the accumulation of training stress with adequate recovery (Budgett, 2000; Hollander & Meyers, 1995). Continuous evaluation of an athlete's performance levels, stress levels, and recovery states during a competitive season is important in determining an athlete's readiness for competition. This study's purpose was to examine effects of training load on performance, perceived stress, and recovery among collegiate female athletes across a competitive season. Nineteen NCAA Division I female swimmers completed monthly testing including six tethered swim tests and seven Recovery-Stress Questionnaires (RESTQ-76), yielding mean force ( $F_{mean}$ ) and Total Recovery-Stress Score (TRSS). This study's results indicate that, while there was no difference between groups for performance, perceived stress, and recovery, there were significant changes across a season that could have practical implications for coaches working with these athletes.*

### **Introduction**

Chronic sport training has increased interest in performance testing and monitoring of competitive athletes to help reduce injury and fatigue. One major concern for coaches is promoting the balance between training stress and recovery. Although the manifestation of this imbalance is unique to each individual, some commonly experienced symptoms include physiological changes, psychological changes, and decreased sport performance. Overtraining is not only sport specific, but it is also specific to the athlete because adaptation to training stress and recovery are unique to the individual. Non-weight bearing sports, such as swimming, make athletes less susceptible to acute injury leading to an even greater capacity for training volume. Swimming has been studied due to the high

frequency of training and training sessions that are long in duration, which results in a high training volume.

There is a large body of literature identifying symptoms of overtraining and its consequences on athletic performance. However, few studies observe athletes throughout an entire season. Previous research has utilized swimming competition results as a measure of performance. However, swim performance has been found to be highly variable because of the inconsistent events and strokes swam, pool lengths, and competition meet formats. Because the signs and symptoms of overtraining are generally observed during anaerobic tests of power output, recent research has used a tethered swimming test as a measure of performance. Studies have shown that the pulling force measured during a tethered swim test correlated with swimming performance. More specifically, mean force has been shown to be the best predictor for swimming performance for all competitive swim techniques and all swim distances.

The purpose of this study was to examine mean force production during a 30-second tethered swimming test and perceived stress and recovery state across a competitive season in collegiate female swimmers.

## **Methods**

### Participants

Sixteen healthy female NCAA Division I swimmers volunteered for the study and completed all six trials. All participants had been swimming competitively and training year round for at least 5 years.

### Design

To assess performance, participants completed a tethered swim test to determine mean force output and filled out a perceived stress and recovery questionnaire monthly throughout the season. Differences in the training load between groups was based on the yardage swam (external load) by subjects and their reported RPE (internal load).

### Measures

The equipment used for the tethered swim test included a Futek™ tension and compression load cell, Model LSB302 (Irvine, CA) firmly attached to the starting platform of the first lane of the pool and connected to a BioPac™ system, Model MP36RWSW (Aero Camino Goleta, CA) by a BioPac™ custom interface that was calibrated by the manufacturer. Connected to the load cell was a 10-meter non-elastic tether with a swim belt attached to the end. The protocol for the tethered swimming test began with subjects completing a 1000-1200 yard warm up. The subject then put on the swim belt and adopted a horizontal position in the water with the cable fully extended. The subjects were then asked to begin a 30 second maximal freestyle tethered swimming test.

The Recovery Stress Questionnaire for Sport (RESTQ-Sport) is a multidimensional questionnaire that evaluates the recovery and stress state of an athlete. The questionnaire

was administered monthly after a full day of rest and prior to the first morning workout of the week. Total Recovery-Stress States (TRSS) is defined as the difference between the mean scores of the recovery and the mean scores of the stress scales.

Total Training Load (TTL) was calculated using session RPE and yardage swam. The participants were divided into three groups: high training load, middle training load, and low training load.

## **Results and Discussion**

The current study investigated the effect of training load on psychological and performance variables of swimmers across a competitive season. Results obtained suggest that, although there were no significant differences between the training load groups for the aforementioned variables, there were significant changes across time ( $p=.004$ ) that aligns with periods of heavy training and periods of relative rest. There was a significant decrease between Trial 1 ( $84.39N \pm 13.58N$ ) and Trial 2 ( $78.90N \pm 15.06N$ ) in  $F_{\text{mean}}$ . However, there was a significant increase in force between Trial 3 ( $75.62N \pm 18.79N$ ) and Trial 4 ( $78.82N \pm 18.65N$ ).

Mean force data is consistent with previous studies. Results of the tethered swimming test did not reveal significant differences between training groups for mean force across the competitive season ( $p=.531$ ). Although no statistical significance was found with corresponding meters completed, it can be suggested that the significant increase in performance observed could be attributed to the rest the athletes may have received when their training was decreased over the University's Thanksgiving break. There were significant increases between Trial 1 ( $18182.12m \pm 5560.57m$ ) and Trial 2 ( $29903.29m \pm 4013.88m$ ) and between Trial 4 ( $29234.33m \pm 14133.38m$ ) and Trial 5 ( $40324.08m \pm 11168.23m$ ). These results are also similar to other studies that observed an inverse relationship between training load and performance. The results also support the importance of sufficient training stimulations paired with recovery to maximize performance, which follows the basic understanding of training stress and recovery.

There was a significant decrease in TRSS observed ( $p<0.001$ ) which confirmed that an increase in training volume induces a significant increase in perceived stress and decrease in perceived recovery. This study further demonstrates the inverse relationship between perceived stress/recovery states and training volume. Also, it appeared that a short-term rest period during the season had a significant and positive impact on the athlete's perceived recovery-stress state. These findings are consistent with the literature suggesting that tapering, or allowing the athlete a short period of rest and recovery, regularly throughout the season is beneficial. Reductions of training consistently reduce feelings of fatigue as well as increased feelings of energy.

Results of this study suggest that evaluation of an athlete's perceived recovery-stress state is important when monitoring athletes throughout the season in order to prevent symptoms of overtraining and underperformance. Monitoring of perceived stress-recovery

state on a regular basis can be an inexpensive, quick, and valuable tool which can improve physical performance and psychological state of athletes.

Overall, results indicate that although there were no statistically significant differences between training load groups for the performance and psychological variables, there were significant changes across time for both variables. Furthermore, the significant changes detected for both performance and psychological variables corresponded with significant changes in weekly training meters completed, revealing an inverse relationship between meters and the aforementioned variables. The results of the current study demonstrate the intricate relationship between training load, performance, perceived stress, and recovery during a competitive collegiate season in female division I swimmers.

The intentions of this study were to examine the relationships between training load and subsequent performance and perceived stress-recovery state across a competitive season. For coaches, the results of the current study suggest training stress-recovery state along with measures of performance should be monitored in order to help ensure optimal training adaptation. This information can then be used in future training decisions to hopefully avoid symptoms of overtraining and possible overuse injuries. Constant monitoring of athletes in such a way can provide optimal training volumes and potentially yield the highest possible performances. From a practical perspective, the measures used in this study are minimally invasive and provide immediate results that can be quickly disseminated to coaches.