Hormone and Adpokine Alterations across Eleven Weeks of Training in Division I Collegiate Throwers: an Exploratory Study

W. Guy Hornsby  
West Virginia University

Christian R. Carter

Guy Gregory Haff  
Edith Cowan University

Micheal R. Ramsey  
East Tennessee State University

Andy R. Dotterweich  
East Tennessee State University, dotterwa@etsu.edu

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Introduction

Conceptually, it is important to understand the underlying physiological mechanisms of any training program model. This understanding aids the coach/athlete in identifying better choices in manipulating variables in formulating the training model. These underlying mechanisms can be associated with training variable manipulation and fatigue management aspects as well as the overall health of the athlete. Hormone and cytokine concentrations can be linked to alterations resulting from the manipulation of training variables and to subsequent alterations in performance (Haff et al., 2008; Ishihara et al., 2005; Jurimae et al., 2010; Stone et al., 2007). For example, alterations in the testosterone: cortisol (T:C) has been associated with alterations in training volume as well as physiological aspects such as lean body mass (LBM), fat content and stress. Stress hormones could be measured after a training session within 2 hours (e.g., Stone et al., 2008; Hakkinen, 1989; Stone et al., 2007).

The present study followed NCAA Division 1 (D-1) collegiate throwers over a period of an 11 week fall semester preparation-phase block form of periodized training. Volume and intensity alterations and their effects on physiological variables (e.g. neuropeptide, hormonal, cytokine) are a key component in understanding the process of a training process. Alterations in these physiological variables were tracked over time. A better understanding of physiological adaptations to a training program assists a coach in constructing a more optimal periodization plan.

Methods

Subjects

Nine (9) Division 1 collegiate throwers and 4 control subjects participated in this study. The ability level of the throwers (6 male and 3 female) ranged from conference champions and potential NCAA Division 1 regional qualifiers to competitive at a club/training (non-sanctioned) meets) ranging from 19.09m to 16.9m in the shot put and 12.03m to 18.6m in the weight throw. The control subjects (3 males and 1 female) were sedentary individuals and were instructed not to change their dietary habits and to remain sedentary throughout the study. Prior to the initiation of the study, the throwers had just completed a 4 wk period of moderately high volume resistance, conditioning and throwing period.

Experimental Design

The present investigation was a time series study, analyzing physiological and performance changes over 11 weeks of training in 9 D-1 collegiate throwers. It was a collaborative effort between the sport coach (track and field), the event coach (throws), the strength and conditioning staff, and sport scientists at East Tennessee State University (ETSU). Daily training outcomes were recorded and “monitored” while the throwers executed a periodized throws and resistance training program that was structured and sequenced with the objective of enhancing various strength characteristics to potentially optimize performance for the indoor conference championships and produce a foundation for training for the outdoor season. A series of three testing periods were organized periodically throughout the study (weeks 1, 7, and 11) to measure hormonal alterations, and cytokine concentrations. The control group took part in pre and post (T1 and T3) measurements 11 weeks apart.

Sample Collection Procedures

Blood was collected from an antecubital vein into clot activator blood collection tubes. After standard preparation serum samples were analyzed in one data set at the end of the study. Testosterone (T), Cortisol (C), adiponectin, leptin, and resistin were measured by ELISA; intra-assay CV’s were <4.1%, used successfully with collegiate throwers (Stone et al., 2003).

Training Protocol

The development of the training program was a collaborative effort and involved input from the strength and conditioning coach, as well as the throws coach, multiple scientific sources as its foundation (Bompa & Haff, 2009; Garcia-Pallares et al., 2009; Harris et al., 2000; Pink & Stone, 2003; Jones et al., 2007).

The resistance training program was sequenced with a series of three 3-4 week blocks (summarized micro cycles) of training. The beginning of the preparatory phase focused on a short period of higher volume and less technical work with an emphasis on strength endurance, while the end of the preparatory phase had a shift towards a focus on strength and a small increase in technical work. Block 1 consisted of a strength-endurance emphasis while during block 2 and block 3 the emphasis shifted towards strength. Exercises were chosen in concert with the set/rep/.scheme in an attempt to achieve the goals and objectives of each block. Alterations in relative intensity were added into the weekly training structure to produce heavy and light days. Similar programs have been used successfully with collegiate throwers (Stone et al., 2003).

Results

Differences between male and females were determined using adjusted t-tests. Due to the Exploratory nature of the observation and the relatively small number of subjects differences over time were determined using effect sizes and 95%. A small control group was measure over the same time period (pre-post).

Table 1: Hormone and Adipokine Data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Testing 1*</th>
<th>Testing 2*</th>
<th>Testing 3*</th>
<th>95% CI</th>
<th>t</th>
<th>p</th>
<th>%A</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>14±10.3</td>
<td>18±9.11.7</td>
<td>14.9±11.1</td>
<td>0.24</td>
<td>0.2</td>
<td>&lt; 0.05</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>653±197</td>
<td>612±265</td>
<td>586±235</td>
<td>0.39</td>
<td>&lt; 0.05</td>
<td>12.9</td>
<td></td>
</tr>
<tr>
<td>T/C ratio</td>
<td>0.025±0.01</td>
<td>0.039±0.09</td>
<td>0.032±0.12</td>
<td>0.23</td>
<td>&lt; 0.05</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Adiponectin</td>
<td>587±333</td>
<td>412±307</td>
<td>424±258</td>
<td>0.29</td>
<td>&lt; 0.05</td>
<td>19.5</td>
<td></td>
</tr>
<tr>
<td>Leptin</td>
<td>197±32</td>
<td>170±248</td>
<td>188±248</td>
<td>0.066</td>
<td>0.4</td>
<td>4.9</td>
<td></td>
</tr>
</tbody>
</table>

Discussion

Potential trends in the data may be associated with important alterations in physiology and performance. Only three potential trends (Cortisol, T:C and adiponectin concentrations) were determined along with the data presented.

In the present study, based on the consistency of change across time, a moderate effect size; and 95% cortisol appears to have steadily decreased from T1 to T3. This trend indicates that cortisol, while generally a negatively alter agonist, could potentially have followed alterations in volume load as T2 and T3 corresponded to periods in which volume load was reduced. These alterations which should reduce training stress, the alterations in cortisol support this contention.

Training induced alterations in the T:C may effect body composition as well as stress in the body. Training induced alterations in cortisol concentration is not only very small, but also a moderate - high volume of training lasting several weeks, this may explain the relatively low T:C ratio noted at T1. Furthermore, the T:C ratio was markedly higher at weeks 7 and 11 when training volume load was reduced. These trends agree with previous findings among well-trained strength athletes (Haff et al., 2008; Hakkinen et al., 1989).

Resting adiponectin concentrations are generally inversely related to these inflammatory cytokines. However paradoxically adiponectin appears to be positively correlated with non-obesity related inflammatory conditions (Fattamuzi, 2008). This indicates that adiponectin is regulated in the opposite direction in typical versus obesity-associated inflammatory conditions and therefore may exert different effects (Fattamuzi, 2008). These findings also suggest that all inflammation is not the same or at least is produced as a result of different mechanisms. Furthermore, considering the relationship of adiponectin to synovial inflammation it may be possible that training induced increases in adiponectin concentrations could be associated with more typical inflammatory responses. One potential trend was noted (Figure 1), based on consistency, effect size and 95%, there was an increase in the throwers adiponectin levels. This is a potentially advantageous trend since it is generally associated with a reduction in obesity related inflammation (Boussaid et al., 2010), on the other hand it could be related to training increased joint inflammation a more negative outcome of training. Adiponectin concentration has non-linear correlations with body composition. It has an inverse relationship with resting cortisol concentrations (Falco et al., 2004; Yang et al., 2004). Interestingly, in the present study the decrease in cortisol was accompanied endurance, which could be a result of volume load being high volume load decreased. Assuming that increases in adiponectin is a positive outcome of a sound training protocol, the present observation indicates that adiponectin increased in concert with decreases in cortisol and increases in the T:C ratio. Considering effects of the these hormones and cytokines; these alterations over time indicate a lesser degree of obesity related inflammation and a higher degree of “fitness” and preparedness (Mujika, 2009).

References


