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To cite this article: Mohammad Karimi, Hossein Heydari & Javad Eghbian (2011) The Effect of Tapering on Selected Plasma Cytokine Levels Following Incremental Training in Elite Male Wrestlers, International Journal of Wrestling Science, 1:2, 37-40, DOI: 10.1080/21615667.2011.10878929

To link to this article: https://doi.org/10.1080/21615667.2011.10878929

Published online: 15 Oct 2014.
THE EFFECT OF TAPERING ON SELECTED PLASMA CYTOKINE LEVELS FOLLOWING INCREMENTAL TRAINING IN ELITE MALE WRESTLERS

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ABSTRACT
The aim of this study was to determine the effect of tapering on the concentration of plasma interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNFα) in elite male wrestlers after a period of incrementally increasing training volume. After completing 4 weeks of the incremental training exercise, the subjects were randomly assigned to one of two groups: a control group of wrestlers (n = 10) which continued performing the incremental weekly training volume for one week while a taper group of wrestlers (n = 10) proceeded with a 75% reduction in weekly training volume relative to the control group. Blood samples were collected from all participants at the beginning of the 1st week and at the end of the 4th and 5th weeks. Plasma levels of IL-6 and TNFα were assayed using standard commercial ELISA kits (Quantikine; R & D Systems, Minneapolis, MN). Data were analyzed by using t-test (P<0.05). The results showed that after one week of tapering, plasma levels of IL-6 significantly decreased (P<0.05). Although the plasma levels of TNFα decreased in the experimental group, it was not statistically significant (P>0.05). According to the results, increasing plasma level of IL-6 and TNFα in the wrestlers who continued incremental training might be related to the high volume of training.

KEY WORDS: Tapering, Interleukin-6, Tumor Necrosis Factor--alpha, wrestling

INTRODUCTION
Intense exercise with inadequate recovery can lead to overtraining syndrome, a state where performance and the sense of well being may be compromised for several months (3). Immune suppression is one of the main side effects of overtraining. Acute and chronic exercise influence several markers of immune system function (3). These markers and other biochemical changes which are associated with heavy training have been proposed as potential markers of overtraining. Prolonged periods of heavy training with different intensity and duration cause to temporary depression of several aspects of immune function that usually last 3-24 h after exercise (3,11). Epidemiological studies show that exercise with high volume and intensity causes athletes to be more susceptible to minor infection (16,20). For example, athletes who do intensive and prolonged exercise, are more likely than non-athletes to experience common cold and sore throat symptoms. In athletes this may cause a decline in athletic performance and an inability to sustain heavy training (19). In fact, there is no clinical disorder present in the athlete’s immune system, but the total changes in various parts of the immune system cause a decline in the athlete’s resistance to infection, especially during the most important competition when athletes should be at peak performance (7). There are different factors that interfere with immune system impairment that are completely unknown, but most physiologists believe that the changes in the immune system related to exercise are associated with changes in plasma cytokines and neuro-hormonal factors such as changes in the amounts of cortisol, catecholamine and growth hormone (17,18). Cytokines are immune system proteins that modulate or influence the immune response. Intense exercise induces increased levels of cytokines in the blood. While most studies have focused on the acute effects of exercise on cytokines, some have investigated the chronic effects in well-trained athletes during tapering periods. The majority studied three cytokines; interleukin-6 (IL-6), TNFα and interleukin-1α (IL-1α) (15). Generally, the concentration of these cytokines in response to exercise such as marathon is unchanged or increased (15). The intensity and type of training affected the cytokine response (22). Gokhale et al. (2007) investigated cytokine response to strenuous exercise in athletes and non-athletes. Their results showed that in both groups, the plasma levels of IL-6 increased, whereas TNFα decreased (8). Gorzi et al. (2006) reported that after ten weeks of endurance training plasma levels of cortisol and TNFα did not show significant decrements (9). Farhangimaleki et al. (2009) studied the effect of two different tapering periods on the concentrations of plasma IL-6, IL-1β and TNF-α, as well as performance in elite male cyclists. The results showed significant reductions in (ρ < 0.001) IL 1β, IL-6 and TNFα concentrations in the taper group relative to the control group at the end of the 3 week tapering period, but not at the end of the 1 week tapering period (1). Despite the high level of research interest in the effects of exercise on immunity, there are only a limited number of studies that have directly examined immunological changes in athletes during the taper phase prior to competition (12). Most of these studies were done in sports such as swimming, cycling and endurance running. There are a few studies investigating the immunological changes in wrestling, specifically in the tapering phase. The primary
The purpose of this study was to investigate the effect of tapering (75% reduction in training volume) on the concentration of post-exercise plasma levels of IL-6 and TNFα in elite male wrestlers.

MATERIALS AND METHODS
Twenty Iranian high-level wrestlers (age = 21.8±1.4 years, weight = 71.5 ± 6.9 kg, BF% = 10.6 ± 1.9) volunteered to participate in this study as subjects. After receiving oral and written information about the study plans and procedures, the subjects signed an informed consent form. After completing 4 weeks of incremental training exercise, the subjects were randomly assigned to one of two groups: a control group of wrestlers (n = 10) which continued performing the incrementally increasing training volume for one week while a taper group of wrestlers (n = 10) proceeded with a 75% reduction in weekly training volume relative to the control group.

To create a realistic reduced training scenario, the 20 elite wrestlers were fully trained as if preparing for a competition season. The training status of every subject over the preceding 8 weeks was obtained by questionnaire, training log, and a personal interview. Blood samples were collected from all participants at the beginning of the 1st week, and at the end of 4th and 5th weeks. Plasma levels of IL-6 and TNFα were analyzed using validated ELISA kits (Quantikine; R & D Systems, Minneapolis, MN).

All participants completed a 4-week incremental, high-intensity training period (Table 1). After this four-week progressive training and before the tapering period began, the subjects were randomly divided into two equal groups: an experimental tapering group (75% reduction in training volume) and a control group (continued weekly incremental training).

Table 1. Training programs; values in parentheses denote the number of sessions for each item per week

<table>
<thead>
<tr>
<th>Mesocycle Group</th>
<th>Incremental training</th>
<th>Tapering control</th>
<th>experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeks</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Warm-up (min)</td>
<td>15 (6)</td>
<td>15 (6)</td>
<td>15 (6)</td>
</tr>
<tr>
<td>Interval training (min)</td>
<td>20 (3)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Resistance training (min)</td>
<td>45 (3)</td>
<td>45 (3)</td>
<td>45 (3)</td>
</tr>
<tr>
<td>Speed training (m)</td>
<td>160 (2)</td>
<td>190 (2)</td>
<td>210 (2)</td>
</tr>
<tr>
<td>Plyometric training (j)</td>
<td>-</td>
<td>30 (3)</td>
<td>36 (3)</td>
</tr>
<tr>
<td>Technical training (min)</td>
<td>16 (3)</td>
<td>18 (3)</td>
<td>20 (3)</td>
</tr>
<tr>
<td>Wrestling competition (min)</td>
<td>10 (3)</td>
<td>12 (3)</td>
<td>14 (3)</td>
</tr>
<tr>
<td>Warm-down</td>
<td>10 (6)</td>
<td>10 (6)</td>
<td>10 (6)</td>
</tr>
</tbody>
</table>

RESULTS
The results are presented as mean values and standard deviation. Independent t-tests were used for comparing any significant difference between groups after week 5 of training. The level of significance was set at p<0.05. Descriptive values of cytokines level in three phase of measurement were presented in Table 2.

Table 2. Mean ± SD level of IL-6 and TNFα (pg.ml⁻¹) in studied groups

<table>
<thead>
<tr>
<th>Group</th>
<th>wk1</th>
<th>wk4</th>
<th>wk5</th>
<th>wk1</th>
<th>wk4</th>
<th>wk5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>4.99 (0.85)</td>
<td>7.84 (0.67)</td>
<td>8.82 (0.72)</td>
<td>3.81 (0.66)</td>
<td>5.33 (0.61)</td>
<td>5.45 (0.54)</td>
</tr>
<tr>
<td>Tapering</td>
<td>4.94 (0.66)</td>
<td>7.71 (0.72)</td>
<td>5.85 (0.52)</td>
<td>3.73 (0.55)</td>
<td>5.48 (0.62)</td>
<td>5.25 (0.57)</td>
</tr>
</tbody>
</table>

The result of t-test showed that the IL-6 concentrations between two training groups were significantly different (P<0.05). Means at the end of week 4 were 57% greater than those at the beginning the training protocol. After one week of tapering IL-6 concentrations declined 24% in the tapering group.

Plasma TNFα levels between the two training groups showed no significant differences (p>0.05). The mean TNFα concentrations at the end of week 4 were 43% more than those at the day before beginning of the training protocol. After one week of tapering TNFα concentrations decline 4.2% in the tapering group.

DISCUSSION/CONCLUSIONS
This study showed that following four weeks of incremental training, post-exercise plasma levels of IL-6 and TNFα increased in elite male wrestlers. This elevation of pro-inflammatory cytokines can be attenuated after one week of tapering. In the tapering group with a 75% reduction in weekly training volume the plasma levels of these cytokines decreased. Continuation of incremental training in the control group lead to increasing the plasma levels of these cytokines. These findings agree with that reported by Nielsen et al. (2003) and Gokhale et al. (2007). Impairment of the immune system is influenced by different factors that are not presently known. The changes in the immune system related to exercise are impressive with changes in plasma cytokines and neuro-hormonal factors observed more than others (17,18). The studies show that high levels of IL-6 and TNFα during training are a part of the acute inflammatory response due to exercise. It is probable that systemic inflammation causes a catabolic state that is in part related to plasma cytokines and glucocorticoids (6,10). Smith (2000) reported that high levels of IL-6 and TNFα is a symptom of high volume of training (21). Elevation of these cytokines may lead to immune suppression. A greater incidence of infection among athletes is probably due to repetitive intense exercise with insufficient recovery.

According to the results of this study, high levels of IL-6 and TNFα in the control group may result from a high volume of training and thereby contribute to a higher rate of infection in athletes. These findings are similar to those reported by Gleeson et al. (2000) and Gokhale et al. (2007) and disagree with those reported by Tsukui et al. (2000). Elevation of these cytokines also prevent protein synthesis due to muscular proteolysis, which finally leads to impairment of performance (2). Following physical exercise, there are decreases in circulatory anabolic factors and increases in catabolic cytokines like IL-6 and TNFα (13). Elevation of these plasma cytokines is related to increased susceptibility to infection (Gleeson et al., 2004).

The release of IL-6 by the contractile muscles may be a sign for the liver to increase glucose output and it may also prevent a glucose concentration decline caused by training. If the training duration is decreased, or the recovery times between training sessions is increased, IL-6 secretion will be decreased (23), because of increasing muscle glycogen stores.

As our findings showed that after one week of tapering plasma levels of IL-6 decreased. This is most likely related to the increasing muscle glycogen during the tapering. Our findings support suggestions that a reduction in training volume prior to competition may reduce the negative effects of overtraining. Increases in the plasma levels of IL-6 and TNFα in wrestlers who continue incremental training seem to be related to a high volume of training and could indicate a greater susceptibility to infection.

**PRACTICAL APPLICATIONS**

According to the results of this study, a four-week incremental training program used with elite male wrestlers can significantly elevate post exercise plasma levels of IL-6 and TNFα. A tapering approach with a 75% reduction in weekly training volume may reverse these levels, while at the same time improve subsequent performance. The optimal length and amount of the training reduction needs to be refined.

**REFERENCES**