The Utility of IGF-I And IGFBP-3 as Markers of Training Status in Elite Swimmers

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Introduction

Insulin-like growth factor- I (IGF-I) plays an important role in mediating the anabolic effects of growth hormone (GH). IGF-I is also thought to play a direct role in training adaptations such as increased muscular strength and fitness. The majority (~75%) of IGF-I circulates bound to its principle binding protein, insulin-like growth factor binding protein-3 (IGFBP-3). IGFBP-3 is essential because it prolongs the half-life of IGF-I and acts to regulate its biological actions. It is well established that exercise can influence circulating levels of IGF-I and IGFBP-3. Numerous studies have investigated the effects of acute exercise on IGF-I and IGFBP-3, however, the effects of long-term training remain poorly documented. Studies have also suggested that IGF-I and IGFBP-3 concentrations are related to an individual's fitness and training status, however, this has not been examined over the course of a long-term training period.

Objective

The purpose of this study was to assess the effects of long-term swim training on resting levels of IGF-I and IGFBP-3 in elite swimmers. A second objective was to determine if changes in IGF-I or IGFBP-3 were associated with changes in fitness or symptoms of overtraining.

Design

This study employed a within-subject repeated measures design with three testing periods. At each period we measured resting levels of IGF-I and IGFBP-3, maximal aerobic power, body composition, nutritional status, and athletic performance.

Setting

Dept. of Kinesiology & Physical Education; Exercise Physiology Lab

Subjects

12 swimmers (5 males and 7 females) from the University of Lethbridge swim team volunteered for the study (20.1 ± 1.7 yrs). On average subjects had been swimming competitively for nine years. Initial VO_2 max = 47.6 ± 8.3 ml/kg/min; initial relative fat = 15.9 ± 5.8 %. (Mean ± SD)

Intervention/Main Outcome Measures

The study consisted of three testing periods. Initial testing took place in September prior to the onset of intensive training (week 0). The second testing period was eight weeks after the initial testing during a one-week tapering phase prior to competition (week 8). The last testing period was 16 weeks after initial testing, also during a one-week tapering phase (week 16).

During each testing period participants were required to attend two sessions on consecutive days at the Exercise Physiology Lab. Prior to each testing period participants kept a 3-day food record. During the first session, participants completed an overtraining questionnaire developed by the French Society of Sports Medicine (SFMS) and a resting blood sample was collected. During the second session fitness measurements were obtained, including: anthropometric measures (body mass index and skinfolds), maximal aerobic power (VO_2 max), and maximal blood lactate. In addition, the result of a time trial for each subject in their dominant event was obtained at each testing period. Serum samples were analyzed for IGF-I and IGFBP-3 concentration using Enzyme-linked Immunosorbent Assay kits (Diagnostic Systems Laboratories, TX, USA).

Main Results

There were no significant differences in resting serum IGF-I or IGFBP-3 concentrations across testing periods. When the IGF-I data were normalized to baseline values and expressed as percent change, there was a significant difference in results from 0 to 8 weeks (12 ± 16.7% increase in IGF-I) versus 8 to 16 weeks (-5 ± 12% decrease in IGF-I). A significant correlation between IGFBP-3 and scores on the SFMS questionnaire was found at week 0 (Fig 1; $r = 0.45$, $p<0.05$), however, this relationship did not persist after 8 or 16 weeks of training.

Conclusions

This study cannot confirm the hypothesis that resting levels of IGF-I and IGFBP-3 will change in response to training. Several factors may have influenced our results including the participants' initial fitness levels or the intensity of the training program.

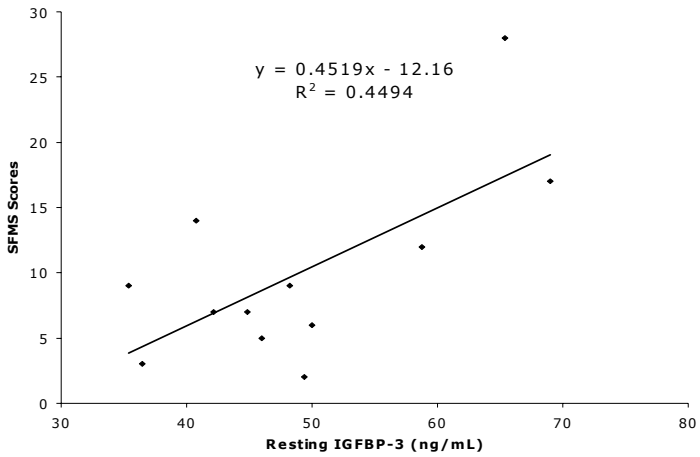

Figure 1. Relationship between IGFBP-3 and scores on the SFMS overtraining questionnaire at Week 0.

The small sample size was also a limitation as there was large individual variability in the IGF-I and IGFBP-3 response to training. There was a significant positive correlation between serum IGFBP-3 and scores on the SFMS questionnaire at week 0 which suggests higher IGFBP-3 levels in more fatigued athletes. This relationship did not persist and SFMS scores generally increased following 8 and 16 weeks of training while IGFBP-3 levels remained unchanged. There was no relationship between IGF-I or IGFBP-3 and any other measures of fitness or performance. These results suggest resting levels of IGF-I or IGFBP-3 may not be sensitive markers of training status in young athletes.

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