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Level of insulin-like growth factor in greco-roman wrestlers

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Key words: insulin-like growth factor, muscle damage, sport training, wrestlers

Summary

Introduction. IGF-I plays an important role in muscle regeneration and hypertrophy due to the ability to stimulate the activation, proliferation and differentiation of muscle satellite cells. The study was designed to estimate the level of insulin-like growth factor in wrestler during preparatory and competition training periods and its relation to muscle damage.

Material and methods. Six high-qualified wrestlers, members of national team, were observed during two training periods differed in type and intensity exercise. In serum, concentrations of insulin-like growth factor (IGF-I) was measured. Total creatine kinase (CK) activity was determined as a marker of muscle damage.

Results. Wrestlers demonstrated higher level of muscle damage at 24 h after the hard training session. Serum CK activity reached the higher values during competition than preparatory period. IGF-I concentration tended to high values in preparatory period. Analysis of percent changes in CK revealed that increase in muscle damage stimulates increase IGF-I concentration. IGF-I did not correlate with body composition.

Conclusions. The study has demonstrated that wrestling training period has not significantly influence on insulin-like growth factor I. However, the release of IGF-I to blood may be related to extent of skeletal muscle damage.

Introduction

The effectiveness of physical training depends on the training load, the individual toleration ability and an imbalance between the two may lead to under or over-training. One of the unique features of an exercise is that it leads to a simultaneous increase of antagonistic mediators. On the one hand, exercise elevates catabolic inflammatory mediators. On the other hand, exercise stimulates anabolic components such as insulin-like growth factor (IGF-I). If the anabolic response is stronger, exercise will probably lead ultimately to an increased muscle mass i.e. hypertrophy [1,2].

Both in vivo and in vitro studies have shown that IGF-I is key regulators of muscle mass. IGF-I is small peptide associating in plasma to high-affinity IGF-I binding proteins (IGFBP), which increase its half-life in circulation. Under normal conditions, 75-80% of circulation IGF-I remains bound to IGFBP-3 and the acid labile subunit in a ternary protein complex [3]. However, other tissues, including skeletal muscles, also express and produce IGF-I. It plays an important role in muscle regeneration and hypertrophy due to the ability to stimulate the activation, proliferation and differentiation of muscle satellite cells, but also they have indicated strong antidepressant-like effects [4,5]. IGF-I production is stimulated by growth hormone (GH). They share many similarities in their modes of action and it is in part due to the fact that binding of GH to certain GH receptors results in a signalling cascade that leads to the generation of IGF-I. The large part of IGF-I comes from liver, but this growth factor can be secreted locally in muscle cells in response to tissue injury and also it is produced centrally in brain [6]. Muscle-derived IGF-I plays an important role in reducing the chronic inflammatory response and promoting the muscle recovery [7].

The study was designed to estimate the level of insulin-like growth factor in wrestler during preparatory and competition training period and its relation to muscle damage and body composition.

Material and methods

Subjects. Six high-qualified Greco-Roman wrestlers, members of national team (Tab.1), were observed during preparatory (January) and competition training periods (in-season June). The training loads were demonstrated using program Trening 1.2. prepared by Department of Sport Theory at University School of Physical Education Warsaw (Tab. 2). The subjects were informed of the aim of the study and were given their written consent for participation in the project. The protocol of the study was approved by the ethics committee at Medical University Poznan, in accordance with the Helsinki Declaration.

Body composition. Body mass (BM) and body composition were estimated using a bioelectrical impedance floor

Table 1. Anthropometric characteristic of wrestlers (N = 6)

	Age [years]	Body mass [kg]	High [cm]	BMI	FM [kg]	FFM [kg]	FM%
PREPARATORY January	21.8 ± 2.7	78.2 ± 13.1	175.5 ± 8.5	25.2 ± 2.6	10.5 ± 4.3	67.7 ± 9.8	13.2 ± 3.1
COMPETITION in season training June	21.8 ± 2.7	79.0 ± 12.4	175.5 ± 8.5	25.5 ± 2.1	10.0 ± 5.3	69.0 ± 7.8	12.2 ± 4.6

BMI body mass index, FM fat mass, FFM free fat mass.

Table 2. Exercise intensity during training periods

Training period	Type of training	Training load %
PREPARATORY January	Endurance Directed Special/wrestling	53 9 38
COMPETITION in season training June	Endurance Directed Special/wrestling	55 10 35

Endurance training: team games, marches and cross-country running, cross-country skiing, acrobatic exercises, climbing at ropes, pull ups, exercises with partner.
Directed training: intervals, toss from knees, back suples, reverse waist, turns, gym.
Special/wrestling training: elevation from the low position, keys, trolleys, throws with different amplitude of movement.

scale (Tanita Body Composition Analyser BC-418MA, Japan) calibrated in accordance with manufacturer guidelines prior to each test session. One hour following a light breakfast, participants voided their bladder and bowels and, clad only in briefs, underwent duplicate measures while in the standing position recommended by the manufacturer guidelines.

Biochemical measurement. Blood samples were taken from the elbow vein at 8 a.m. after 15 minutes of rest (and an overnight sleep). After collection, the samples were immediately placed in 4°C temperature. Within 10 min, they were centrifuged at 3000 g and +4°C for 10 min. Aliquots of serum were stored at -80°C.

Serum creatine kinase (CK) activity was used as a marker of muscle damage and was evaluated by Emapol kit (Poland) at a temperature of 20-25oC. CK detection limit for the applied kit was 6 U . l-1. The intra-assay coefficient of variation for the CK kit was 1.85%. CK activity was determined 3-fold (I, II and III measurement) during the second week of training camp in Central Sports Centres in Zakopane (preparatory period) and Giżycko (competition period).

Serum total insulin-like growth factor (IGF-I) concentration was determined by enzyme immunoassay methods using commercial kits R&D Systems (USA). Detection limits for IGF-I was 0.026 ng . ml-1. The average intra-assay coefficient of variation was <4.5%. IGF-I concentration was determined in blood samples collected during III measurement of CK activity.

Statistical analysis. Statistical calculations were performed using STATISTICA 9.0. Statistical significance was assessed by repeated analysis of variance (ANOVA). Associations among measured parameters were analyzed using Pearson's linear regression (coefficient, r). Statistical significance was set at P<0.05. Results are expressed as mean and standard deviation (x ± SD).

Results

As expected, wrestlers had higher level of muscle damage at 24 h after the hard training session (Tab.3). CK reached the highest values >2000 U . L-1 at II measurement (January) and III measurement (June). IGF-I concentration was similar in both training period but it tended to high values in preparatory period.

Table 3. Changes in serum creatine kinase (CK) activity and insulin-like growth factor (IGF-I) concentration

	CK [U . L^{-1}]			IGF-I [pg . mL^{-1}]
	I	II	III	
PREPARATORY January	691 ± 478	2479 ± 1032	721 ± 186	137 ± 30
PREPARATORY January	307 ± 220	2010 ± 631	2920 ± 764*	105 ± 30

significant differences (P<0.05) between preparatory and competition period

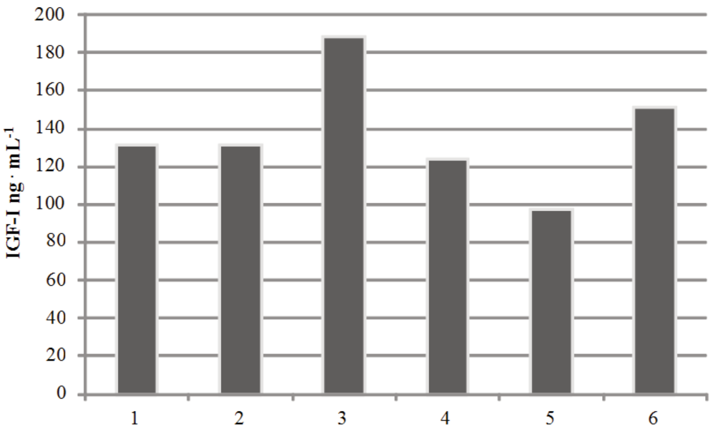

Figure 1. Individual concentration of insulin-like growth factor (IGF-I) in six wrestlers during preparatory period (January)

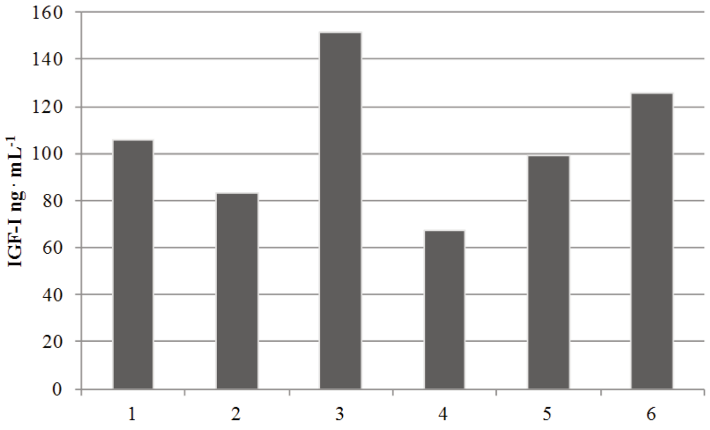

Figure 2. Individual concentration of insulin-like growth factor (IGF-I) in six wrestlers during competition period (June)

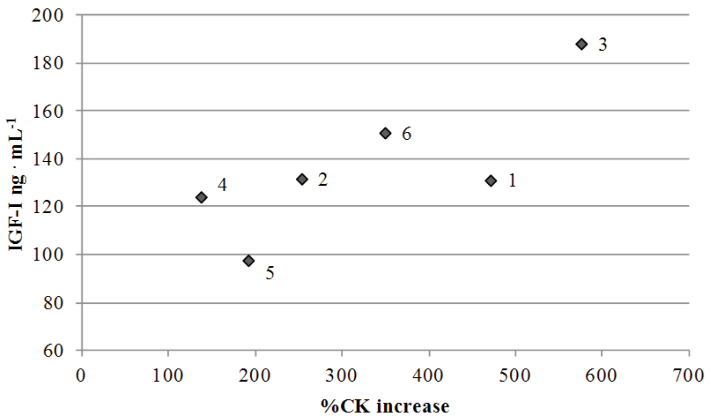

Figure.3. Relationship between percent of increase in serum creatine kinase (CK) activity and concentration of insulin-like growth factor I (IGF-I) at 24 h after hard training session during preparatory period (January)

Also, individual analysis changes in IGF-I shown elevated values in preparatory period compared to competition one (Fig.1-2).

Moreover, analysis of percent changes in CK revealed that increase in muscle damage stimulates increase IGF-I concentration in preparatory period (Fig. 3). However, IGF-I did not correlate with free fat mass and other variables of body composition.

Body composition was similar in both training periods however body mass was elevated during competition. The increase in body mass was probably connected with increase in free fat mass and slow decrease in fat mass.

Discussion

Disruption of the myofiber integrity is reflected by increased blood level of muscle proteins, such as creatine kinase, myoglobin, lactate dehydrogenase, troponin etc. In human and animal models, increased serum CK activity is observed after mechanical stress (e.g. extensive physical exercises) and in the course of muscle degenerative diseases [8]. Athletes, as a rule, have higher serum/plasma CK activity than non-athletes because of the regular strain imposed by training on their muscles [9]. Brancaccio et al. [8] reported that significant increase of CK was observed after fourth day of football training and then was dropping till tenth day of training, what is likely an adaptation to exercise. In the present study, serum CK activity was elevated >2000 U. L-1 in both training periods which indicate the presence of muscle damage.

A well designed study by Barbas et al. [10] on Greco-Roman wrestlers while five matches in one-day tournament, has shown that values of serum CK reached the highest level in the last of the five matches. In our study, wrestlers had the highest level of CK in competition (June) compared to preparatory period (January). The increase in CK activity was accompanied by high concentration of IGF-I. It suggests the muscle damage is the necessary component inducing a release of IGF-I and muscle reconstruction in athletes. IGF-I increases muscle mass and strength in two main ways. First, IGF-I acts directly on the muscle fibers to increase protein synthesis and muscle mass. It also drives activated satellite cells (a stem cell like population residing close to muscle fibers and a source for replenishing nuclear content of the muscle) to fuse to existing muscle fibers, helping to repair damaged regions of the fibers and promote muscle growth [11]. However, according Nindl et al. [12], IGF-I is positively associated with aerobic fitness and muscular endurance, but not with measures of muscle strength or FFM. In our study, we did not observed any relation between IGF-I and FFM and other variables of body composition.

Conclusions

The study has demonstrated that wrestling training period has not significantly influence on insulin-like growth factor I. However, the release of IGF-I to blood may be related to extent of skeletal muscle damage.

Acknowledgments

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