International Journal of Human Sciences
ISSN:1303-5134

Volume: 8 Issue: 1 Year: 2011

Changes in the level of growth hormone, insulin like growth factor-1 and insulin like growth factor binding proteine-3 in young males 24 hours after submaximal training

Hakkı ÇOKNAZ[1]

Abstract

The study was accomplished as a control study, under the question whether 6-weeks endurance training affects the growth hormone (GH), insulin like growth factor-1 (IGF-1) and the IGF bindings protein-3 (IGFBP-3) levels. Sixty male subjects participated in the study. The subjects were separated into 2 groups as control (n=30; mean age=21,13±1,16 years) and study (n=30; mean age=21,53±1,61 years) randomly, prior to the runtest. Blood samples were drawn before breakfast and analyzed in the laboratory of the medical faculty of Abant Izzet Baysal University concerning GH, IGF-1and IGFBP-3. VO2max was measured in all individuals. The individuals experimental group trained 3 times a week (Monday, Wednesday, and Friday) for 6 weeks, on the other hand the control group had rest/rested for 6 weeks. Trainings included 30-40 minutes submaximal run on the treadmill, per day. After the last session of training, blood samples were drawn from all subjects following day before breakfast, and were analyzed similar to the first measurements. Then, all subjects (experimental and control groups) were subjected to VO2max measurement again. There were no differences within groups and between the groups in GH, IGF-1, IGFBP-3 levels before ($p>0.05$) and after the test ($p>0.05$). VO2max was found to be significantly higher in the study group compare to controls ($p<0.05$). We conclude that submaximal training does not affect the production of growth hormones, although it may increase oxygen consumption.

Keywords: Submaximal training; growth hormones

1 Abant İzzet Baysal University, School of Physical Education and Sport, Bolu, Turkey coknaz_h@ibu.edu.tr

Çoknaz, H (2011). Changes in the level of growth hormone, insulin like growth factor-1 and insulin like growth factor binding proteine-3 in young males 24 hours after submaximal training**.** *International Journal of Human Sciences* [Online]. 8:1. Available: http://www.insanbilimleri.com/en

Genç erkek bireylerin submaksimal antrenmanlardan 24 saat sonra büyüme hormonu (GH), insulin benzeri büyüme fatörü-1 (IGF-1) ve IGF bağlama proteini-3 (IGFBP-3) seviyelerindeki değişim

Hakkı ÇOKNAZ[1]

Özet

Bu çalışma, 6 haftalık antrenmanların büyüme hormonuna (GH), İnsulin Benzeri Büyüme Fatörü-1 (IGF-1) ve IGF Bağlama Proteini-3 (IGFBP-3)'e etkisi olup olmadığını belirlemek amacıyla yapılmıştır. Çalışmaya 60 genç erkek denek katılmıştır. Denekler rast gele seçim yöntemiyle iki gruba ayrılmıştır. 1. Grup: Kontrol Grubu (n = 30, yaş ortalaması = 21,13 ± 1,16 yıl), 2. Grup: Antrenman Grubu (n = 30, ortalama yaş = 21,53 ± 1,61 yıl) olarak belirlenmiştir. Araştırma öncesi ve sonrası kan örnekleri kahvaltıdan önce alınmış, Abant İzzet Baysal Üniversitesi Tıp Fakültesi laboratuarında analiz edilmiştir. Aynı şekilde deneklerin max VO2'leri araştırma öncesi ve sonrasında belirlenmiştir. Deney grubu haftada üç kez (pazartesi, çarşamba ve cuma) 30-40 dakikalık süre ile koşu bandı üzerinde submaksimal antrenmanlarını sürdürürken, kontrol grubu hiçbir antrenmana katılmamıştır.

Çalışma sonrasında deney grubunun maxVO2' lerinde artış görülürken ($p<0.001$), kontrol grubunda artış gözlenmemiştir ($p<0.07$). Yapılan kan analizlerinde GH, IGF-1 ve IGFBP-3 değerlerinde grup içerisinde ($p>0.05$) ve gruplar arasında ($p>0.05$) istatistiksel farka rastlanmamıştır. Sonuç olarak, submaksimal antrenmanlar genç bireylerde maxVO2 artışına etki ederken, GH, IGF-1ve IGFBP-3' e istatistiksel olarak etki etmemiştir.

Anahtar Kelimeler: submaksimal antrenman; büyüme hormonları

1 Abant İzzet Baysal Üniversitesi, Beden Eğitim ve Spor Yüksekokulu, Bolu, coknaz_h@ibu.edu.tr

Çoknaz, H (2011). Changes in the level of growth hormone, insulin like growth factor-1 and insulin like growth factor binding proteine-3 in young males 24 hours after submaximal training. *International Journal of Human Sciences* [Online]. 8:1. Available: http://www.insanbilimleri.com/en

Introduction

Growth hormone (GH) is a hormone with a pulsatil profile and is secreted on a 3-5 hourly rhythm (Powers, 2005). Secretion of GH can be stimulated by different physiological influences. Exercises and sleeping are the strongest activators (Godfrey, et al., 2003). Insulin like growth factor-1 (IGF -1) is polypeptide hormone, which is excreted through the liver (Mejri, et al., 2005; Turgut, et al., 2003). Insulin like growth factor binding proteine-3 (IGFBP-3) is a glycoprotein, which transports IGF-1in the blood circulation. In addition to this action, IGFBP-3shows many more complicated effects. It modulates the endocrine and parakin effects of the IGF-1 hormone, as well as the independent effects of the target cells of the IGF hormone (Mejri, et al., 2005).

Some authors express that training has an increased effect on the basal level of GH (Vasankari, et al., 1993), but others postulate other opinions (Zaccaria, et al., 1999). Also, the effects of the endurance training experienced a considerable public and scientific attention on growth with young people in the past years. Although, earlier studies questioned the use of force training on children, newer studies pointed the use out, both on children and on adults. The need for investigation about the effects of training with different conditions to detect the optimal intensity and the training extent for young people has been reported (Falk, & Eliakim, 2003). Actually the changes in growth hormones just after training and a few hours after training have been studied previously. Generally such studies investigated the changes in growth hormones 15 and 60 minutes after the training (Mejri, et al., 2005). However, it is not clear how long this effect continues, and when the level hormones become normal. This study was conducted to point out the changes in the level of GH, IGF-1, and IGFBP-3 24 hours after the last exercise of a 6 week submaximale training program, to see whether they come to normal or not.

Methods

The study begun after the approval of the ethical committee of the Medical Faculty of the Abant Izzet Baysal University, Bolu (Turkey). Sixty male subjects participated in the study, ams randomly assigned into two groups as experimental (Group E) and the control group (Group C), each consisted of 30 male participants. The participants were included to the study after informed consent. Furthermore, the participants were examined for any disease that could cause any restriction in the study. The groups were asked not to change

their nutritional habits during the time of the study. Blood samples were taken 24 hours prior to first exercise in the morning before breakfast, and analyzed in the laboratory of the Medical Faculty of Abant Izzet Baysal University for determining the levels of GH, IGF-1, and IGFBP-3 using the method described before (Babson, 1991). Following the first blood test VO_2max was measured in all individuals on a moving walkway/treadmill (h/p/cosmos quasor 4.0, Germany) with an increase angle of 1.5%. After a three-minute- standing on the treadmill, individuals walked on the treadmill for three minutes at 3 km/h, and started to run with the speed of 10 km/h without pause. The speed was increased 2 km/h in every 3 minutes until a subjective overload was reached. The oxygen uptake was measured with an ergospirometry (Ergotest 680, ZAN, Germany) with the method described before (Mellwig, et al., 2009). The individuals in group E trained 3 times per week (Monday, Wednesday and Friday) with an intensity counted of 70-80 % of VO_2max. Training lasted between 30 - 40 min. per training, and was performed on the treadmill. The temperature in training area was kept between 21-23°C. The study lasted 6 weeks. Individuals in the control group were asked to refrain from any physical activity during this period of time. The blood sample collection was performed from all participants in both groups again 24 hours after the last training of group E. Tests were repeated to see the effects of training, and groups were compared. The results are represented as average values ± to standard deviation. The data was distributed normally. The Independent Samples test was used for the comparison of the groups and the Paired Samples test was used for the comparison of the data in the respective group. A p-value < 0, 05 was rated as significant.

Results

In this study the mean age of the individuals in group E was 21.53±1.61 years, their weight was on the average 68.24±7.37 kg, their body size was about 174, 67 ±4,31 cm. The mean age of the kg 21,13±4.31 their mean weight was 6 7, 04 ±9, 78 kg, their mean body size was 17 6, 23 ± 6.65 cm.

Çoknaz, H (2011). Changes in the level of growth hormone, insulin like growth factor-1 and insulin like growth factor binding proteine-3 in young males 24 hours after submaximal training**.** *International Journal of Human Sciences* [Online]. 8:1. Available: http://www.insanbilimleri.com/en

Table 1. Comparative of values $VO_{2\,max}$ test

Groups	**Before submaximal training**	**After submaximal training**	**p *values***
Group E	47,25 ± 2,99	49,68 ± 3,03*Δ	0,001
Group C	46,16 ± 2,37	47,02 ± 2,50	0,07
***p* values**	0,12	0,001	

Vales are mean ±SD.
**p<0.001* compared with before submaximal training *i*n the group E.
Δ *p<0.001* compared with group C after submaximal training.
VO_2max: ml· kg $^{of\text{-}1\cdot}$ min $^{-1}$. Group E: Experimental. Group C: Control.

The VO_2max values were presented in table 1. VO2max did not change in the control group, but increased significantly in group E after 6 week training ($p<0.05$). There are no significant differences in VO2max between the groups before the test, but after 6 week training it was found to be significantly higher in Group E than that of group C ($p<0.05$).

Table 2. Comparative of values GH, IGF-1, and IGFBP-3

Groups	**Before submaximal training**	**After submaximal training**	**p values**
Group E (GH, ng/mL)	1,08 ± 1,78	0,83 ± 1,67	0,08
Group C (GH, ng/mL)	1,21 ± 2,14	0,92 ± 2,21	0,59
***p* values**	0,79	0,86	
Group E (IGF-1, ng/mL)	202,97 ± 38,89	206,37 ± 24,80	0,67
Group C (IGF-1, ng/mL)	212,43 ± 38,89	214,33 ± 29,76	0,76
***p* values**	0,35	0,26	
Group E (IGFBP-3, ng/mL)	5.06 ±0, 52	4.93 ±0, 68	0,23
Group C (IGFBP-3, ng/mL)	4, 81 ±0,6 3	4.82 ±0, 59	0,97
***p* values**	0,10	0,48	

Vales are mean ±SD. Group E: Experimental. Group C: Control. GH:Growth hormone. IGF-1: Insulin Like Growth Faktor-1. IGFBP-3: Igf binding proteine-3.

GH, IGF-1and IGFBP-3 values of the groups are presented in table 2. There was no difference in GH, IGF-1, IGFBP-3 levels between groups before and after training ($p>0.05$). Hormone levels did not change significantly within groups either ($p>0.05$).

Discussion

The main finding of this study is that the levels GH, IGF-1, and IGFBP-3were found to be normal 24 hours after the last exercise of 6 week submaximal training program, although oxygen consumption has been increased. This finding show that baseline value of these hormones is not affected from submaximal training, and becomes normal even after 24 hors. In different studies it was shown that regular training, of an extent of 3 training units per week, increases VO_2max. Similar to previous studies in this study higher VO_2max values were determined in the EG group before and after the test. We performed the second VO_2max test after we took the blood for hormone test. If we did so, hormone levels would be affected from the test. It was reported in the literature that there is a correlation between IGFBP-3 and VO_{2max} (Le Mura, et al., 1999). In our study we did not find such a correlation 24 hours after last training. This difference in correlation may be related to the time interval after the exercise.

Training promotes the endocrinological changes for the homeostasis of the body. One of these endocrinological changes is the excretion of GH. Different opinions were postulated about the excretion of GH. The reason for the increase of the GH after training is thought to be the lactate, the hydrogen concentration, the catecholamine and the increased body heat. But the determining factors for the excretion are still not clear (Langfort, et al., 2001). A direct relationship between the excretion of the GH of hormone and the excretion of IGF-1and IGFBP-3has been reported (Koistinen et al., 1996; Koziris, et al., 1999). However, there is no agreement/consensus between the authors about these hormones. Some authors state that intensive training causes the basal level of the IGFBP-3hormones to decrease, and there is a negative correlation between the intensity of training and the secretion of IGFBP-3which may show the degree of training (Bouix, et al., 1997). There are also studies showing that submaximal training increases the basal level of these hormones (Mejri et al., 2005; Vasankari et al., 1993; Koziris, et al., 1999). In our study basal levels of the GH, IGF-1and IGFBP-3hormones did not change after a 6 week training period. In a recent study, Eliakim et

al studied that the effect of a single exercise as well as exercise training on the growth hormone (GH)-insulin-like growth factor (IGF-1) axis and inflammatory cytokines mainly in adults participating in individualized endurance-type sports. Blood samples were collected just before and immediately after the practice. Exercise led to significant increases in GH, testosterone, and IL-6 in men and women, but did not affect IGF-1, insulin-like growth factor binding protein-3, and cortisol levels. They suggested that changes in GH and testosterone after the volleyball practice may be due to exercise-related anabolic adaptations. In the liver IGF-1-deficient (LID) mouse model, Matheny et al (Matheny, et al., 2009) found that in twelve- to 13-month-old male LID and control (L/L) mice subjected to 16 weeks of resistance training resistance exercise resulted in equal strength gains. They suggested that; performance and recovery in response to resistance training is normal even when there is severe deficiency of circulating IGF-1. They also suggested that upregulation of local IGF-1 may be involved in the compensatory growth of muscle that occurs in response to resistance training. In another study, Buresh et al (Buresh, et al., 2009) compared that the effects of different between-set rest periods (1 and 2.5 minutes) on changes in hormone response, strength, arm cross-sectional area (CSA), thigh muscular cross-sectional area (MCSA), and body composition during a 10-week training period. In week 1, postexercise plasma testosterone levels were greater in SR than in LR, and postexercise cortisol levels were greater in SR than in LR. Week 1 postexercise GH levels were not different. The differences between hormone levels in weeks 5 and 10 were not significant. The differences in our findings from the previous studies may be related to the time of the measurement that we measured the hormone levels 24 hours after the last exercise. However, we can not comment about the changes in hormone levels just after the exercise, because we did not measure the levels of these hormones during that time which is a limitation of our study.

As a result, we conclude that normal levels of GH, IGF-1, and IGFBP-3 are achieved 24 hours after the last exercise of a 6 week submaximal training program, although oxygen consumption is increased.

Çoknaz, H (2011). Changes in the level of growth hormone, insulin like growth factor-1 and insulin like growth factor binding proteine-3 in young males 24 hours after submaximal training**.** *International Journal of Human Sciences* [Online]. 8:1. Available: http://www.insanbilimleri.com/en

References

- Babson, A.L. (1991). The Cirrus Immulite: a new random access automated immunoassay system. *Journal of Clincal Immunoassay*, 14, 83-8.
- Bouix, O., Brun, J., Fedou, C., Micallef, J., Charpiat, A., Rama, D., & Orsetti, A. (1997). Exploration de gymnastes adolescents de classe sportive: quelle suivi médical pour la croissance et la puberte? *Science & Spor*, 12(1), 51-65.
- Buresh, R., Berg, K., French, J. (2009). The effect of resistive exercise rest interval on hormonal response, strength, and hypertrophy with training. *Journal of Strength and Conditioning Research*, 23(1), 62-71.
- Falk, B. & Eliakim, A. (2003). Resistance training, skeletal muscle and growth. *Pediatric Endocrine*, 1(2), 120-7.
- Godfrey Rj, Madgwick Z., & Whyte G.P. (2003). The exercise-induced growth hormone response in athletes. *Sports Medicine*, 33(8), 599-613.
- Koistinen, H., Koistinen, R., Selenius, L., Ylikorkala, Q., & Seppälä, M. (1996). Effect of marathon run on serum IGF-I and IGF-binding protein 1 and 3 levels. *Journal of Applied Physiology*, 80(3), 760-4.
- Koziris, L., Hickson, R., Chatterton, R., Groseth, R., Christie, J., Goldflies, D., & Unterman, T. (1999). Serum levels of total and free IGF-I and IGFBP-3are increased and maintained in long-term training. *Journal of Applied Physiology*, 86(4), 1436-42.
- Langfort, J., Zarzeczny, R., Nazar, K.& Kaciuba-Uscilko, H. (2001). The effect of low-carbohydrate diet on the pattern of hormonal changes during incremental, graded exercise in young men. *International Journal of Sport Nutrition and Exercise Metabolism*, 11(2) 248-57.
- Le mura L., M., Dullivard S., P., Carlonas R., & AndreaccI, J. (1999). Can exercise training improve maximal aerobic power (VO2max) in children: A meta-analytic review. *Journal Exercise Physiology online*, 2(3), 1-22,
- Matheny, R., Merritt, E., Zannikos, S.,, Farrar, R., & Adamo, M. (2009). Serum. IGF-I-deficiency does not prevent compensatory skeletal muscle hypertrophy in resistance exercise. *Experimental Biology & Medicine*, 234(2), 164-70.
- Mellwig, K.P., Fruend, A., Van Buuren, F., Schmidt, H.K., Treusch, A., Langer, C., Butz, T., Odenburg, O., Hallmaier, B., Baum, K. & Horstkotte, D. (2009) Entwicklung Der Maximalen Sauerstoffaufnahme Bei Den Spielern Der Deutschen Männer-Handball-Nationalmannschaft. *Deutsche Zeitschrift für Sportmedizin*, 60(1), 4-6
- Mejri, S., Bchir, F., Ben Rayana Mc., Ben Hamida, J., & Ben Slama, C. (2005). Effect of training on GH and IGF-1responses to a submaximal exercise in football players. *European Journal of Applied Physiology*, 95(5-6), 496-503.
- Powers M (2005). Performance-Enhancing Drugs. in Deidre Leaver-Dunn; Joel Houglum; Harrelson, Gary L(Ed.), Principles of Pharmacology for Athletic Trainer (pp. 331–332). Slack Incorporated.
- Turgut, G., Kaptanoglu, B., Turgut, S., Genç, O.& Tekintürk, S. (2003). Influence of acute exercise on urinary protein, creatinine, insulin-like growth factor-I (IGF-I) and IGF binding protein-3 concentrations in children. *The Tohoku Journal of Experimental Medicine,* 201(3), 165-70.

- Vasankari, T.J., Kujala, U.M., Taimela, S. & Huhtaniemi L.T. (1993). Pituitary-gonadal response to gonadotropin-releasing hormone stimulation is enhanced in men after strenuous physical exercise. *Acta Endocrinol (Copenh*), 129(1), 9-14.
- Zaccaria. M., Varnier, M., Piazza, P., Noventa, D.& Ermolao, A. (1999) Blunted growth hormone response to maximal exercise in middle-aged versus young subjects and no effect of endurance training. *The Journal of Clinical Endocrinology Metabolism*, 84(7), 2303-7.