PHYSICAL EDUCATION OF STUDENTS

The effect of acute exercise and gender on the levels of irisin in elite athletes

Arıkan Ş.[ABCDE]

Faculty of Sports Sciences, Department of Trainer Education, Selçuk University, Konya, Turkey

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: Irisin is defined as a myokine secreted by skeletal muscle contraction. Myokines are associated with energy metabolism and muscle regeneration capacity. They provide support for active muscles with acute or regular exercises. The aim of this study was to determine the effect of acute exercise on the hormone levels of irisin in taekwondo athletes.

Material: Thirteen volunteer elite taekwondo athletes (7 males, 6 females) participated in the study between the ages of 16-20. At the beginning of the study, participants' body compositions were determined. Blood samples were taken before and after acute exercise at 8:00 am after overnight fasting. Plasma irisin hormone analyzes were determined by Enzyme-Linked Immuno Sorbent Assay (ELISA) method. The analysis of the data was tested with two-factor (time-gender) analysis of variance in repeated measures.

Results: Significant differences were found between body weight, height and body fat percentage in both male and female athletes ($p<0.05$). There was no significant difference between the averages of age, sports experience and body mass index (p>0, 05). The effect of acute exercise and gender on irisin levels was not significant ($p>0.05$).

Conclusions: As a result, it can be said that acute exercise and gender did not affect the hormone levels of irisin in elite taekwondo athletes.

Keywords: irisin, acute exercise, gender, skeletal muscle, blood.

Introduction

Skeletal muscle is to be a secretory organ responsible for the production of hundreds of peptides classified as myokines [1, 2]. Irisin, a myokine that is linked to the recently-defined peroxisome proliferator-activated receptor -γ coactivator -1α (PGC-1α) is released from the skeletal muscle [3]. The irisin hormone stimulates the fibronectin type III domain containing 5 (FNDC5)'s expression [4]. FNDC5 divided into parts and ensures the increase of energy expenditure thanks to exercise [5. 6]. Irisin takes part the circulation and connects with the white adipose tissue receptor [3]. Irisin, stimulating the uncoupling protein-1 (UCP1) secretion, causes the white adipose tissue to transform into a brown adipose tissue that has more mitochondrias [7]. It has been reported that irisin increases the expression of the genes for oxygen and energy consumption [3]. It reports that irisin plays an important role in obesity and metabolic disorders [8].

Many studies conducted after the discovery of irisin revealed controversial results in terms of circulating levels of irisin, especially after exercise The studies reported that acute or chronic exercise has an important effect on the increase of the irisin levels [9, 10]. In addition, there are studies that exercise has no impact on the irisin level [11, 12] or has reductive impacts on it [13, 14].

In the literature, I observed that the subjects were not high level athletes. I have found that the studies on the determination of the acute endocrine responses taking place after the fight contact sports were highly insufficient. In this study, the objective is set to determine the effect of acute exercise and gender on irisin of the elite taekwondoists in the Turkish national team.

Material and Methods

Participants: Elite-level male (n=7, age=19.29 ±0.57 years) and female (n=6, age=20.17±0.87 years) taekwondoists participated in the study. Athletes have been composed of Turkish national team who won various degress in European, World and Olympic. Prior to the study, the subjects were examined by a physician. Their written permissions specifying that they are ready to participate in it were received. The study was conducted in compliance with the Helsinki Declaration and approved by the local ethics committee at Faculty of Sports Sciences, Selçuk University.

General design of the study: The body composition measurements of the subjects were taken at 8:00 am after staying hungry at the previous night. Blood samples were taken before and immediately after acute exercise under equal conditions. The subjects were warned not to perform heavy physical activities until at least 48 hours. They were told not to use any drug or liquid food that could affect the values.

Determination of body composition: The body heights (cm) of the volunteers were measured by using a Seca-brand mechanic weight with height measuring mechanism with 1 mm sensitivity. Their body weights (kg) were determined at 100 g sensitivity with their outfits of shorts and t-shirts. The body mass index (BMI) was calculated by dividing the body weight (kg) by the body height (m) square [15]. To determine the percentage of the body fat, a Holtain skinfold caliper was used applying 10 g/sq mm pressure at every angle. Triceps, biceps, subscapularis and suprailiac skinfold thicknesses were taken and body fat

doi:10.15561/20755279.2018.0604

was determined [16].

Acute exercise: After 30 minutes of general warm-up, the athletes completed 25 minutes main technical repetition, a binary loading competition, a high level of technical work and 15 minutes cooldown. Taekwondo training, which was 120 minutes in total, was applied in %70-80 intensity.

Biochemical analysis: After an overnight fasting, the blood samples were taken by the health personnel at 8:00 a.m. in the morning before and after the exercise. The plasma samples were centrifuged at $+4^0$C at 3000 rpm for 20 minutes and were frozen at -20^0C. Plasma irisin levels were determined by Enzyme-Linked Immuno Sorbent Assay (ELISA) method using commercial kits. Plasma total cholesterol, triglyceride and glucose levels were determined by Abbort-brand (Archıtect model) device.

Statistical analysis: Statistical analysis was performed using SPSS for Windows (version 16.0, SPSS Inc. Chicago, IL, USA). Arithmetic mean and standard error average of all variables obtained in the study were calculated.

The normal distribution and homogeneity of the data were examined. The effects of exercise and gender on plasma irisin level and other biochemical variables before and after exercise were tested. After post-hoc Bonferroni correction, it was tested with two-factor (time-gender) variance analysis in repeated measurements. In the variables where gender factor is important, the differences between the groups were analyzed by t test. The pre- and post-exercise changes in the variables where exercise factor is important were analyzed with t-test in dependent groups. The levels of statistical significance were set at $p<0, 05$.

Results

No significant difference between the age, sports experience, and body mass index averages of the male and female athletes were determined ($p>0, 05$). It was observed that the body weight, height and body fat percentage were significantly within the groups ($p<0, 05$) (Table 1).

The effect of acute exercise ($p=0.34$) and gender ($p=0.57$) on hormone levels of plasma irisin was not

Table 1. Physical characteristics of subjects

Indicators	Men			Women			p
	Ort	±	SEM	Ort	±	SEM	
Age [years]	19, 29	±	0, 57	20, 17	±	0, 87	0, 40
Sports experience [years]	8, 14	±	1, 03	8, 17	±	0, 60	0, 99
Body weight [kg]	72, 71	±	4, 78	57, 00	±	4, 11	0, 03*
Height [cm]	186, 43	±	3, 06	172, 67	±	1, 45	0, 00*
BMI [kg/m^2]	20, 79	±	0, 82	19, 03	±	1, 08	0, 22
Body fat, %	8, 91	±	0, 53	18, 40	±	1, 34	0, 00*

*p<0, 05 Significant differences among the groups; Body mass index (BMI)

Table 2. Effect of gender and the training irisin and biochemical variables

Variables	Group	Pre				Post				E	E×G	G
		Ort	±	±	SEM	Ort	±	±	SEM			
İrisin (ng/mL)	M	46, 14	±	±	11, 15	47, 76	±	±	10, 36	0, 34	0, 11	0, 57
	W	57, 92	±	±	8, 99	51, 85	±	±	6, 91			
Glucose (mg/dL)	M	84, 43	±	±	2, 62	103, 43	±	±	9, 06*	0, 00	0, 36	0, 66
	W	82, 50	±	±	4, 26	113, 17	±	±	11, 03*			
Total Cholestrol	M	7, 29	±	±	0, 21	8, 49	±	±	0, 72	0, 08	0, 88	0, 59
	W	6, 90	±	±	0, 43	8, 30	±	±	0, 85			
Triglycerides	M	80, 29	±	±	12, 14	95, 14	±	±	13, 89	0, 01	0, 48	0, 25
	W	57, 83	±	±	7, 60	82, 00	±	±	8, 47			

* Significant difference in pre-exercise values (p<0, 05); ¥p<0, 05 Significant differences among the groups; E= Effect of exercise; G= Effect of gender; E×G= Exercise-gender interaction; M=men; W=women.

significant. There was no significant change in the hormone level of irisin after acute exercise in both women and men. Changes in the hormone level of irisin after acute exercise were not different significantly in male and female athletes (p=0.11). The effect of acute exercise on glucose (p=0.00) and triglyceride (p=0.01) was significant (Table 2).

Discussion

The irisin is a miyokine that plays a significant role in the regulation of metabolic systems [3]. Hence, numerous studies were conducted on how the irisin is affected by training but contradictory results were obtained. In many studies conducted on humans and rodents, presence of a relation between the irisin levels and energy consumption was identified [17, 18]. There is a positive correlation between acute exercise and circulating levels of irisin [19, 20]. Huh et al. [20] reported that acute whole-body vibration exercise increased the level of irisin, but there was no change in irisin levels after a 6-week training program. Likewise, Tsuchiya et al. [21] compared the levels of irisin in the male individuals in different types of exercises. The results of the study showed that endurance exercises resulted in a more significant increase than the exercises performed in combination (resistance + endurance).

The results of present study are incompatible with the above studies, which report that acute exercise has an increasing effect on the levels of irisin. In this study, acute exercise and gender did not affect the levels of irisin in athletes. In addition, it was concluded that the changes of irisin levels were similar in both male and female athletes before and after exercise. In accordance with this study, Kurdiova et al. [12] reported that acute exercises of endurance and strength training performed did not affect the levels of irisin in both sedentary and trained individuals. Pekkala et al. [22] found no difference in the levels of PGC-1α, FNDC5 and serum irisin in the skeletal muscle after a 1-hour low-intensity aerobic exercise in adult males. In the same way, Czarkowka-Paczek et al. [23] reported that serum irisin levels of rats did not change after 60 minutes treadmill acute exercise.

In a different study to determine gender difference it was reported that irisin levels were higher in women than men but this difference was not statistically significant [24]. In this study, I have found determined that the irisin levels were higher in females than males as well even if there is no statistically significant difference.

This research has some limitations; Firstly, the individuals who participated in the research were informed about the nutritional contents of the night before the test days but were not checked. In addition, it appears that the groups in the articles referenced are mainly sedentary, obese, or ill, while this study consists of elite-level athletes.

Conclusions

As a result, it can be said that the irisin levels of elite athletes are not affected by acute exercise and gender. There are similarities and inconsistencies between the findings of present study and the results of other studies. Some of the inconsistencies may be caused by differences such as type, intensity and duration of exercise. In addition, hormone levels can be affected by many differences, such as gender, age, body composition, physical fitness, stress, sleep and measurement protocols.

Acknowledgements

This research was supported by the Selçuk University Scientific Research Projects Coordinatorship (S.U.-BAP, Konya, Turkey), (Project number: 16701677). The author thanks Şükrü Serdar Balcı, PhD for the statistical analysis. Also she thanks Serkan Revan, PhD for measurement of body composition.

Conflict of Interests

The author declares that there is no conflict of interest.

References

1. Yoon JH, Yea K, Kim J, Choi YS, Park S, Lee H, et al. Comparative proteomic analysis of the insulin-induced L6 myotube secretome. *Proteomics*. 2009;9(1):51–60. https://doi.org/10.1002/pmic.200800187
2. Henningsen J, Rigbolt KTG, Blagoev B, Pedersen BK, Kratchmarova I. Dynamics of the Skeletal Muscle Secretome during Myoblast Differentiation. *Molecular & Cellular Proteomics*. 2010;9(11):2482–96. https://doi.org/10.1074/mcp.M110.002113
3. Boström P, Wu J, Jedrychowski MP, Korde A, Ye L, Lo JC, et al. A PGC1-α-dependent myokine that drives brown-fat-like development of white fat and thermogenesis. *Nature*. 2012;481(7382):463–8. https://doi.org/10.1038/nature10777
4. Cunha A. Irisin—behind the benefits of exercise: Basic research. *Nature Reviews Endocrinology*. 2012;8(4):195–195. https://doi.org/10.1038/nrendo.2012.11
5. Lee P, Linderman JD, Smith S, Brychta RJ, Wang J, Idelson C, et al. Irisin and FGF21 Are Cold-Induced Endocrine Activators of Brown Fat Function in Humans. *Cell Metabolism*. 2014;9(2):302–9. https://doi.org/10.1016/j.cmet.2013.12.017
6. Panati K, Suneetha Y, Narala VR. Irisin/FNDC5 an updated review. *Eur Rev Med Pharmacol Sci*. 2016;20:689-97.
7. Zhang Y, Li R, Meng Y, Li S, Donelan W, Zhao Y, et al. Irisin Stimulates Browning of White Adipocytes Through Mitogen-Activated Protein Kinase p38 MAP Kinase and ERK MAP Kinase Signaling. *Diabetes*. 2014;63(2):514–25. https://doi.org/10.2337/db13-1106
8. Huh JY, Siopi A, Mougios V, Park KH, Mantzoros CS. Irisin in Response to Exercise in Humans With and Without Metabolic Syndrome. The Journal of Clinical Endocrinology & Metabolism. 2015;100(3):E453–7. https://doi.org/10.1210/jc.2014-2416
9. Tsuchiya Y, Ijichi T, Goto K. Effect of sprint training on resting serum irisin concentration — Sprint training once daily vs. twice every other day. *Metabolism*. 2016;65(4):492–5.

https://doi.org/10.1016/j.metabol.2015.12.006
10.Zhao J, Su Z, Qu C, Dong Y. Effects of 12 Weeks Resistance Training on Serum Irisin in Older Male Adults. *Frontiers in Physiology* [Internet]. 2017 Mar 22 [cited 2018 Dec 5];8. Available from: http://journal.frontiersin.org/article/10.3389/fphys.2017.00171/full. https://doi.org/10.3389/fphys.2017.00171
11.Benedini S, Dozio E, Invernizzi PL et al. Irisin: A potential link between physical exercise and metabolism-an observational study in differently trained subjects, from elite athletes to non-athlete people. *Hindawi Journal of Diabetes Research*. 2017;7:100-105.
12.Kurdiova T, Balaz M, Vician M, Maderova D, Vlcek M, Valkovic L, et al. Effects of obesity, diabetes and exercise on Fndc5 gene expression and irisin release in human skeletal muscle and adipose tissue: in vivo and in vitro studies: Human Fndc5 /irisin in prediabetes, type 2 diabetes and exercise. *The Journal of Physiology*. 2014;592(5):1091–107. https://doi.org/10.1113/jphysiol.2013.264655
13.Hecksteden A, Wegmann M, Steffen A et al. Irisin and exercise training in humans-results from a randomized controlled training trial. *BMC Med.* 2013;11:235. https://doi.org/10.1186/1741-7015-11-235
14.Qiu S, Cai X, Sun Z et al. Chronic exercise training and circulating irisin in adults: A meta-analysis. *Sports Med.* 2015;45:1577-88. https://doi.org/10.1007/s40279-014-0293-4
15.American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. Sixth Edition. USA. Lippincott. Williams&Wilkins, 2000.
16.Durnin JV, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. *Br J Nutr.* 1974; 32: 77-97. https://doi.org/10.1079/BJN19740060
17.Roca-Rivada A, Castelao C, Senin LL et al. FNDC5/irisin is not only a myokine but also an adipokine. *PLoS One.* 2013;8:e60563. https://doi.org/10.1371/journal.pone.0060563
18.Stengel A, Hofmann T, Goebel-Stengel M et al. Circulating levels of irisin in patients with anorexia nervosa and different stages of obesity--correlation with body mass index. *Peptides*. 2013; 39: 125-30. https://doi.org/10.1016/j.peptides.2012.11.014
19.Sanchis-Gomar F, Perez-Quilis C. İrisinemia: A novel concept to coin in clinical medicine? *Ann Nutr Metab.* 2013;63:60-61. https://doi.org/10.1159/000354090
20.Huh JY, Mougios V, Skraparlis A et al. Irisin in response to acute and chronic whole-body vibration exercise in humans. *Metabolism*. 2014;63: 918-921. https://doi.org/10.1016/j.metabol.2014.04.001
21.Tsuchiya Y, Ando D, Takamatsu K et al. Resistance exercise induces a greater irisin response than endurance exercise. *Metabolism*. 2015;64(9):1042-50. https://doi.org/10.1016/j.metabol.2015.05.010
22.Pekkala S, Wiklund PK, Hulmi JJ et al. Are skeletal muscle FNDC5 gene expression and irisin release regulated by exercise and related to health? *J Physiol.* 2013;591:5393-5400. https://doi.org/10.1113/jphysiol.2013.263707
23.Czarkowska-Paczek B, Zendzian-Piotrowska M, Gala K et al. Onesession of exercise or endurance training does not influence serum levels of irisin in rats. *J Physiol Pharmacol*. 2014;65:449-54.
24.Anastasilakis AD, Polyzos SA, Saridakis ZG et al. Circulating irisin in healthy, young ındividuals: day-night rhythm, effects of food ıntake and exercise, and associations with gender, physical activity, diet, and body composition. *J Clin Endocrinol Metab.* 2014; 99(9):3247-3255. https://doi.org/10.1210/jc.2014-1367

Information about the author:

Arıkan Ş. (Corresponding author); http://orcid.org/0000-0002-2625-0898; sarikan@selcuk.edu.tr; Faculty of Sports Sciences, Department of Trainer Education, Selçuk University; Alaaddin Keykubat Campus, 42075, Selçuklu/Konya, Turkey.

Cite this article as: Arıkan Ş. The effect of acute exercise and gender on the levels of irisin in elite athletes. *Physical education of students*, 2018;22(6):304–307. doi:10.15561/20755279.2018.0604

The electronic version of this article is the complete one and can be found online at: http://www.sportedu.org.ua/index.php/PES/issue/archive

Received: 19.09.2018

Accepted: 17.10.2018; Published: 26.12.2018