OPEN ACCESS
Freely Available Online

JOURNAL OF WOMAN'S REPRODUCTIVE HEALTH
ISSN NO: 2381-862X

Research Article

DOI : 10.14302/issn.2381-862X.jwrh-17-1750

Effect of 8 Weeks Exercise on Irisin in Obese Women

Vahid Sari_Sarraf[1], Saeid Nikoukheslat[1], Zahra Niknam[2,*]

[1]Associate Professor of Exercise Physiology, University of Tabriz

[2]PhD candidate of Exercise Physiology, University of Tabriz

ABSTRACT

BACKGROUND:

The prevalence of obesity and type2 diabetes is escalating at an alarming rate in many developed as well as developing countries. Irisin is a novel muscle and adipose drived chemokine that is, proteolytically processed from the product of the FNDC5 (fibronectin type ш domain containing 5) gene. The purpose of this study is to examine the effect of three kind of training on irisin in sedentary obese women. METHODS33 obese women (medium age: 37.99 ± 3.7 year, height: 1.55 ± 0.03 meter, BMI: 34.6 ± 5.07 kg/m^2) participated in the study, on three groups, including endurance, resistance and concurrent.

RESULTS:

After 8 weeks exercise we did not find significant differences in fasting glucose, insulin, HOMA-IR and irisin between the groups (P>0.05), but glucose and insulin in resistance groups and irisin in all groups had significant changes (P<0.05).

CONCLUSIONS:

In summery in this study in contrast to hypothesis there were no difference between groups of training. It can be hypothesise that the increase of irisin in obese people is one of the preventing ways against of obesity's side effects. Exercise could improve the signaling pathways and consume the fat accumulations, therefore at the end of exercise duration, irisin decreased.

Corresponding author: Zahra Niknam, Department of Physical Education and Sport Science, University of Tabriz, Street of 29 Bahman, Tabriz, Iran. E-mail: zniknam@tabrizu.ac.ir

Key words: Exercise, Obesity, Irisin, Women

Received: Aug 27,2017 **Accepted**: Oct 23,2017 **Published:** Oct 30, 2017

Introduction

Discovery of myokines has emphasized the role of muscle as an important source of exercise-induced hormones to communicate information and interact with other tissues, including fat, the liver, and the pancreas, to alter metabolism (1).

Metabolic diseases such as obesity and diabetes are undoubtedly some of the most challenging health issues of our times (2). The prevalence of obesity and type 2 diabetes is escalating at an alarming rate in many developed as well as developing countries and is basically a consequence of imbalance between energy intake and energy expenditure (3,4). Obesity on itself could be the source of other disease like type2 diabetes. The prevalence of obesity among the women is more than the men that may be because of the lowest knowledge and lack of exercise and sport facilities in some countries (5,6). The health benefits of regular exercise are undisputed, thereby reduce the risk of lifestyle-related diseases, such as obesity but the molecular mechanisms are not completely understood (7).

Irisin is a novel muscle and adipose drived chemokine that is, proteolytically processed from the product of the FNDC5 (fibronectin type ш domain containing 5) gene. Both exercise and the PGC1α (peroxisome proliferator-activated receptor gamma coactivator 1 α) induce irisin expression. Irisin induces the browning of adipocytes and thermogenesis by increasing of UCP1 (uncoupling protein 1) level (8,9,10,11,12). It is mentioned that irisin could orchestrate many metabolic pathways (13,14,15,16,17,18), for example irisin has gained great interest as a potential new target to combat obesity and its associated disorders, such as type 2 diabetes mellitus (10).

Although circulating irisin was shown to increase in humans in response to exercise (8), but relevance of irisin in human physiology is not fully understood under effect of endurance, strength and in particular concurrent training obscure, and conflicting data in humans have recently emerged, thereby more researches are needed. It has been shown that although circulating irisin is associated with signs of metabolic syndrome and insulin resistance but it is differently regulated by training in normal versus overweight subjects (19,20,21,22,23,24,25,26). Some mechanism have suggested about the effect of irisin role in glucose uptake and lipid homeostasis (15, 16, 27, 28, 29). In diabetic mice, persistent subcutaneous perfusion of irisin improved the insulin sensitivity, reduced fasting blood glucose, increased GSK3 and Akt phosphorylation, glycogen content and irisin level, and suppressed GS phosphorylation, PEPCK and G6Pase expressions in liver. Irisin improves glucose homeostasis by reducing gluconeogenesis via PI3K/Akt/FOXO1-mediated PEPCK and G6Pase down-regulation and increasing glycogenesis via PI3K/Akt/GSK3-mediated GS activation. Irisin may be taken as a novel therapeutic strategy for insulin resistance and type 2 diabetes (16). But it is necessary to investigate it in different population and under different conditions like exercise, Then in this study it is tried to explore the effect of three kind of isocaloric exercise (Endurance, Resistance and concurrent) on irisin circulation in obese sedentary women.

Materials and methods

This study was carried out during the three month (July to August) in the Northwest of Iran, in the capital city of East-Azerbaijan, Tabriz. At first near the 200 obese women were enrolled by public announcement from different big sectors of the city. Finally according to inclusion criteria and the property of exercise program in many stages by cluster sampling method, all the remained women randomly assigned into endurance, resistance and concurrent exercise training groups on base of obesity. Some of subjects failed during the study and could not complete it. Lastly 33 obese and sedentary women participate in this study (endurance n=10, resistance n=12 and concurrent n=11). Subject characteristics are shown in table 1. The inclusion criteria required a BMI>25 kg/m^2 or a body fat percentage ≥ 30%. Subjects with a history of disease such as major cardiovascular disease, hemodialysis, asthma and other problems were excluded. This study was approved by the ethics committee of IR. TBZMED. REC. 1395. 927. Informed written consent was obtained from each subject. Participants were evaluated before and after the exercise training in all of the measurement (physiologic like irisin, insulin, glucose, HOMA-IR and anthropometric like BMI, Fat% and etc.). BMI (kg/m^2) and body composition was determined. Bio-impedance body composition analyzer was used. Also skeletal

Table 1 : subject characteristic in three exercised groups.

	Endurance		Resistance		concurrent	
	Pre	Post	Pre	Post	Pre	Post
Age (years)	39.6±3.1		37.1±4.2		37.27±3.8	
Height (m)	1.54±0.03		1.55±0.03		1.56±0.04	
Weight (Kg)	81.62±9.5	80.46±10.8	82.94±10.4	74.09±15.27	85.44±11.01	83.32±11.3
BMI (Kg/cm^2)	34.36±4.72	33.87±5.22	34.43±5.58	30.78±6.04	35.01±4.93	34.08±4.5
%Fat (%)	42.46±4.8	41.89±4.05	44.28±4.2	40.71±5.99	45.31±4.7	44.47±4.05
VO_{2max} (ml/Kg/min)	21.3±9.46	34.7±7.8	22.7±8.9	36.6±10.13	22.1±8.2	35.44±5.94

muscle mass (kg), body fat mass (kg), percent body fat (%) were measured. Blood samples were collected after overnight fasting. Serum Glucose was measured via enzymatic colorimetric assay using an autoanalyzer. Serum insulin and irisin were measured using an enzyme linked-immunosorbent assay (ELISA) commercial kit (Demeditec Insulin Elisa DE2935-Germany and Human Irisin Elisa Kit E3253Hu, Shanghai Crystal day Biotech Co., Ltd. With assay range: 0.2 ng/ml-60 ng/ml and Sensitivity: 0.095 ng/ml and intra-Assay: CV<8%, Inter-Assay: CV<10%).The homestasis model assessment of insulin resistance (HOMA-IR) was calculated as the product of fasting serum insulin (mU/l) and FG (mg/dl) concentrations, divided by 405 (11, 18, 26, 30) . The exercise program was executed 3 days/week during 8 weeks. The endurance training sessions were consisted of 60 minutes including 10 minutes warm up, 40 minutes exercise and 10 minutes cooldown. The endurance-training program on treadmill was performed with 50-70% VO_{2max} of the individual which was measured at baseline, according to table 2.

Table 2. Endurance-training program

Weeks of exercise	Intensity of exercise
1-2	50-60 % VO_{2max}
3-4	50-60 % VO_{2max}
5-6	60-70% VO_{2max}
7-8	60-70% VO_{2max}

The resistance-training program sessions consisted of 60 minutes exercise on upper and lower body (shoulder press, seated rows, lat pull down, bench press, push up, leg extension, leg curls, leg press, biceps) mixed of upper and lower movement were choosen for 40 minutes of each sessions. The resistance load was 60-80% of one repetition maximum (1RM) testing which was performed at baseline. According to table 3. Each exercise was performed in the moderate contraction velocity (~1 s concentric, ~1 s eccentric). The resting interval between sets was near 1 minute. And the concurrent training program was include of both endurance and resistance programs in way that in odd sessions subjects done endurance training and in even sessions subjects done resistance training (31,32,33,34,35,36).

Rackport VO2max test was used for testing of the subject's cardiovascular fitness. After a brief warm up, the subjects walk as briskly as possible for one mile (1609 meters) with a heart rate monitor. Tester records heart rate (beats per minute) and time of completion. At the end their cardiovascular fitness was evaluated. During the exercise, the subjects were encouragement to finish their duration of work. Participants were instructed not to change their eating habits in the course of the study. The participants report

Table 3. Resistance-training program

Weeks of exercise	Intensity of exercise
1-2	12 reap 2 set 60-65% 1RM
3-4	10-12 reap 3 set 70% 1RM
5-6	6-10 reap 3 set 80% 1RM
7-8	According to recent 4 weeks

ed a three-day- dietary record during pre- and post-training. One weekend day was comprised for each three-day-dietary record. The result of food intake was presented as the amount of total kcal per day. The influences of training groups (endurance, resistance and concurrent) and the two time points (pre and post) on serum samples concentration were evaluated by two-way repeated-measure ANOVA, followed by Bonferroni correction. Normal distribution of data was determined using Shapiro-wilk's test. All analyses were performed using SPSS version 18 and figures were produced using Prism 5.04.

Results

At the beginning, there were not different among groups in blood (P>0.05) (Table 4). After 8 weeks exercise we did not find significant differences in fasting glucose, insulin, HOMA-IR and irisin between the groups (P>0.05), but glucose and insulin in resistance groups and irisin in all groups had significant changes inner the groups (P<0.05) (Fig 1,2,3,4).

Table 4. Differences among the groups at the beginning of study.

	Mean Square Between Groups	Df	F	P<0.05
Irisin	0.086	2	2.607	0.092
Insulin	0.013	2	1.57	0.226
Glucose	0.001	2	0.298	0.745
HOMA-IR	0.04	2	1.689	0.203

Discussion

Irisin is a novel muscle and adipose derived chemokine that is, proteolytically processed from the product of the FNDC5 (fibronectin type ш domain containing 5) gene. Both exercise and the PGC1α (peroxisome proliferator-activated receptor gamma coactivator 1 α) induces the browning of adipocytes and thermogenesis by increasing of UCP1 (uncoupling protein 1) level (8,10,11,12). Although Bostrom et al observed increase of irisin after endurance training (8), but a significant increase in irisin was not found after exercise therapy in non-obese individuals, and no significant changes in irisin occurred in obese patients after 8 week endurance training and 12 week strength and endurance training (30). Previous studies pointed to different results, these conflicting reports may be because of differences between duration and intensity of exercise, time of blood samplings, age and health problem of population of studies and the difference of measurement assays and kits (12, 22, 23, 24, 25, 26). In summery in this study in contrast to hypothesis there were no difference between groups of training. It just observed that irisin was significantly decreased in all three groups of obese women. Some studies indicated that circulating irisin correlated positively with increased risk of metabolic syndrome and insulin resistance as assessed with these kinds of findings it has been

Figure 1._Irisin in different groups

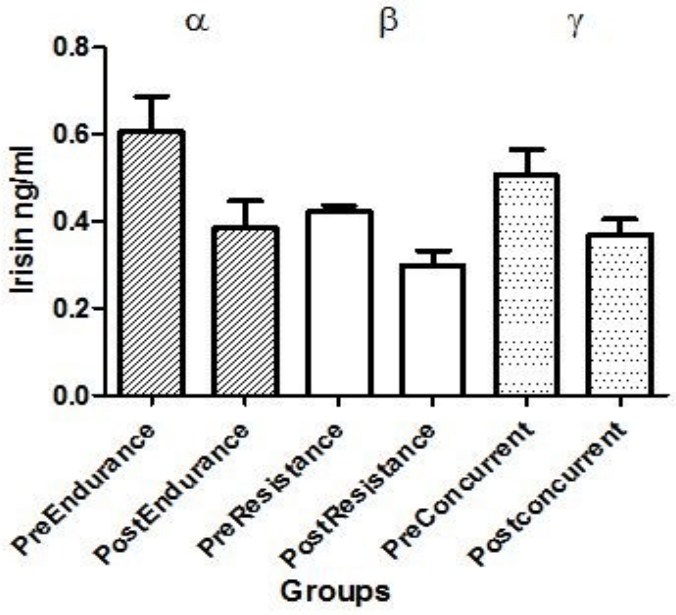

Fig 1. . Changes of Irisin in three groups before and after the training. Significant differences inner the groups. α, β, γ: P<0.05.

Figure 2._Glucose in different groups

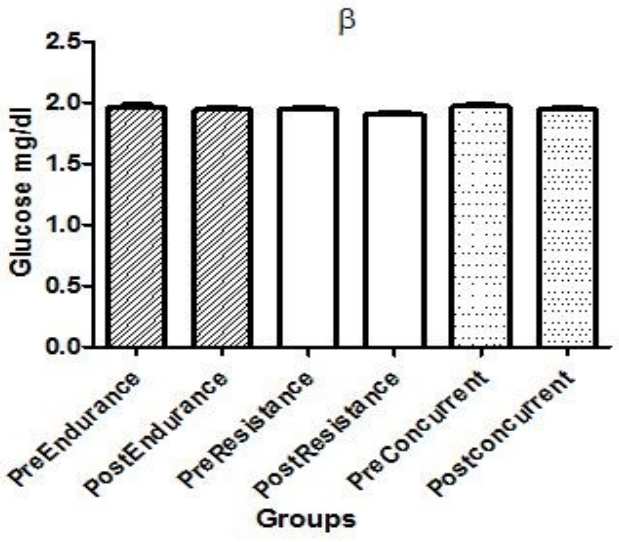

Fig 2. Changes of Glucose in three groups before and after the training. Significant differences inner the groups. β : P<0.05.

Figure 3.__Insulin in different groups

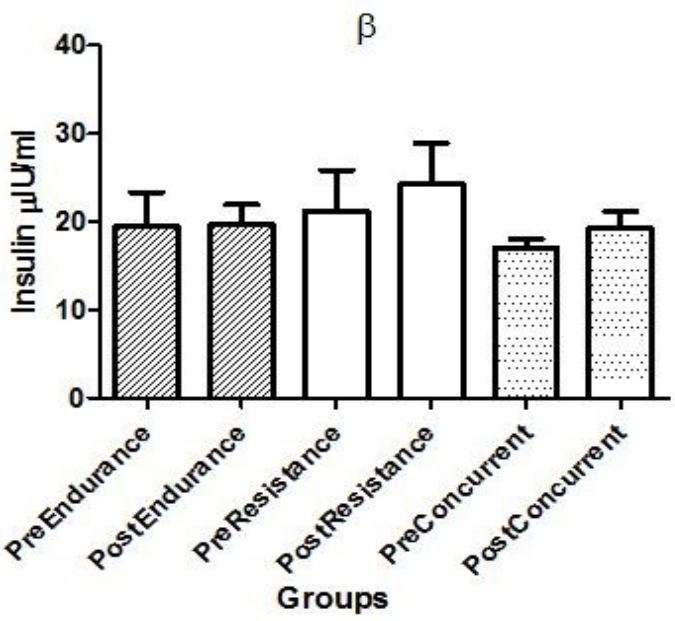

Fig 3. Changes of Insulin in three groups before and after the training. Significant differences inner the groups. β: P<0.05.

Figure 4._HOMA-IR in different groups

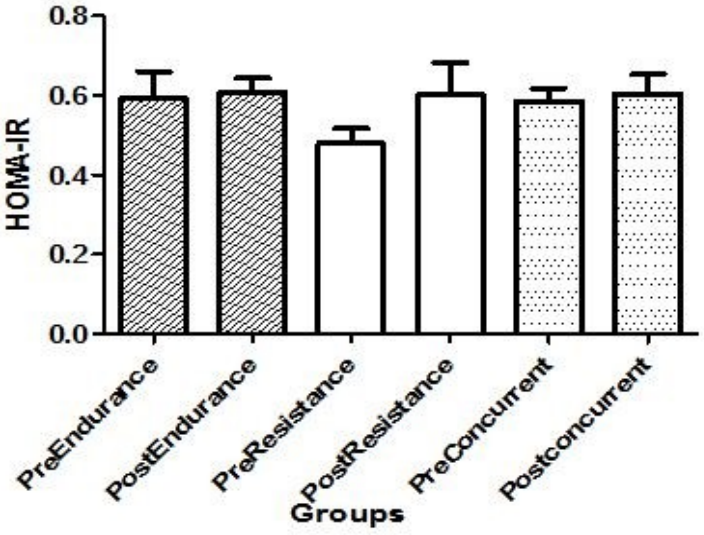

Fig 4. Changes of HOMA-IR in three groups before and after the training. P<0.05. There are no significant differences inner and between the groups.

observed indicated that circulating irisin correlated positively with increased risk of metabolic syndrome and insulin resistance as assessed with these kinds of findings it has been observed higher levels of irisin in overweight pre-diabetes subjects compared with healthy controls (4, 30). Many recent studies in obese patients have shown that irisin decreases with weight reduction. Moreno et al found that irisin was higher in subjects with low activity than in those with average or high activity (37). Huh et al showed that irisin was highest in obese prediabetic patients, followed by obese patients and non -obese individuals, and lowest in athletes (10). The higher irisin in obese persons is due to compensation for metabolic homeostasis, and this suggests that irisin should be decreased by body weight reduction due to discontinuation of compensatory action (14). Due to the difference in metabolism in obese and non-obese individuals, there are disturbances and differences in the signaling processes and intramuscular stimuli of these individuals. Recent investigates suggested that probably irisin has effects on gluconeogenesis and glycogenesis via PI3K/ populations. Irisin secretion in response to adipose and insulin resistance probably enhanced metabolic homeostasis in a compensatory way by altering lipid metabolism via browning of white adiposities (37). Therefore, with regard to one of the important sources of irisin secretion, the adipose tissue, it seems that in this study, the high levels of irisin in obese individuals who did not have a metabolic disorder would have a protective and supportive role in obstructing the complications of obesity, so obese people are less likely to suffer from obesity. In these people, physical activity could decrease the complications of obesity by improving the glucose signaling pathways and other routes, as well as the higher body fat intake, thus reducing Irisin by the end of the period. In general, the present study did not show a significant difference in the effect of different types of training on the Irisin of sedentary and obese women.

This study is not without limitations. We did not any lean control group, however all subjects completed the study in random order then served as their own controls. Also by finding of receptor(s) of irisin in different part of body would open the door to better understand of its role and its mechanisms. Additional researches are needed to elucidate the potential and hidden interaction of irisin and exercise by different intensity and duration in several populations.

Conclusions

With regard to one of the important sources of irisin secretion, the adipose tissue, it seems that in this study, the high levels of irisin in obese individuals who did not have a metabolic disorder would have a protective and supportive role in obstructing the complications of obesity, so obese people are less likely to suffer from obesity. In these people, physical activity could decrease the complications of obesity by improving the glucose signaling pathways and other routes, as well as the higher body fat intake, thus reducing Irisin by the end of the period. In general, the present study did not show a significant difference in the effect of different types of training on the Irisin of sedentary and obese women.

Reference

1. Kim H, So B, et al. Resistance exercise training increases the expression of irisin concomitant with improvement of muscle function in aging mice and humans. Experimental Gerontology. 2015; (70): 11–17.
2. Nygaard H, Slettaløkken G, Vegge G, Hollan I, et al. Irisin in Blood Increases Transiently after Single Sessions of Intense Endurance Exercise and Heavy Strength Training. PLOS ONE. 2015; 10 (3): 1- 12.
3. Guariguata L, Whiting R, Hambleton I, Beagley J, et al. Global estimates of diabetes prevalence for 2013 and projections for 2035. Diabetes Research and Clinical Practice. 2014; 137 – 149.
4. Norheim F, Langleite M T, Hjorth M, Holen T, et al. The effects of acute and chronic exercise on PGC-1a, irisin and browning of subcutaneous adipose tissue in humans. FEBS Journal. 2013; 739 -749.
5. Nakhostin-roohi B, Niknam Z. BMI,fat percentage and VO2max in college female staff. JSPORT MED PHYS FITNESS. 2008;48:211-6.
6. Nakhostin-roohi B, Sojudi A, Niknam Z. Nutritional status and physical activity in 7-11 year-old female students of Pars-abad in the province of Ardabil. MED SPORT. 2010;63:521-9.
7. Mikami M E, Sato K, Kurihara T, Hasegawa N, et al. Endurance Training-Induced Increase in Circulating Irisin Levels Is Associated with Reduction of Abdominal Visceral Fat in Middle-Aged and Older

Adults. PLOS ONE. 2015; 10 (3): 1- 12.

8. Bostrom P, et al. Is irisin a human exercise gene? Brief communications arising. 2012; 463–468.
9. Castillo-Quan JI. From white to brown fat through the PGC-1α-dependent myokine irisin: implications for diabetes and obesity. Disease Models & Mechanisms 5, 293-295 (2012).
10. Chen J, Huang Y, Gusdon A, Qu S. Irisin: a new molecular marker and target in metabolic disorder. Chen et al. Lipids in Health and Disease. 2015; 14 (2): 1-6.
11. Hwang Y, Jeon W, et al. The ratio of skeletal muscle mass to visceral fat area is a main determinant linking circulating irisin to metabolic phenotype. Cardiovasc Diabetol 2016; 15(9).
12. Poher A, Altirriba J, Durebex Ch, Jeanrenaud F, et al. Brown adipose tissue activity as a target for the treatment of obesity/insulin resistance. Frontiers in Physiology. 2015; 6 (4): 1-9.
13. Gamas L, Matafome P, Seiça R. Irisin and Myonectin Regulation in the Insulin Resistant Muscle: Implications to Adipose Tissue: Muscle Crosstalk. Journal of Diabetes Research. 2015; 1-8.
14. Kurdiova T, Balaz M, 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. J Physiol .2014: 1091–1107.
15. Lee HJ, Lee JO, Kim N, et al. Irisin, a Novel Myokine, Regulates Glucose Uptake in Skeletal Muscle Cells via AMPK. Mol Endocrinol. 2015 Jun;29(6):873-81.
16. Liu T, Shi Ch, et al. Irisin inhibits hepatic gluconeogenesis and increases glycogen synthesis via the PI3/Akt pathway in type 2 diabetic mice and hepatocytes. Clinical Science. 2015; (10): 839-850.
17. Loste M, Ranchal I, et al. Irisin, a Link among Fatty Liver Disease, Physical Inactivity and Insulin Resistance. Int. J. Mol. Sci. 2014; (15): 23163-23178.
18. Park KH, Zaichenko L, Brinkoetter M, et al. Circulating irisin in relation to insulin resistance and the metabolic syndrome. J Clin Endocrinol Metab. 2013 Dec;98(12):4899-907.
19. Brenmoehl J, Albrecht E, Komolka K, Schering L, et al. Irisin Is Elevated in Skeletal Muscle and Serum of Mice Immediately after Acute Exercise. International Journal of Biological Sciences.2014;10 (3): 338-349.
20. Butler H T, Piwowar L K, Byrd G, et al. Plasma irisin in runners and nonrunners: no favorable metabolic associations in humans. Physiological Reports. 2015; 3 (1): 1-12.
21. Gonzalez P B, Ortega V F, Oteyza P E, Sanchez T, et al. Irisin Levels Before and After Physical Activity Among School-Age Children with Different BMI: A Direct Relation with Leptin. Obesity. 2015; 23 (4): 729-732.
22. Lu Y, Li H, et al. Swimming exercise increases serum irisin level and reduces body fat mass in highfat-diet fed Wistar rats. Lu et al. Lipids in Health and Disease (2016) 15:93.
23. Moienneia N, Attarzadeh Hosseini S R. Acute and chronic responses of metabolic myokine to different intensities of exercise in sedentary young women. Obesity Medicine 1 (2016) 15e20.
24. Peterson M J,Mart R,Bond E Ch.Effect of obesity and exercise on the expression of the novel my-okines,Myonectin and Fibronectin type III domain containing 5.PeerJ.2014.
25. Sun C, Zeng R, Cao G, Song Zh, et al. Vibration Training Triggers Brown Adipocyte Relative Protein Expression in Rat White Adipose Tissue. BioMed Research International. 2015; 1-10.
26. Winn NC, Grunewald Z I, et al. Plasma Irisin Modestly Increases during Moderate and High-Intensity Afternoon Exercise in Obese Females. PLoS One. 2017. Jan 26;12(1):e0170690.
27. Knudsen G J, Murholm M, Carey L A, Biensø S R, et al. Role of IL-6 in Exercise Training- and Cold-Induced UCP1 Expression in Subcutaneous White Adipose Tissue. PLOS ONE. 2014; 9 (1): e84910 - e84910.
28. Lally V J, Ford J R, Johar J, Crane D J, et al. Skeletal muscle AMPK is essential for the maintenance of FNDC5 expression. Physiological Reports. 2015; 3 (5): 1-8.
29. Tang H, Yu R, Liu S, et al. Irisin Inhibits Hepatic Cholesterol Synthesis via AMPK-SREBP2 Signaling.

EBioMedicine 2016.

30. Fukushima Y, Fukushima S, et al. Effects of Body Weight Reduction on Serum Irisin and Metabolic Parameters in Obese Subjects. Diabetes Metab J 2016;40:386-395.
31. Carnero A E, Amati F, Pinto S R, Valamatos J M, et al. Regional Fat Mobilization and Training Type on Sedentary, Premenopausal Overweight and Obese Women. Obesity. 2014; 22(1): 86 -93.
32. Cunha F, Midgley A. et al. Effect of continuous and intermittent bouts of isocaloric cycling andrunning exercise on excess postexercise oxygen consumption. Journal of Science and Medicine in Sport 19 (2016) 187–192.
33. Filho A B, Bellaguarda F, Rebouças M, et al. Concurrent exercise program plus diet intervention on body adiposity and lipid profile in obese adolescents. Gazz med ital - arch sci med. 2015; 174: 259-266.
34. Greer B, Sirithienthad B, et al. EPOC Comparison Between Isocaloric Bouts of Steady-State Aerobic, Intermittent Aerobic, and Resistance Training. Research Quarterly for Exercise and Sport, 2015; (86): 190–195.
35. Schjerve I, Tyldum G, et al. Both aerobic endurance and strength training programmes improve cardiovascular health in obese adults. Clinical Science. 2008; 115: 283–293.
36. Swain DP, Abernathy KS, et al. Target heart rates for the development of cardiorespiratory fitness. Med Sci Sports Exerc. 1994 Jan;26(1):112-6.
37. Moreno-Navarrete JM, Ortega F. et al. Irisin Is Expressed and Produced by Human Muscle and Adipose Tissue in Association With Obesity and Insulin Resistance. J Clin Endocrinol Metab, April 2013, 98(4):E769–E778.
38. Peirce V, Vidal-Puig A. Regulation of glucose homoeostasis by brown adipose tissue. Published online August 27, 2013.
39. Tiano P J, Springer A D, Rane G S. SMAD3 negatively regulates serum irisin and skeletal muscle FNDC5 and PGC-1□ during exercise. The American Society for Biochemistry and Molecular Biology. 2015; 1-23.