

# Impact of exercise induced skeletal muscle strain on energy regulatory hormones of irisin and nesfatin-1 in sedentary males

## Sedanter erkeklerde egzersize bağlı iskelet kası zorlanmasının enerji düzenleyici hormonlar olan irisin ve nesfatin-1 üzerine olan etkileri

Seda UĞRAŞ<sup>1</sup>, Oğuz ÖZÇELİK<sup>2</sup>

### ABSTRACT

**Objective:** Exercise important tool to regulate body energy metabolic system activity by increasing mechanical activity or hormonal effects. In this study, we aimed to examine effects of aerobic exercise on levels of irisin, which increases energy expenditure and nesfatin-1, which suppress energy intake and their connection with CK, which reflects increased muscle injury.

**Methods:** Total of 30 healthy sedentary male preformed 30 min of aerobic running exercise work intensity associated with their anaerobic threshold. Blood samples were taken before and after exercise. Serum irisin nesfatin-1 and creatine kinase (CK) were analysed.

**Results:** During exercise serum irisin and CK levels increased in all subjects (16.4% and 25.7%, respectively). Despite the mean values increased statistically significant, nesfatin-1 levels did not increased in all subjects (12.1%). There was a positive statistically significant correlation between increase of irisin and CK levels.

**Conclusion:** Consequently, exercise induced skeletal muscle activity may cause increase in CK and irisin levels. Nesfatin-1 hormones may not seem to be exercise-induced hormone and did not correlate with

### ÖZET

**Amaç:** Egzersiz, vücut enerji metabolik sistem aktivitesini, mekanik aktiviteyi veya hormonal etkileri artırarak düzenleyen önemli bir yöntemdir. Bu çalışmadaki amacımız aerobik egzersizin enerji tüketimini artıran irisin hormonu ve enerji alımını baskılayan nesfatin-1 hormonu üzerine etkilerini ve bunların kas hasarı artışını yansıtan kreatin kinase (CK) ile ilişkisini incelemektir.

**Yöntem:** Toplam 30 sağlıklı, sedanter erkek katılımcıya anaerobik eşiklerinde 30 dakika aerobik koşu egzersizi uygulandı. Egzersiz öncesi ve sonrası kan örnekleri alındı. Serum irisin, nesfatin-1 ve CK analiz edildi.

**Bulgular:** Tüm katılımcılarda egzersiz süresince serum irisin ve CK düzeyleri artış gösterdi (%16.4 ve %25.7 sırası ile). Ortalama değerler istatistiksel olarak anlamlı artış göstermesine rağmen nesfatin-1 düzeyi tüm katılımcılarda artış göstermedi (%12.1). Irisin ve CK seviyelerindeki artışlar arasında pozitif yönde istatistiksel olarak anlamlı korelasyon sapyandı.

**Sonuç:** Egzersize bağlı iskelet kası aktivitesi CK ve irisin seviyelerinde artışa neden olabilir. Nesfatin-1 egzersize bağlı hormon gibi görünmeyebilir ve artmış kas aktivitesi ile korelasyon göstermemektedir. Orta

<sup>1</sup>Yozgat Bozok University, Faculty of Medicine, Department of Physiology, Yozgat

<sup>2</sup>Kastamonu University, Faculty of Medicine, Department of Physiology, Kastamonu



İletişim / Corresponding Author : Seda UĞRAŞ  
Yozgat Bozok Üniversitesi Tıp Fakültesi Yozgat - Türkiye  
E-posta / E-mail : sedaugras@hotmail.com

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increased muscle activity. Moderate intensity aerobic exercise may provide beneficial effects on body energy regulatory systems by altering metabolic hormones.

**Key Words:** Irisin, nesfatin-1, creatine kinase, aerobic exercise

yoğunluktaki aerobik egzersiz metabolik hormonları değiştirerek vücut enerji düzenleyici sistemleri üzerinde faydalı etkiler sağlayabilir.

**Anahtar Kelimeler:** İrisin, nesfatin-1, kreatin kinaz, aerobik egzersiz

## INTRODUCTION

Exercise has many important effects on improvement on fitness levels (1) and protects against many serious diseases including metabolic, cardiovascular and pulmonary (2). Exercise training is well known for its beneficial effects on metabolism and by increasing metabolic activity induced energy consumption (3).

In addition, in recent years, various hormones, secreted from skeletal muscle and adipose tissue, that regulating body energy balance have been introduced (4). Irisin is a newly described myokine secreted from skeletal muscle and increases energy expenditure by inducing the browning of white adipose tissue (5). Irisin may also improve glucose tolerance and reduce fasting insulin levels (6,7).

Nesfatin-1, which was first introduced in 2006, is an important source of peripheral signal to brain and potent regulator of energy homeostasis by reducing food intake (8,9). The effects of nesfatin-1 in glucose control (10,11), cardiovascular functions (12) and psychiatric disorders (13) has been shown.

The effects of exercise on these two hormones have become popular among scientists especially those interested with conditions of energy regulation disorders. The studies conducted on irisin levels response to the exercise showed contradictory results some investigators showed increased irisin (14-16) some others did not find (17-19). In addition, the results of previous studies also revealed various conclusions concerning exercise and nesfatin-1 relationships (20-23).

To understand relationships between increased muscle activity and metabolic hormones of irisin and

nesfatin-1, response of CK may provide important outcome. CK is widely used indirect biomarker of exercise induced muscle cell damage or disturbance (24-26). Thus, it is logical to expect aerobic exercise induced CK activity may have an effect on levels of irisin and nesfatin-1 hormones. We aimed to examine effects of aerobic exercise on levels of irisin, which increases energy expenditure and nesfatin-1, which suppresses energy intake and their connection with CK, which reflects increased muscle injury.

## MATERIAL and METHOD

Total of thirty healthy male aged between 18 to 25 years and body mass index between 18.5 to 25 kg/m<sup>2</sup> were participated to this study. Body composition analyses were performed using BIA method (27). The subjects' physical characteristics are 20.8 ±2.5 years, 179±10 cm, 65.2±9.1 kg and body mass index 20.3±2.3 kg/m<sup>2</sup>. The ethical approval for this study has been taken from local ethical committee. A signed informed consent was obtained from each subject before participating to the study.

The subjects should be in sedentary condition and they had no daily or weekly regular exercise. The subjects should not be smokers and taking no any drug, alcohol, caffeine or medication. They should be free of any metabolic cardiac or pulmonary system diseases. Before participating the study, the subjects were advised not to change their food intakes. The subjects were also instructed to avoid any physical activity at least 72 hours before the test.

Following an overnight fasting, all subjects were performed a running exercise approximately 30 min after 5 minutes of warm up period in morning between 8:00 am to 9:00 am. The exercise intensity associated with anaerobic threshold reflecting moderate intensity and estimated approximately 65% of their predicted maximal heart rate (220-age) (28). Polar heart rate monitor used to control heart beat and prescribe to exercise intensity.

Venous blood samples were taken in to the aprotinin containing tube to avoid protein denaturation before and immediately after exercise. The samples centrifuged and serum was separated and stored at -80 C until analysis. Serum nesfatin-1 levels were measured using a commercial ELISA kit with a measurement interval of 31.2 pg/ml to 2000 pg/ml (Boster Biological Technology Co Ltd, USA; Cat No: EK1138). Irisin level was determined by ELISA kit to have a sensitivity of 0.78 ng/mL (Phoenix Pharmaceuticals Inc, Burlingame, California, USA). CK analysis was performed using auto analyser.

Data are expressed as mean ( $\pm$  SD). The Paired-t test, which is a parametric comparison, was used to analyses the significance of basal and end exercise values. Pearson correlation analyses were performed between the parameters of CK, irisin and nesfatin-1. A value of  $p < 0.05$  was accepted as statistically significant.

## RESULTS

Exercise caused significant changes in serum levels of irisin in all subjects ( $p < 0.0001$ ) (Table 1,

Figure 1). There was no systematic increase in all subject's nesfatin-1 levels, 6 subjects (20%) showed decrease while 24 subjects (80%) showed increase (Figure 1). However, in totally there was significant increase (12.1%) in nesfatin-1 levels ( $p = 0.003$ ) (Table 1). During exercise, systematic increase in CK levels were observed in all subjects ( $p < 0.0001$ ) (Table 1, Figure 1). There was no correlation between increase of nesfatin-1 and CK levels. However, a positive significant correlation between change of irisin and CK levels were observed  $R = 0.63344$  ( $p < 0.0001$ ) (Figure 2).

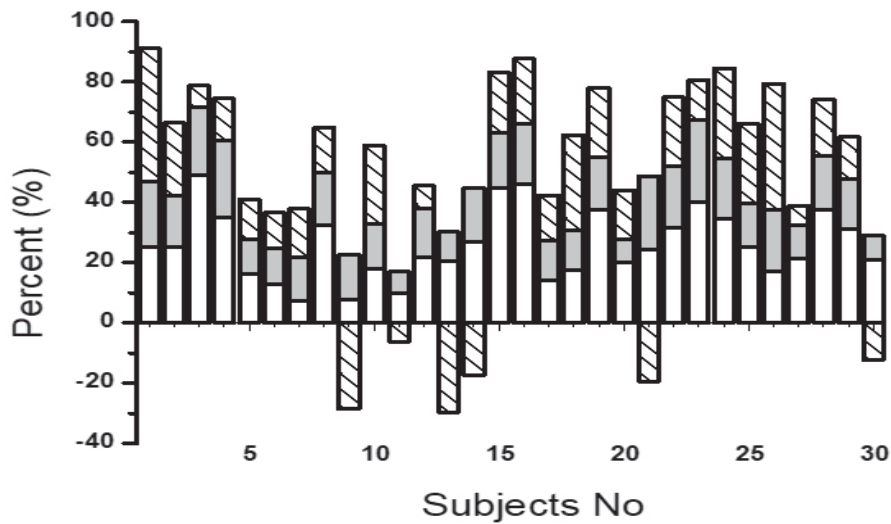
## DISCUSSION

In this study, moderate intensity walking exercise as determined from subjects' anaerobic threshold has significant effect on energy regulation hormones of irisin and nesfatin-1 levels. While exercise resulted in significant increase in irisin levels in all subjects, exercise had no impact on serum nesfatin-1 levels in all subjects (Figure 1). Despite the variation individually, nesfatin-1 levels (considering as a total mean values) were showed significant increase ( $p = 0.003$ ). Increase of irisin (approximately 16.4%) in response to the moderate intensity exercise are similar to the result of previous studies (29-31). Short term high intensity exercise also increases blood irisin levels (14). However, it has also been reported that exercise has no significant effects on irisin (17, 32).

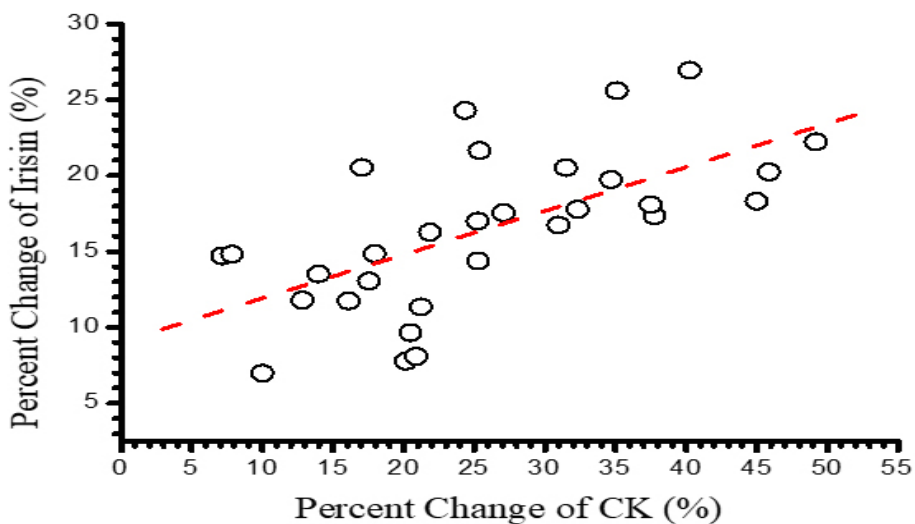
We found a statistically significant positive correlation between change of irisin and CK levels (Figure 2). However, we did not find any statistically

**Table 1.** The mean (SD) values of irisin, nesfatin-1 and creatine kinase at the basal, at the end of the exercise and percent change during exercise. \*reflects statistically significant difference

No	Basal	End	% change
Irisin (ng/mL)	108.7 $\pm$ 7.6	126.4 $\pm$ 7.5	16.4 $\pm$ 5.1
Nesfatin-1 (pg/mL)	125.3 $\pm$ 23.2	139.4 $\pm$ 31.2	12.1 $\pm$ 18.4
CK (U/L)	131.4 $\pm$ 43.3	165.5 $\pm$ 55.1	25.7 $\pm$ 11.3



**Figure 1.** The percent change of irisin (white column), nesfatin-1 (grey column) and creatine kinase (dashed column) response to the aerobic exercise for each individual subjects



**Figure 2.** The correlation analysis between change of irisin and creatine kinase levels during aerobic exercise for each subjects

significant correlation between change of nesfatin-1 and CK during aerobic exercise. It is known that CK levels can be raised from the damage of the skeletal muscle tissue as a consequence of both metabolic and mechanical causes (25). Increase of CK during aerobic exercise may provide to obtain information on the state of exercising muscle (10). In a previous study performed in patient with metabolic syndrome

showed that increase in CK levels by resistance exercise induced muscle damage evokes the release of irisin into the circulation (29). However, it has been reported that exhaustive exercise causes increase in irisin levels without correlated CK levels (33). Increase in irisin levels in response to the elevated oxidative stress has been shown (34). Irisin is thought as a therapeutics agent for the metabolic diseases

(35). Considering exercise and irisin response, there is various results, while it has been suggested that time of exercise may effect irisin levels (36) but other showed irisin levels increases without depending the time of exercise (37).

Nesfatin-1 also thought for strong agent for fighting against metabolic diseases especially diabetes and obesity (10,37). However, there is no consensus with regarding nesfatin-1 and exercise relationships among the studies. Despite the opposite response among the subjects in this present study, we have found significant increase in nesfatin-1 levels. However, it has also been shown that acute or chronic exercise has no effects on nesfatin-1 levels (10,23). In contrast, anaerobic exercise resulted significant increases in nesfatin-1 levels (21). In other study, nesfatin-1 levels increased in night time exercise (13).

The present study was limited by lack of comparability with a group of subjects with high and/or low fitness. It was not possible to discuss the influence of fitness status of subjects on CK, irisin and nesfatin-1 levels.

Consequently, this study shows that irisin is an exercise induced hormones and closely related with muscle activity as determined from increase of CK levels. However, despite the statistically significant increase in mean (SD) nesfatin-1 levels, some subjects showed decrease while other have increased nesfatin-1 levels.

The results of this study shows exercise is an effective way to regulate energy homeostasis by mechanical effects and may also enhance by an exercise regulatory hormones.

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