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Effects of aerobic exercise induced oxidative stress on energy regulatory hormones of irisin and nesfatin-1 in healthy females

Sağlıklı kadınlarda aerobik egzersizin neden olduğu oksidatif stresin irisin ve nesfatin-1'in enerji düzenleyici hormonlar üzerine etkileri

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ABSTRACT

Objectives: Exercise is an important tool to stimulate oxidative stress and metabolic demands. We intended to evaluate impact of aerobic exercise on oxidative stress parameters and their relationships between irisin and nesfatin-1 levels.

Material and Method: Total of ten healthy sedentary female subjects exercise for a 30 min of aerobic running exercise work intensity corresponded to associated their anaerobic threshold. Venous blood samples were taken before and at the end of the exercise. Serum irisin nesfatin-1 and TAS and TOS levels were analysed using ELISA methods.

Results: Exercise caused increase of irisin (11%) and nesfatin-1 (12%) levels. During exercise a decrease in TAS (-11%) and increased in TOS (29%) levels were observed. There was a significant correlation between changes of irisin and TAS levels (R=-0.67594, p=0.03).

Conclusion: Consequently, exercise induced skeletal muscle activity may cause increase in oxidative stress, irisin and nesfatin-1 levels. Irisin hormone may be a secreted against to increased exercise-induced increased oxidative stress muscle activity.

Keywords: Exercise, oxidative stress, irisin, nesfatin-1

ÖZET

Amaç: Egzersiz, oksidatif stresi ve metabolik ihtiyaçları karşılamak için önemli bir araçtır. Amacımız, aerobik egzersizin oksidatif stres parametreleri üzerindeki etkisini ve irisin ile nesfatin-1 seviyeleri arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntem: Totalde on sağlıklı sedanter kadın, anaerobik eşiğe denk gelen 30 dakikalık aerobik koşu egzersizine katıldı. Egzersiz öncesi ve sonrası venöz kan örnekleri alındı. Serum irisin, nesfatin-1 ile TAS ve TOS seviyeleri analiz edildi.

Bulgular: Egzersiz, irisin düzeyinde (%11) ve nesfatin-1 düzeyinde (%12) artışa neden oldu. Egzersiz esnasında TAS'da düşüş (%11) ve TOS (%29) düzeyinde artış gözlendi. İrisin değişiklikleri ve TAS seviyeleri arasında önemli bir korelasyon bulundu.

Sonuç: Sonuç olarak egzersize bağlı iskelet kası aktivitesi oksidatif stres, irisin ve nesfatin-1 düzeylerinde artışa neden olabilir. İrisin hormonu, egzersize bağlı artmış oksidatif stres kas aktivitisine karşı salgılanabilir.

Anahtar Kelimeler: Egzersiz, oksidatif stres, irisin, nesfatin-1

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INTRODUCTION

The regulation of energy intake to energy consumption ratio, called as energy homeostasis, is crucially important parameter for human health. The imbalance in energy regulation (increased intakes and/or decreased consumption), may cause serious metabolic diseases including diabetes and obesity (1). Exercise has long been considered as the cornerstone for the maintaining of body energy metabolic functions homeostasis (2,3).

In literature, the studies conducted on energy regulation by some hormones that secreted from muscle and fat tissues resulted great interest among the scientist. Nesfatin-1 hormone is first introduced in 2006 as a strongly potential factor on energy regulation (4). Studies revealed that nesfatin-1 has vital power on supressing energy intake via signals from peripheral tissues to energy controlling center in brain (5) and and protects against serious metabolic impairments (6). Nesfatin-1 is secreted by many peripheral tissues including adipose tissue and could be pass through blood brain barrier (7).

In addition, recently described hormone called as irisin that secreted from skeletal muscle cell muscle and adipose tissue has been introduced a new energy regulatory hormone (8). Irisin has potential effects on browning of white adipose tissue, improve insulin sensitivity, mitochondrial biogenesis (8-10). The studies also reported that nesfatin-1 (11) and irisin (12) hormones have important beneficial effects on oxidative stress parameters.

There is an increasing interest among the investigators concerning with exercise induced increase in energy regulatory hormones of nesfatin-1 and irisin (13-15). It is also known that exercise induced increased metabolic and muscle activity enhance oxidative stress levels (16,17). In this study, we intended to evaluate impact of aerobic exercise induced altered oxidative stress parameters on the on irisin and nesfatin-1 levels in sedentary young females.

MATERIAL AND METHOD

Total of ten healthy female subjects were participated to this study. The subjects body composition were analysed carefully using foot to foot bioelectrical impedance analysis to avoid body hydration content on misestimating of body composition (18). The subjects' physical characteristics are age 20.8±1.2 years, height 167±1 cm, weight 58.8±2.7 kg, fat mass 10.74±1.39 kg and body mass index 20.9±1.0 kg/m². The ethical approvement for this study has been taken from Bozok University Ethical Committee (date: 28.02.2019, number: 2017-KAEK-189_2019.02.28_14). A signed informed consent was obtained from each subject before participating to the study. The subjects are not performing any exercise or physical activity regularly and they are in sedately conditions. They did not smoke or taking alcohol or any drug including vitamin or energy contains. Before the study, they were avoided exercise or any physical activity or having meal containing high fat or carbohydrate.

The subjects were performed a running exercise for a 30 minutes in morning after an overnight fasting. The anaerobic threshold concept which were estimated approximately 65% of the subjects' maximal heart rate (19). The subjects hear rate was monitored using polar heart rate watch and prescribe to exercise intensity.

The blood samples from antecubital vein were taken in to the aprotinin containing tubes to avoid protein denaturation before and at the end of the exercise. The blood samples were separated and stored at -80°C until analysis. Serum nesfatin-1 (Boster Biological Technology Co Ltd, USA; Cat No: EK1138) and irisin levels (Phoenix Pharmaceuticals Inc, Burlingame, California, USA) were determined using commercial ELISA kits. During exercise, total oxidan status (TOS) and total antioxidan status (TAS) of the subjects were determined using ELISA methods.

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

RESULTS

The effect of aerobic exercise on nesfatin-1 levels is shown in figure 1. A significant increase in nesfatin-1 levels were observed from baseline values of 155±8 ng/mL to 174±12 ng/mL end of exercise ($p<0.05$). There was 12% increase in nesftain-1 levels.

Irisin levels response to the aerobic exercise have been shown in **Figure 1**. There was a statistically significant increase in irisin levels from onset value of 76.9±6.4 ng/mL to 85.4±7.4 ng/mL end of exercise ($p<0.05$). The mean increase of irisin levels during exercise was found to be 11%.

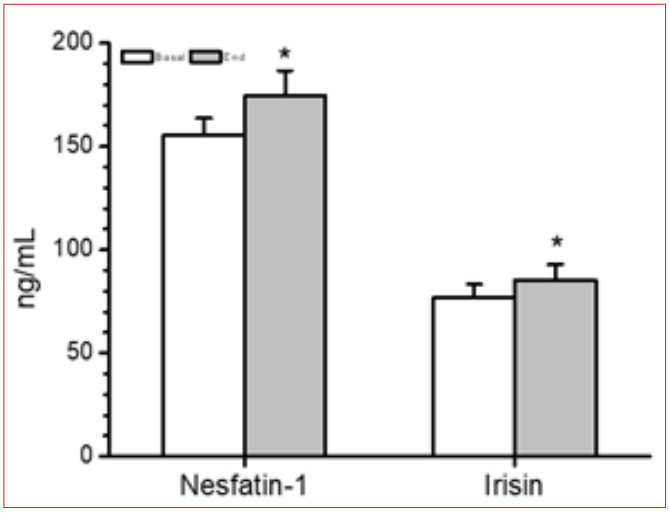

Figure 1. Mean (±SD) values for change of Nesfatin-1 and irisin response to the exercise. White column represent baseline values and grey column represent end of exercise values * represents statistically significance compared to baseline

During exercise, systematic increase in TOS levels were observed in all subjects ($p<0.05$) (**Figure 2**). TOS levels increased from 12.17±1.7 µmol/L to 15.70±2.3 µmol/L ($p<0.05$) (Figure 2) The mean increase of TOS during exercise was found to be 29%.

In contrast to TOS, there was statistically significant decreases in TAS levels from basal value of 1.147±0.05 mmol/L to 1.019±0.05 mmol/L end of exercise ($p<0.05$) (**Figure 2**). The mean decrease of TAS during exercise was found to be -11%.

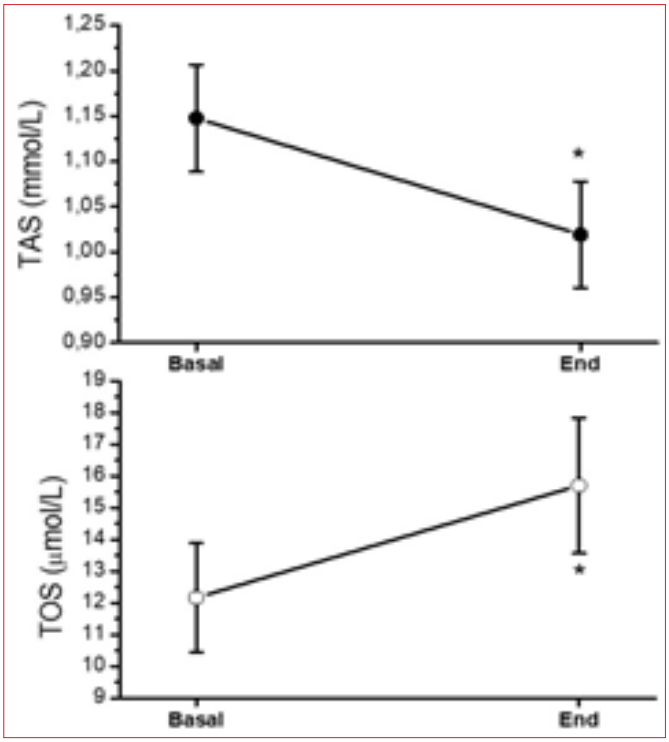

Figure 1. Mean (±SD) values for change of Nesfatin-1 and irisin response to the exercise. White column represent baseline values and grey column represent end of exercise values * represents statistically significance compared to baseline

During exercise, there was no a statistically significant correlation between change of nesfatin-1 and TAS (p=0.6) and TOS levels (p=0.3). However, there was a statistically significant negative correlation between change of irisin and TAS levels (R=-0.67594, p=0.03), but did not found between irisin and TOS (R=-0.53014, p=0.1)

DISCUSSION

In this study, performing exercise at the intensity of anaerobic threshold in female subjects showed significant increase on energy regulatory hormones of nesfatin-1 and irisin (**Figure 1**).

In literature the studies concerning exercise and nesfatin-1 relationships showed varied conclusions among the studies. In contrast to finding of this study, a significant decrease in nesfatin-1 levels during exercise intensity corresponded to anaerobic threshold has been reported (20). Interestingly, some studies performed acute or chronic exercise reported no significant change in nesfatin-1 levels during exercise performed in male subjects (21-23). However, in trained subjects performing boxing or taekwondo machetes caused significant increase in nesfatin-1 levels (24,25). It has also been reported that exercise performing in night time causes a significant increase in nesfatin-1 levels which did not occurred in morning exercise (13). The importance of exercise induced altered nesfatin-1 levels may contribute energy regulation in addition to mechanical effects of exercise. In addition to energy regulatory role, nesfatin-1 has also great influence on stress related depressive situation (26).

In the present study we have found systematically increase in irisin levels in all female subjects. In concordance with the results of many previous studies performed in male and female, it is logical to emphasise that irisin is undeniably exercise hormone (8,13-15,27,28).

Aerobic exercise intensity resulted marked increase in oxidative stress levels as indicated increase of TOS and decrease of TAS levels (29). In the present study, we did not found a significant correlation between change of nesfatin-1 levels and altered TAS and TOS responses. However, we have found a significant negative correlation between increased irisin levels and decrease of TOS. Exercise induced alteration in levels of TAS and TOS may not indicator of muscle damage but point out the stress levels of muscle cells. During exercise performed in healthy male, a close relationship between increased muscle damaged as indicated with increased creatin kinase levels and changes of irisin levels (30). In addition, irisin also showed correlation with exercise induced increased asymmetric dimethylarginine (ADMA) levels in trained male subjects (31). The important beneficial effects of irisin and nesfatin-1 on oxidative stress parameters needs o b solve in future studies (11,12).

The present study has some limited by the number of subjects which is low and their body composition in normal ranges. The further studies performing with large subjects' groups with different fitness levels and various body composition will provide much better results for concerning irisin nesfatin-1 and oxidative stress parameters.

CONCLUSION

Consequently, aerobic exercise has significant impact on energy regulatory hormones of nesfatin-1 and irisin. Aerobic exercise could have significant effects on oxidative stress parameters reducing antioxidant parameters and increase oxidant parameters. However, there is no direct relationships between oxidative stress and energy regulatory hormones of irisin and nesfatin-1 except irisin and TOS relationships.

ETHICAL DECLARATIONS

Ethics Committee Approval: The ethical approvement for this study has been taken from Bozok University Ethical Committee (date: 28.02.2019, number: 2017-KAEK-189_2019.02.28_14).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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