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ARAŞTIRMA YAZISI / RESEARCH ARTICLE

KOMBİNE EGZERSİZLERİN İRİSİN, İNSÜLİN, LİPİD PROFİLİ VE VÜCUT BİLEŞİMİ ÜZERİNE ETKİSİ

EFFECT OF COMBINED EXERCISES ON IRISIN, INSULIN, LIPID PROFILE AND BODY COMPOSITION

Şeniz KARAGÖZ[1], İrfan YILDIRIM[2], Yasin ERSÖZ[2], Halit Buğra KOCA[3], Tülay KÖKEN[3]

[1]Afyon Kocatepe Üniversitesi, Spor Bilimleri Fakültesi
[2]Mersin Üniversitesi, Spor Bilimleri Fakültesi
[3]Afyonkarahisar Sağlık Bilimleri Üniversitesi Tıp Fakültesi Biyokimya Ana Bilim Dalı

ÖZET

AMAÇ: Düzenli egzersizin sağlık üzerindeki tartışılmaz yararlı etkilerine rağmen, bu etkileri düzenleyen altta yatan moleküler yolaklar hakkında daha çok veriye ihtiyaç vardır.Bu çalışmada, sedanter sağlıklı genç kadınlarda düzenli kombine egzersizlerin serum irisin ve insülin düzeyleri ile lipid profili üzerine etkilerinin incelenmesi amaçlandı.

GEREÇ VE YÖNTEM: Araştırmanın örneklem grubunu 35 sağlıklı genç sedanter kadın oluşturdu. Katılımcıların yaş ortalamaları 21.4±1.94 yıl, boy ortalamaları 164.3±5.89 cm ve vücut ağılıkları 62.2±8.1 kg idi. Katılımcılara 10 hafta, haftada 3 gün ve günde 75'er dakika kombine egzersizler (aerobik + direnç) yaptırıldı. Araştırmada öçülmek istenen değişkenler (boy,vücut ağırlığı, bel ve kalça çevresi,vücut yağ yüzdesi, lipit profili belirteçleri, irisin ve insülin hormonları) egzersize başlamadan önce(0.hafta) ve egzersiz uyglamasından (10.hafta) sonra ölçüldü. Verilerin analizi, bağımlı örneklem t-testi ve pearson kolerasyon testi ile değerlendirildi.

BULGULAR: Verilerin değerlendirilmesi sonucunda, sedanter genç kadınlarda 10 haftalık düzenli kombine egzersizlerin insülin düzeyini azaltırken (p=0.003), irisin düzeyilerini artırdığı (p=0.012) bulunmuştur. Lipid profili belirteçlerinden biri olan trigliserit değerlerinde de istatistiksel olarak anlamlı bir fark olduğu bulunmuştur (p=0.008).

SONUÇ: 10 hafta boyunca düzenli olarak yapılan kombine egzersizlerin sağlıklı sedanter genç kadınların irisin ve insülin üzerinde önemli etkileri olduğu belirlendi. Aerobik ve direnç egzersizlerinin birlikte uygulanmasının halk sağlığını korumada ve hareketsizliğin neden olduğu hastalıkları önlemede ve tedavi etmede önemli bir egzersiz türü olduğu düşünülmektedir.

ANAHTAR KELİMELER: Egzersiz, Kadın, Hormonlar, İnsülin, Lipidler.

ABSTRACT

OBJECTIVE: Despite the indisputable beneficial effects of regular exercise on health, more data are needed on the underlying molecular pathways that regulate these effects. In this study, it was aimed to investigate the effects of regular combined exercises on serum irisin and insulin levels and lipid profile in sedentary healthy young women.

MATERIAL AND METHODS: The sample group of the study consisted of 35 healthy sedentary young women. The mean age of the participants was 21.4±1.94 years, their mean height was 164.3±5.89 cm, and their body weight was 62.2±8.1 kg. The participants were given combined exercises (aerobic + resistance) for 10 weeks, 3 days a week, 75 minutes a day. The variables to be measured in the study (height, body weight, waist and hip circumference, body fat percentage, lipid profile markers, irisin and insulin hormones) were measured before starting the exercise (week 0) and after the exercise application (10 weeks). Data analysis was evaluated with a dependent sample t-test and pearson correlation test.

RESULTS: As a result of the evaluation of the data, it was found that 10 weeks of regular combined exercises decreased insulin levels (p=0.003) and increased irisin levels (p=0.012) in sedentary young women. A statistically significant difference was also found in triglyceride values, which is one of the lipid profile markers (p=0.008).

CONCLUSIONS: It was determined that the combined exercises performed regularly for 10 weeks have significant effects on irisin and insulin of healthy sedentary young women. It is thought that the application of aerobic and resistance exercises together is an important type of exercise to protect the public health by preventing and treating diseases caused by inactivity.

KEYWORDS: Exercise, Female, Hormones, Insulin, Lipids.

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Yazışma Adresi / Correspondence: Doç. Dr. Şeniz KARAGÖZ
Afyon Kocatepe Üniversitesi, Spor Bilimleri Fakültesi
E-mail: senizkaragoz@gmail.com
Orcid No (sırasıyla): 0000-0003-2899-1689, 0000-0002-9632-8697, 0000-0001-5116-3246, 0000-0002-5353-3228, 0000-0001-5510-9415
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INTRODUCTION

Today, urban living conditions, technological developments, economic and environmental, etc. conditions lead individuals to an inactive lifestyle. Inactive lifestyle, which is a sedentary lifestyle, and the energy imbalance that occurs with unbalanced and irregular nutrition cause health problems (1). It is generally accepted that the protective effects of exercise on public health have important benefits related to energy metabolism. It is also known that there is a delicate balance in the ratio of energy expenditure to energy intake, and the molecular mechanism underlying this balance is complex (2).

Disruption of energy metabolism causes obesity and metabolic diseases, which are the diseases of our age (3). Genetic factors, balanced and regular diet, regular exercise and physical activity, as well as metabolic diseases and hormones, affect energy metabolism. Investigating the structures and mechanisms of action of hormones, knowing the changes that occur in both acute exercise and regular exercise create new thoughts and ideas in terms of public health.

The effects of hormones such as irisin, leptin, ghrelin, insulin, etc. on energy regulation and their changes in acute and chronic exercise have been among the important research topics in recent years (2, 4). In this context, one of the current research topics is to investigate the circulating level of the hormone irisin (5, 6) secreted by myocytes, which mediates the positive effects of exercise on metabolism, and the parameters associated with it. Irisin is a recently identified peptide hormone derived from the extracellular domain of the fibronectin domain-containing protein 5 (FNDC5) (7). Irisin has been extensively studied by Boström et al., (2012) for its potential therapeutic aspects (5). Irisin is involved in the transformation of white adipose tissue into brown adipose cells by decomposing uncoupling protein1 (UCP1) (8). The resulting brown adipocytes are rich in mitochondrial UCP1 and are involved in heat production and energy expenditure (3). It has also been shown to control mitochondrial biogenesis and oxidative metabolism in many cell types (5).

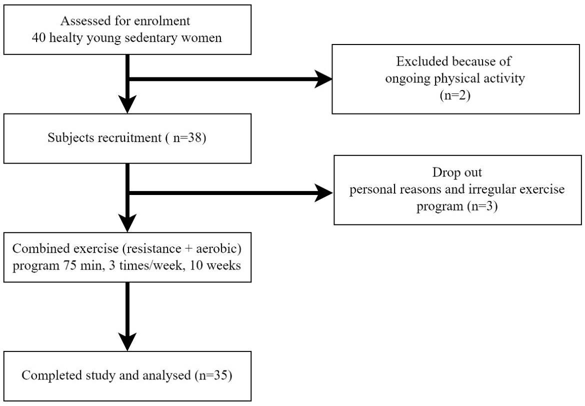
Irisin increases glycerol release and reduces lipid accumulation in adipocytes, and also increases glucose uptake capacity by increasing Glucose transporter type 4 (GLUT4) expression in brown fat cells (9). Thus, circulating irisin levels are associated with improved glucose homeostasis by reducing insulin resistance (10). For these reasons, irisin has been proposed as a therapeutic hormone for obesity and other metabolic conditions (11). When the literature is examined, the effects of irisin and insulin hormones on energy metabolism have been observed along with changes in irisin and insulin hormone levels, biochemical parameters, and body composition during regular exercises (3, 5, 12). However, while studies indicate that irisin level increases with acute and chronic exercise (13), it has been reported in the literature that acute exercise does not have an increasing effect on irisin level (14, 15) and exercise has irisin-reducing effects (16, 17). In the literature, it is seen that exercise has different effects on the irisin level, but still, no consensus has been reached and investigation of irisin changes and effects in exercise is still a current issue. In addition, longitudinal studies examining serum irisin and insulin changes in healthy sedentary young women with combined exercise intervention and showing the relationship of these hormones with lipid profile and body components have not been found. In this context, the investigation of changes in the levels of irisin, insulin and related parameters during regular combined exercises is accepted as original research. In this direction, it is thought that the results of the research will make an important contribution to the literature.

MATERIALS AND METHODS

Sample selection

The sample group of the study consisted of 35 sedentary healthy young women aged under 30 from Afyon Kocatepe University and between the ages of 19-28 who did not exercise regularly for the last three months **(Figure 1).** The convenience sampling approach was used as the sampling method. Sedentary lifestyle and physical inactivity were defined as the number of hours per week spent during leisure time, e.g., computer use, video game playing, television viewing, and reading. Consumed time was measured by a physical activity questionnaire. The questionnaire included information on activity types, frequencies, and an average of time spent on these activities over the last three months before the interviews. Subjects with underlying cardiovascular diseases, hypertension, impaired mobility, hepatic and renal function were excluded. Flow chart of the study representing subject enrolment, exercise intervention (Figure 1).

Figure1: Study flow diyagram



Exercise program

The adaptation training program was applied for the first week of exercises. The exercises increased gradually and the maximum heart rate reserve (HRR) of the subjects has been 40-50% in the first two weeks, 51-60% in 3-4.weeks, 61-70% in 5-6.weeks, and 71-80% in 7-8. weeks and 71-80% in the 9-10.weeks **(Table 1).** To determine the exercise intensity/intensity of the subjects, the intensity of the study was determined for each individual using the Karvonen method (15,18). The heart rate (HRN) interval between the individual's resting heart rate (RHR) and maximum heart rate (MHR) was taken into account. The target heart rate (THR) formula was calculated as follows.

Karvonen method: Max.HRN= 220-years; THR = % Exercise intensity x (MHR -RHR)+RHR. Heart rates were checked with a polar M400 GPRS heart rate monitor. The intensity of the exercise was reduced to decrease the heart rate of the subjects with pulse intervals above the heart rate range (18). To determine the resistance exercise intensity of the participants, the maximal weights lifted (1 TM) were determined using the Weight × (1 + (0.033 × number of repetitions) formula) and the exercises were applied at a rate of 40% of each participant's 1 TM weight (19). Shows the details of the exercise program at 10 weeks applied (Table 1).

Table 1: Shows the details of the exercise program at 10 weeks applied

Exercise	Week 0–2	Week 3–4	Week 5–6	Week 7–8	Week 9-10
Warm-up (15min.)	The dynamic warm-up protocol has been applied (straight runs, various running drills, various educational games, dynamical stretching exercises)				
Resistance exercises (30 minutes)	Sets × rep /rest	Sets × rep / rest	Sets × rep / rest	Sets × rep / rest	Sets × rep / rest
Leg leg-press leg curl	1x8 rep./ 2 minutes rest between sets	2x8 rep./ 2 minutes rest between sets	2x10 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets
Back Lat pull down- back extension	1x8 rep./ 2 minutes rest between sets	2x8 rep./ 2 minutes rest between sets	2x10 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets
Chest Dumbbell press Dumbbell fly	1x8 rep./ 2 minutes rest between sets	2x8 rep./ 2 minutes rest between sets	2x10 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets
Shoulders Dumbbell front raise Dumbbell side lateral raise	1x8 rep./ 2 minutes rest between sets	2x8 rep./ 2 minutes rest between sets	2x10 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets	2x12 rep./ 2 minutes rest between sets
Abdominal Crunch Double leg raise Russian twist	1x10 rep./ 2 minutes rest between sets	2x10 rep./ 2 minutes rest between sets	2x15 rep./ 2 minutes rest between sets	2x20 rep./ 2 minutes rest between sets	2x20 rep./ 2 minutes rest between sets
Aerobic exercises (20 minutes)	Brisk straight walks (%40-50)	Brisk Incline Walks (%51-60)	Walking+Jogging (%61-70)	Jogging (%71-80)	Jogging (%71-80)
Cooldown (10 minutes)	Static stretching exercises were applied (Lower backstretch, lying knee to chest stretch, kneeling reach forward stretch, groin stretch, glute stretch, hip flexor stretch, quad stretch, hamstring stretch, calf				

Data Collection Tools

Volunteers who will participate in the study were asked not to use any drugs and ergogenic aids within 48 hours before the measurements to standardize the study. No diet program was applied during the program. All subjects were asked to continue their normal lives and not to do extra physical activity during the exercise protocol. In addition, blood samples were taken after night fasting in the morning on the 7th day after the menstrual cycle for lipid profile and hormone measurements.

In the study, before and after the exercise program, the participants' body weights, heights, waist and hip circumference measurements, body fat percentage, lipid profile (total cholesterol (TC), triglyceride (TG), High-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol), irisin, and insulin hormones were analyzed from 10 ml blood samples of the participants' forearm venous taken by specialist health personnel into serum tubes. At the end of the exercise period (10 weeks), post-test measurements and blood collection for all parameters to be checked were performed using the same protocol.

Height measurement: It was measured using the Seca brand height meter with a precision of 1 mm, wearing as light clothes as possible. Bodyweight, Body fat percentage measurement: Bodyweight (BW), body fat percentage (BFP), and body mass index (BMI) of sedentary young women, were evaluated with a bioelectric impedance analyzer (BIA) (Tanita BC-418 USA brand) with light clothing as much as possible. Before the BIA measurement, the participants were informed, and they were asked not to drink alcohol until 48 hours before, not to eat and drink 4 hours before, not to consume tea, coffee, and cola for 12 hours, and not to exercise. It was also stated that women would not be able to participate in the measurements during the menstrual period. For measurements, attention was paid to bare feet with light clothing, not having any metal objects on them, to be on an empty stomach and empty bladder.

Waist-Hip measurement: All circumference measurements (waist, hip) were taken with a tape measure with an accuracy of 0.1 cm. Waist circumference measurements of the exercise group participants were measured with a tape measure just above the belly button (umbilicus) and recorded in centimeters (cm). The hip circumference measurements of the participants were made with a tape measure from the widest part of the hip (the most swollen part of the gluteus maximus muscle) and recorded in centimeters.

Collection of blood samples: To determine the irisin, insulin and lipid profile of the exercise group subjects, 10 ml blood samples were taken from the forearm venous of the participants by the specialist health personnel into serum tubes between 08.00-09.00 in the morning on an empty stomach, in the physiology laboratory of the Faculty of Sports Sciences of Afyon Kocatepe University. The blood samples taken were delivered to the Afyon Health Sciences University Faculty of Medicine Biochemistry Laboratory in a blood sample transport container (cold chain) without wasting time. Blood samples were separated into serum by centrifugation at 3000 rpm for 10 minutes using a centrifuge device. The separated serums were taken into 2 different Eppendorf tubes for each individual and stored at -20^{0}C until the day of the study. Lipid profile was evaluated by performing irisin and insulin hormone levels, as well as total cholesterol, triglyceride, HDL, and LDL analyzes from the separated serum samples.

Irisin Measurement of Serum

Irisin measurements in serum were made with the USCN brand Human Irisin Elisa kit (Uscn Life Science Inc., Wuhan, Hubei, PRC). Absorbance reading was done on ChemWell 2910 brand Elisa reader device. (Awareness Technology, Inc. Martin Hwy. Palm City, USA). Results are given in ng/ml.

Insulin Measurements in Serum

Insulin measurements in serum were made with DiaMetra brand Human Insulin Elisa kit (DiaMetra, Via Calabria, Segrate - Milano Italy). Absorbance reading was done on ChemWell 2910 brand Elisa reader device. (Awareness Technology, Inc. Martin Hwy. Palm City, USA). Results are given in μIU/ml.

Total Cholesterol, Triglyceride, HDL and LDL Measurements in Serum

Total cholesterol, triglyceride, HDL, and LDL measurements in serum were performed using Biolabo brand commercial kits (Biolabo SA, Maizy, France) as specified in the package insert. Results are given as mg/dl for Total Cholesterol, Triglyceride, HDL, and LDL.

Ethical Committee

This study was approved by the Afyonkarahisar Health Sciences University Faculty of Medicine Research Ethics Committee, clinical research ethics committee (07.09.2018/9) and was carried out in accordance with the Declaration of Helsinki.

Statistical Analysis

The normality test of the data was determined by the Shapiro Wilk test. It was found that the data showed normal distribution. All data were presented as mean±standard deviation and paired sample t-tests were conducted to analyze differences between groups. In addition, the Pearson correlation coefficient was calculated to determine whether serum irisin and insulin levels were associated with body composition and lipid profile. The confidence interval was chosen as 95%, and values below $p < 0.05$ were considered statistically significant.

RESULTS

We analyzed physical characteristics of the participants before and after the training program. We found that BW, BMI, BFP, hip circumference (HC), waits circumference (WC) levels were statistically significantly decreased after training compared to pre-training. After the training program, participants' body weight (t = 4.51; p =0.000), BMI (t = 466; p =0.000), BFP (t = 7.26; p =0.000), hip circumference (t = 12.22); p =0.000) and waist circumference (t = 8.93; p =0.000) mean significantly decreased **(Table 2)**.

Table 2: Changes in the physical characteristics of the participants before and after the training program

	Sedentary healthy young women (n=35)			
	Before	After	t	*p value*
Age (years)	21.4±1.94			
Height (cm)	164.3±5.89			
BW (kg)	62.2±8.1	60.5±7.90	4.51	.000**
BMI (kg/m²)	23.1±3.37	22.4±3.04	4.66	.000**
BFP (%)	30.30±5.56	28.61±4.93	7.26	.000**
HC (cm)	103.17±5.67	99.97±5.41	12.22	.000**
WC (cm)	80.22±6.22	76.14±5.91	8.93	.000**

Values are expressed as mean ± SD. BW, body weight; BMI, body mass index; BFP, body fat percentage; HC, hip circumference; WC, waits circumference.

We analyzed changes in lipid and hormonal profiles of the participants before and after the training program. According to these findings, no significant differences were found in serum TC, HDL and LDL levels between before and after training. However, while after training serum TG and insulin levels were significantly decreasing serum irisin level was significantly increasing. Averages of TC (t=1.34; p=0.187), TG (t=2.80; p=0.008), HDL (t=-1.79; p=0,082) and LDL (t=0.67; p=0.502) in blood samples taken before and after combined training; a significant difference was found only in TG levels. In the combined training program applied to sedentary young women for 10 weeks, the last measurement average of the triglyceride variable was significant (p=0.008). Additionally, significant differences were found in mean serum irisin (t=2.64; p=0.012) and insulin (t=-3.23; p=0.003) values **(Table 3)**.

Table 3: Changes in lipid and hormonal profiles of the participants before and after the training program

	Sedentary healthy young women (n=35)			
	Before	After	t	*p value*
TC (mg/dl)	154.31±21.95	149.16±31.14	1.34	0.187
TG (mg/dl)	93.86±21.13	84.70±25.95	2.80	**0.008***
HDL (mg/dl)	41.19±10.15	43.64±12.28	-1.79	0.082
LDL (mg/dl)	88.87±20.55	86.83±22.82	0.67	0.502
Irisin (ng/ml)	21.34±5.90	24.72±4.93	2.64	**0.012***
Insulin (µIU/ml)	12.76±7.69	10.23±5.17	-3.23	**0.003***

Values are expressed as mean ± SD. TC, total cholesterol; TG, triglyceride; HDL, High density lipoprotein; LDL, Low Density Lipoprotein

In this study, the correlations between serum irisin, insulin levels and lipid profile were also examined. Statistically significant positive correlation was found between TC and HDL and between TC and LDL **(Table 4)**. In addition, the correlation between body composition (BW, BMI, BF, HC, WC) and blood parameters (serum irisin and insulin, TC, TG, HDL, LDL) was also examined. While statistically significant positive correlations were found between serum insulin level and BW, BMI, BF% and HC, statistically significant negative correlations were found between serum HDL level and BMI and WC **(Table 5)**.

Table 4: Correlation between serum irisin, insulin levels, and lipid profile (TC, TG, HDL, LDL)

Variables	n=35	Insulin	Irisin	TC	TG	HDL	LDL
Insulin (µIU/ml)	r		.206	.325	.248	.097	.314
	p		.234	.057	.151	.580	.067
Irisin (ng/ml)	r			.051	.051	.313	.164
	p			.771	.770	.067	.346
TC (mg/dl)	r				.171	**.414***	**.771****
	p				.326	.013	.000
TG (mg/dl)	r					.053	.131
	p					.762	.453
HDL (mg/dl)	r						.281
	p						,101

The variables are expressed: n= number of participants. TC, total cholesterol; TG, triglyceride; HDL, High density lipoprotein; LDL, Low Density Lipoprotein

Table 5: Correlation between body composition (BW, BMI, BF, HC, WC) and blood parameters (serum irisin and insulin, TC, TG, HDL, LDL)

Variables	n=35	BW	BMI	BF %	HC	WC
Insulin (µIU/ml)	r	**.479****	**.362***	**.504***	**.363***	.178
	p	.004	.033	.002	.032	.306
Irisin (mg/dl)	r	-.118	-.069	.040	-.076	-.223
	p	.501	.692	.817	.665	.198
TC (mg/dl)	r	-.003	-.300	-.033	-.211	-.273
	p	.985	.080	.851	.225	.113
TG (mg/dl)	r	.121	.244	.088	.057	.181
	p	,490	.158	.613	.745	.298
HDL (mg/dl)	r	-.223	**-.362***	-.089	-.312	**-.441***
	p	.199	.033	.613	.068	.008
LDL (mg/dl)	r	.238	.050	.200	.001	.027
	p	.168	.777	.250	.997	.876

The variables are expressed: n= number of participants. TC, total cholesterol; TG, triglyceride; HDL, High density lipoprotein; LDL, Low Density Lipoprotein; BW, body weight; BMI, body mass index; BF, body fat; HC, hip circumference; WC, waist circumference

DISCUSSION

This study, it was aimed to examine the effects of 10-week combined exercises applied to healthy sedentary young women on serum irisin levels, serum insulin levels, lipid profiles, and body components. When the pretest and posttest measurement results of 10 weeks of regular combined exercises applied to sedentary young women were compared, it was found that there was a significant increase in serum irisin level and a significant decrease in serum insulin level .

As a result of the pretest-posttest evaluation of the lipid profile of the participants, a significant decrease was found in triglyceride levels. In addition, significant changes were found in body composition, body weight, body mass index, body fat percentage, hip and waist circumference parameters. There were positive and moderately significant correlations between serum insulin hormone and body components. No significant relationship was found between serum irisin hormone and body components. In addition, there was no relationship between serum irisin and serum insulin hormones. Various studies have investigated the effects of different types of exercise on serum irisin levels, and the results have been inconsistent to make a firm judgment (5, 16). In this study, a significant increase in circulating irisin was found as a result of regular combined exercise intervention. Studies indicate that different types of exercise, such as high-intensity swimming, treadmill, and resistance exercise, increase circulating irisin levels regardless of the age, physical fitness level, or health status of the participants (20). Similarly, another study showed that three different exercise protocols significantly increased serum irisin level, especially after maximum exercise workload (21). Although the existence of health-promoting effects of regular physical activity/exercise is known, the molecular, cellular, and systemic mechanisms underlying these effects have not been fully elucidated yet. In addition to defining irisin as a myokine triggered by the effect of exercise in some research results (5, 22) there are also studies stating that exercise has no effect on irisin level or has a reducing effect on irisin level (23). These inconsistent results are thought to be due to differences in study designs, physical and physiological characteristics of the participants, age and gender, healthy and unhealthy conditions, and diet.

It was found that the combined exercise, which was applied for 10 weeks without applying for any diet program, increased the circulating irisin levels of healthy sedentary young women, which is consistent with the results of previous studies (13). It has been predicted that regular combined exercises can have significant effects on circulating irisin levels (24), and it is known that there is an increase in circulating irisin after endurance training intervention in clinical studies (5, 24), It is thought that combined exercises lead to increases in aerobic fitness, muscle mass, and strength in healthy young women, so that exercise promotes the increase of iris by contracting skeletal muscles (5, 13). In this context, combined exercises can be used as one of the important strategies to protect the health status of individuals and to prevent and treat metabolic functional disorders such as obesity that may occur in the future. Another important finding of the study was the decrease in circulating insulin levels. Regular physical activity has positive effects on many diseases such as cardiovascular diseases, diabetes, hypertension, obesity, depression, and osteoporosis (25). It is known that the insulin sensitivity of the tissues increases for individuals who exercise regularly for a long time (26). Researchers state that contractions during exercise increase the uptake of blood sugar into the cell to support intramuscular glycogenolysis, and the decrease in the need for insulin due to the decrease in circulating blood sugar causes a decrease in insulin levels secreted from the pancreas (27). This has also been associated with an increase in the number of mitochondria and regulation of mitochondrial functions during exercise (28).

With regular exercise, changes occur in the blood lipids of individuals. As a result of the study, there was a significant decrease in triglyceride levels analyzed from blood samples. When the studies in the literature are examined, it is seen that the exercises applied to change the blood lipid levels in individuals of different age groups, gender differences, healthy sedentary individuals, or unhealthy sedentary individuals, but the results are contradictory (28, 29). It is thought that the reason for these different results may be the intensity, type, duration of exercise, differences in the physical characteristics of individuals, diet, sleep patterns, and their responses to exercise.

Similar to the results of this study, it was observed in the literature that combined exercises performed regularly in different sample groups caused a decrease in body weights, body fat percentages, waist and hip circumferences (30). As a result of regular combined exercises in healthy sedentary young women, changes were detected in the participants' body weight, body fat percentage, waist, and hip circumferences. Physical activity or exercise is thought to be effective in improving quality of life by reducing fat mass, body weight, and factors affecting it (30, 31, 32). These results obtained without any diet program applied to the participants show that regular combined exercises have positive effects on body composition. This study has some limitations that should be taken into account.

First, a possible limitation of the current study is the lack of a control group and only female subjects. Therefore, all effects of combined exercises on serum irisin, insulin, lipid profile, and body composition should be investigated in a large sample group of male-female, young-old adults. Second, a diet program should be implemented to exclude differences in caloric intake, which may affect the final results.

In this research which was conducted on healthy young women, serum irisin significantly increased and serum insulin significantly decreased after 10 weeks of combined exercise.

The results confirmed our hypothesis that regular combined exercise affects the increase in circulating irisin and the decrease in circulating insulin in healthy young women. In addition, our hypothesis has been confirmed that regular combined exercises have a positive effect on triglycerides and body composition from blood lipids. No relationship was found between irisin and insulin hormones.

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