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RESPONSE AND COMPATIBILITY OF PLASMA LEVELS OF NESFATIN-1, GLUCOSE AND INSULIN RESISTANCE INDEX TO CIRCUIT RESISTANCE TRAINING IN OBESE DISABLED MEN

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ABSTRACT

Nesfatin-1 is a rather new adipokine that secrets from adipose tissue and has a role in the mechanism of blood glucose regulation, improving insulin sensitivity, appetite regulation and metabolism. Given the importance of resistance exercise in the prevention and treatment of overweight and obesity, the aim of this study is to examine the response and adaptation of plasma levels of nesfatin-1 to circuit resistance training among obese men with disabilities. 22 obese disabled men with aged 25±5 years and with an BMI of 30±2.5 kg/m2 were selected and randomly divided into 2 groups: experimental and control. Experimental group included 12 subjects who participated in an eight-week resistance training, 3 sessions per week with intensity of 60-65 % and with the gradual increase to 70-80% with one repetition maximum at the end of each session. And control group included 10 persons who took part in no training or physical activities during the study period. Blood samples to assess the levels of nesfatin-1, glucose and insulin resistance were taken before the study, after one session and after the eight weeks of training. The collected data was analyzed by using K-S test, ANOVA with repeated measures in SPSS and with a significance level of α<0.05. The findings showed that one session immediately after and eight weeks of circuit resistance training didn't affect the plasma levels of nesfatin-1 in obese disabled persons. While the amount of glucose and insulin decreased significantly. Therefore using this type of training can be helpful in decreasing glucose and insulin resistance in obese disabled men. Circuit resistance training has a significant effect on glucose level of blood but has no significant effects on levels of nesfatin-1.

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KEY WORDS

Nesfatin-1, Glucose, Insulin resistance, Resistance exercise, Physically disabled, Obesity

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INTRODUCTION

In the past, adipose tissue was seen as the source of fat storage but in recent years it has been recognized as a major endocrine organ that produces bioactive mediators which have a role in controlling blood pressure, metabolism of glucose, resistance to insulin and inflammation and obstruction of arteries [1]. These bioactive mediators are proteins that are called adipokines. It is thought that adipokines participate in the development of insulin resistance in different tissues, in type II diabetes and cardiovascular diseases [1]. In fact, adipose tissue is not only an inactive source of energy to the body, but also it's known as an active endocrine organ that produces biological materials called adipocytokines [2, 3]. Nesfatin-1 is one of these adipocytokines that is produced in adipose tissue and participates in the regulation of appetite and hemostasis of energy and metabolism and is affected by inflammatory cytokines and insulin [4]. The amount of this adipocytokine in epidermis adipose tissue is more than the amount in visceral adipose tissue and its amount is affected by the diet, inflammatory cytokines and insulin and participates in appetite regulation and energy balance [5]. In 2006, Nesfatin-1 was discovered by Oh et al, as an anti-appetite polypeptide with 82 amino acids derived from the post-translation process of Nucleobindin 2 gene (NUBC2) in hypothalamus of rats; they divided the discovered parts derived from NUCB2 as: number 1 to 82, nesfatin-1; number 85 to 163, nesfatin-2 and number 166 to 396 nesfatin-3. It was found that nesfatin-1 participates in the function of the digestive system and gastric emptying and its plasma concentration changes by feeding, fasting, diabetes and physicals activity [7, 6]. Nestfatin-1 is expressed in hypothalamus of rats and humans and its expression reduces in the paraventricular nucleons of hypothalamus while fasting or hungry [8]. Nesfatin-1 is one of neuropeptides that regulates appetite and is produced in hypothalamus and has an

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important role in energy balance. Ramanjaneya et al (2006) has also shown that the amount of nesfatin-1 has a positive correlation with body mass index in blood circulation [9]. Activity and movement are human beings essential needs and disabled people especially need more movement to be healthy and succulent for they are faced with more movement limitations than others. Until half a century ago it was thought that the disabled people have no place in sports competitions and could only watch sports events. But today due to significant developments in disabled sports, its precious role is becoming more obvious in the lives of the disabled people, in a way that today it has become an inseparable part of their lives but diversity of exercises suitable for the disabled has made them needless of all complicated sports equipment. Different factors affect the production of adipocytokines such as physical activities; and the response of each adipocytokine depends separately on the length and intensity of the exercise. However, enough research hasn't been done with respect to the effects of exercise on nesfatin-1. Haghshenas et al (2011) found that twelve weeks of resistance training increases the level of nesfatin-1 and reduces the level of glucose and insulin significantly [10]. Ramanjaneya et al (2010) showed that fasting for 24 hours before killing the mice will reduce expression of nesfatin in epidermis adipose tissue significantly [9]. Taji Tabas et al (2016) showed that ten weeks of resistance training had an effect on the level of nesfatin in women with type II diabetes, this training brought about a significant increase in nesfatin-1 and a reduced glucose and insulin significantly [11].

Since little research has been conduncted on the effects of exercise and physical activities on this adipocytokine and because these research have conflicting results, and since there has been no research on the response and compatibility of circuit resistance trainings on the amount of nesfatin-1, glucose and body resistance to insulin in obese men, the present research aims to analyze the response and compatibility of an eight-week circuit resistance training program to the plasma levels of nesfatin-1, glucose and resistance to insulin in obese disabled men.

MATERIALS AND METHODS

Subjects

This semi-empirical research was done with two groups: experimental and control. The population includes all the obese disabled men in Zahedan (city in east of Iran). Subjects were selected in a targeted way, after filling out the consent form they were divided into two groups randomly, 12 of them in the experimental group and 10 of them in the control group. In this research it wasn't possible to control the affecting factors precisely, but to control the unwanted influence and confounding variables the subjects were asked to abstain from smoking, using alcoholic beverages or doing any strenuous physical activities during the study period. To omit the influence of circadian rhythm on hormonal changes, all the tests and sampling were done in a particular time for all the groups.

Methods of measuring anthropometric indices

Measurement of the anthropometric indices including weight, height, BMI (body mass index), percentage of body fat and WHR (waist-hip ratio) was done with the least amount of clothes on and without shoes.

Measurement of height and weight was done while the subjects were standing and by using height gauge installed on the wall (with an accuracy of one millimeter) and digital weighing scale (with an accuracy of 0.1 kilogram) respectively. BMI was calculated through the body weight (kilogram) divided by the squared height (square meter). Thickness of the skinfold on the chest, stomach and thigh was measured by Harpenden Skinfold Caliper. Percentage of body fat was estimated by Jackson and Pollock 3-site Skinfold Equation [12, 13, 14].

Jackson and Pollock 3-Site Skinfold Equation [12]:

Db = 1.1093880 – (0.0008267× sum of skinfolds) + (0.0000016 × square of the sum of skinfolds) – (0.0002574 × age)

Db is the body density of men, skinfold sites are abdominal, triceps and suprailiac and age refers to the age of the subjects.

Then the percentage of body fat was measured by Siri formula [12]:

Siri formula is: %F = (4.95/Db − 4.50) | %F=body fat percentage

WHR was measured by inelastic tape measure and without putting any pressure on the body of the person (with an accuracy of 0.1) and by measuring the least waist circumference in the area between the lowest rib and iliac crest, and if the thinnest waist circumference was not recognizable, the measurement was done in the smallest horizontal circumference of this site, and the waist measurement divided by hip measurement calculated the WHR. Hip

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circumference was measured in a relaxed and loose state [15]. All the above mentioned indices were measured again after the eight-week circular resistance training.

Methods of measuring biochemical variables

To measure the biochemical variables of both groups, 10 ml blood was taken of the right brachial vein of each subject in a 12-hour fasting condition 48 hours before the first session of the training and immediately after the training and 48 hours after the last session of training.
The subjects were asked to refrain from any intense exercise 48 hours before the first session and 48 hours after the last session of the training. The blood samples after centrifugation and plasma separation were kept in a -30 degrees centigrade condition to be analyzed with the blood samples after training sessions and the one at the end of the study. The level of fasting blood sugar was measured by the colorimetric method and based on the enzymatic method and by using the glucose laboratory kit of Pars Azmoon company made in Iran and by Hitachi device made in Germany. The insulin resistance index was calculated by using HOMA-IR index [15]:

$$HOMA - IR = (FPL(\mu u/ml).FPG(mmol/l))/22.5$$

FPL= fasting insulin (microU/L)
FPG= fasting glucose (mmol/L)

The plasma level of nesfatin-1 was measured by laboratory kit of human nesfatin-1 made by Phoenix Pharma Company in the USA.

Training Plan

In the experimental group, the circuit resistance training was performed for eight weeks, three sessions each week. The subjects attended two orientation sessions to get familiar with safety precautions related to exercising with weights and systematic use of bodybuilding equipment; then one more repetition for all the six activities was determined, with repletion to the tiring limitation. To use this method the subject moved the weight under the maximum until exhaustion, in a way that the number of movements won't be less than 10 before exhaustion. Then according to Brzychi equation [16] the maximum amount of force (one-repetition maximum) of each subject was calculated for that exercise [17]:

$$1RM = \frac{w}{[1.0278 - (0.0278r)]}$$

1RM= the maximum amount of force, w=the size of the weight, r= the number of receptions before resistance overload

The resistance training included exercising with six devices (bench press, standing cable curl with rope, rope press down, military press, military press behind and arm row cable) and free weights that was six movements all in all. After teaching the subjects how to work with the devices, on each device three sets were performed with 12 repetitions, and after the first four weeks of training, one more repetition maximum was also assigned. The resistance training program started with an intensity of 60 to 65 percent and with one more repetition maximum and gradually increased to 70 to 80 percent with one repetition maximum at the end of each session. The time allocated to perform each movement in any of the stations was 60 seconds and the resting time between two stations were two minutes and the resting time between each two sets was 1 minute. Each training session included warm up (6 minutes of slow running and 4 minutes of stretching exercises), resistance training with devices and free weights (40 minutes) and cool down (5 minutes of slow running or walking and 5 minutes of stretching exercises). During the study period the persons in the control group didn't participate in any training programs.

Data Analysis

Kolmogorov–Smirnov test was used to analyze the normal distribution of the data. For the intragroup and intergroup changes ANOVA with repeated measures was used. In all the tests the significance level was set at $\alpha < 0.05$. The analysis of data was done by using SPSS version 22.

Findings

The average of age of subjects in control and experimental groups was 24.66 and 25.33 respectively. And the average of height in the control group was 171.20 cm and in the experimental group it was 169.66 cm. The normal distribution of the data was confirmed by Kolmogorov–Smirnov test.

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Table: 1. statistics results of anthropometric subjects in control and experimental groups in pretest and posttest

Variable	Group / Stage	Control group (10 persons)	Experimental group (12 persons)
Weight (kg)	Pretest	87.98±6.89	85.63±5.95
	Posttest	88.45±6.41	82.12±4.56
BMI (kg/m^2)	Pretest	29.75±2.55	29.67±2.68
	Posttest	30.24±2.44	28.75±2.54
WHR	Pretest	0.88±0.83	0.91±0.17
	Posttest	0.89±0.85	0.89±0.23
Percentage of body fat	Pretest	32.15±6.22	33.44±6.88
	Posttest	32.48±6.78	32.03±6.43
Age (years)	24.66±3.22		25.33±3.02
Height (cm)	171.20±4.56		169.66±5.34

The values are shown in standard deviation ± average.

According to table 1, the average of body weight, BMI, waist-hip ratio and percentage of body fat in control group has increased during the time between the pretest and the posttest; while the average of these factors in the experimental group has decreased.

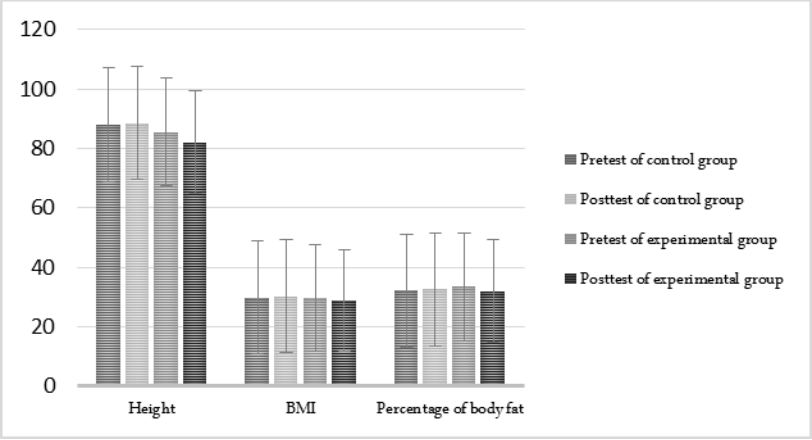

Fig: 1. The comparison of weight, BMI and percentage of body fat in pretest and posttest in control and experimental group

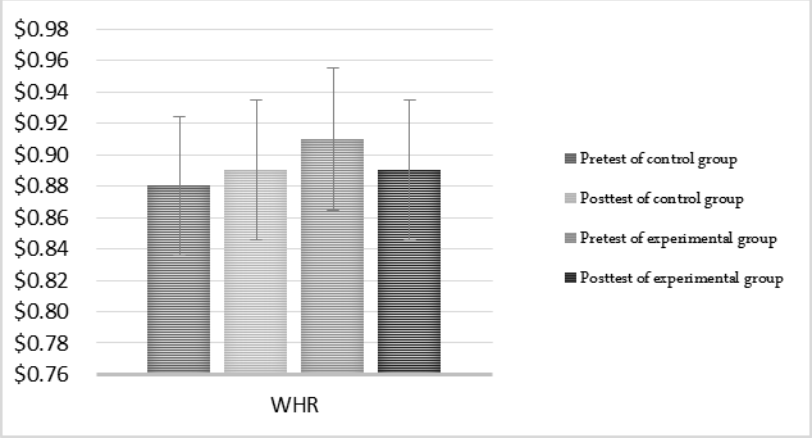

Fig: 2. Comparison of WHR variable in pretest and posttest of control and experimental groups

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Table: 2. Intragroup test of ANOVA with repeated measure in biochemical variables

Variable	Sum of squares of type 3	Degree of freedom	Average of squares	F	P
Nesfatin-1 (ng/ml)	77454.15	2	32278.49	2.50	0.087
Glucose (mol/l)	497.03	2	248.51	4.76	0.015*
Insulin (µU/ml)	5.52	2	2.76	2.36	0.10
Resistance to Insulin	6.59	2	3.30	8.11	0.001*

Difference at the level of 0.05 is meaningful (P<0.05).

By using ANOVA with repeated measures in the amounts of glucose (p=0.015)(figure 3) and body resistance to insulin (p=0.001) (char 4) a significant decrease is seen. While in the amounts of insulin (p=0.10) and nesfatin-1 (p=0.087) a significant change was not seen **[Table- 2]**.

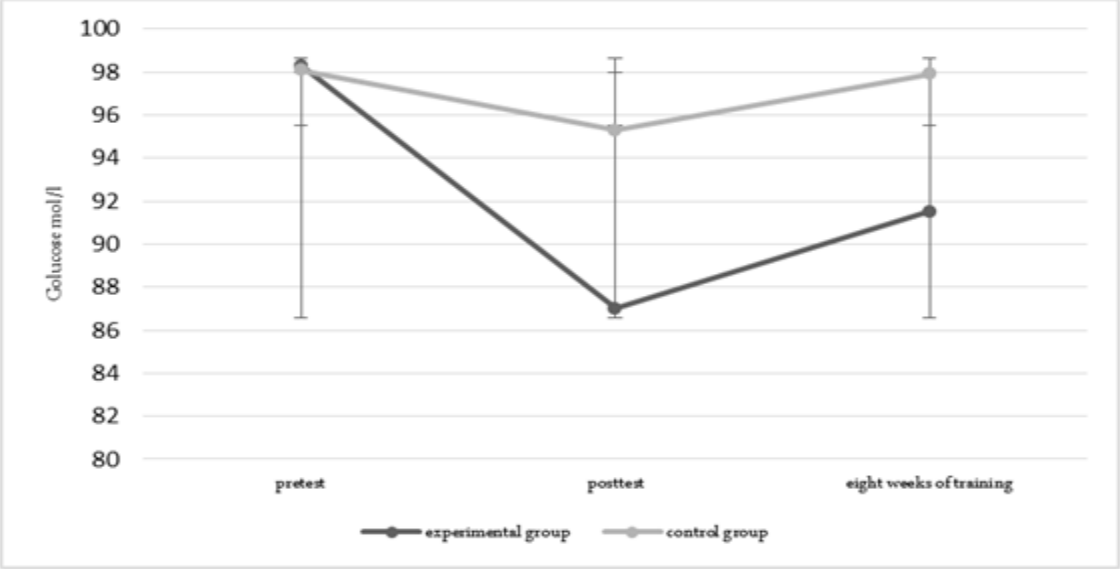

Fig: 3. Glucoselevel in pretest, immediately after one session and posttest

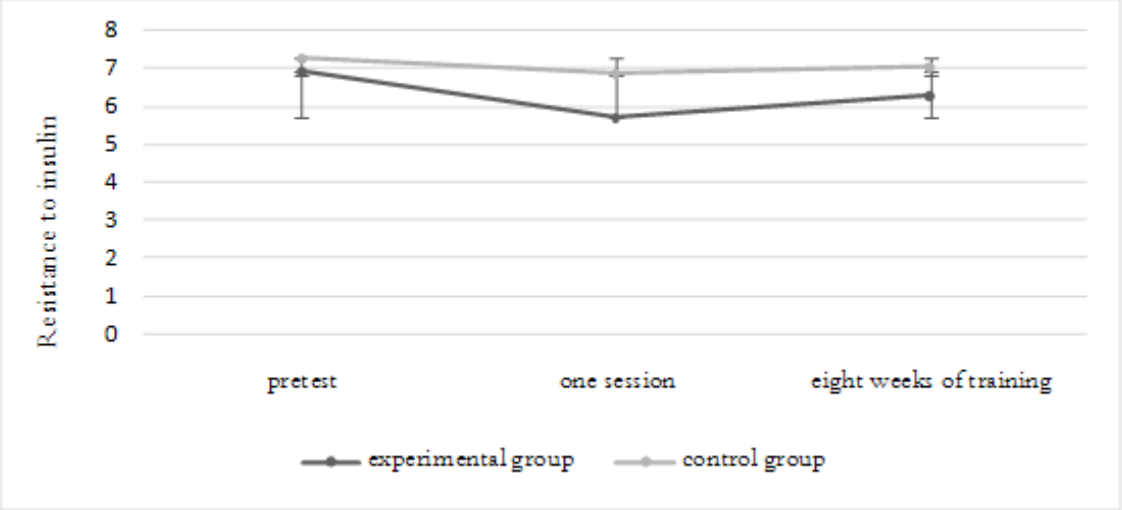

Fig: 4. Resistance to insulin in pretest, immediately after one session and posttest

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Table: 3. Intergroup test of ANOVA with repeated measure in biochemical variables

Variable	Sum of squares of type 3	Degree of freedom	Average of squares	F	P
Nesfatin-1 (ng/ml)	1329241.90	1	1349041.90	1.94	0.18
Glucose (mol/l)	350.41	1	350.41	0.35	0.56
Insulin (µU/ml)	13.55	1	13.55	0.49	0.49
Resistance to Insulin	8.16	1	8.16	1.14	0.29

By using the intergroup ANOVA with repeated measures a meaningful change in the amount of nesfatin-1 (p=0.18), glucose (p=0.56), insulin (p=0.49) and resistance to insulin (p=0.29) was not seen.

Table: 4. The statistical results of biochemical variables in pretest, after one session of training and posttest

Variable	Group / Stage	Control group (10 persons)	Experimental group (12 persons)
Nesfatin-1 (ng/ml)	Pretest	10.11±40.34	10.05±40.31
	After on session	10.06±40.30	10.01±40.16
	Posttest	10.01±40.46	9.26±36.45
Glucose (mol/l)	Pretest	98.10±25.54	98.30±11.43
	After on session	95.30±23.11	87.00±15.27
	Posttest	97.90±24.19	91.50±7.70
Insulin (µU/ml)	Pretest	16.80±3.59	15.93±2.81
	After on session	16.26±3.16	14.99±3.25
	Posttest	16.30±3.27	15.58±2.81
Resistance to insulin	Pretest	7.27±2.09	6.92±1.27
	After on session	6.86±1.95	5.71±1.81
	Posttest	7.02±1.88	6.30±1.01

The values are shown in standard deviation ± average

The major findings of the present research showed that immediately after one session of training and also after eight weeks of circuit resistance training, there was no significant change in the plasma levels of nesfatin-1 and these findings are in line with the works of Ghanbari-Nikai et al (2011) that showed nesfatin-1 hadn't change after one session of RAST and NCKB exercises among young kickboxers [18], and also the work of NazarAli et al that showed no change in nesfatin-1 among overweight women after eight weeks of resistance training [19]. However, the findings aren't in line with the work of Tavassoli et al (2014) that showed a significant change in the level of nesfatin-1 after 12 weeks of circuit resistance training among overweight young adults [20] and the work of Taji Tabas et al that showed after ten weeks of resistance training among women with type II diabetes the amount of nesfatin-1 increases significantly [11]. And with respect to the effects of resistance training on nesfatin-1 little research has conducted. The discrepancy seen in these results is due to the difference in the age and gender of subjects and difference in the length and intensity of training.

One of the limitations in the research that might have caused no change in nesfatin-1 is the diet of subjects in both control and experimental groups. For the expression and secretion of nesfatin-1 is related to nutrition status [21]. And the amount of secreted nesfatin-1 is related to the diet [9]. Therefore, it is suggested to the subjects to control their diet during the study period and refrain from changing their diet. But since this research is semi-experimental controlling the subjects' diet was not possible. Generally, research has shown that the amount of nesfatin-1 is affected by different factors. Ramanjaneya et al (2010), has also shown in their work that TNF and interleukin-6 and insulin increased the inner cell expression of nesfatin-1 genes in cultured fat cells, the findings show that expression and secretion of nesfation-1 is regulated via different ways [9]. Zhang et al (2012) showed the direct effect of central nesfatin-1 on peripheral insulin sensitivity or improvement of insulin activity from changes related to signaling pathways and that nesfatin-1 of hypothalamus through neural pathways can help increasing sensitivity to peripheral insulin by decreasing gluconeogenesis and increasing glucose absorption of glucose [22, 23]. Abaci et al (2012) in a research showed that the amount of oral glucose in fat children might not be enough for nesfatin-1 response and that nesfatin-1 might be an effect of short-term regulators caused by foods [24]. Other findings of this research include significant decrease in glucose level and insulin resistance index in experimental group that is in line with the works of Cauza et al [25], Sharjerd et al [26], Togighi et al [27], Taji Tabas et al [11] and El-Kadar [28] who argue that resistance training can decrease the level of glucose and insulin resistance. The

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findings show that insulin remained unchanged after resistance training and it's in line with the works of Tifighi et al and Taji Tabas et al and it doesn't approve the works of Shahrjerd et al and NazarAli et al who showed significant decrease in insulin. The conflicting results may be due to the difference in the time of blood taking, difference in training protocols and difference in subjects' societies.

According to table 1 the average of weight, BMI, waist-hip ratio and percentage of body fat in control group has increased during the time between pretest and posttest; while the average of these factors in the experimental group decreased. Therefore according to this research weight loss and decrease of body fat can be the reason of glucose decrease and insulin resistance.

CONCLUSION

Generally we can say that eight weeks of circuit resistance training and one session immediately led to significant decrease in glucose level and resistance to insulin; however no change was seen in plasma levels of insulin and nesfatin-1. The results of present research showed that resistance training has an important role in controlling and improving harmful or risk factors in diseases related to glucose (diseases related to metabolism of carbohydrates) and insulin resistance (diseases such as hyperlipidemia, high blood pressure and arteriosclerosis); and by controlling weight, daily exercise and healthy diet (rich in fibers and low fat) lots of these diseases can be prevented. Therefore, it is recommended to the obese disabled persons to use resistance trainings as a preventive measure to lose weight and decrease the probability of obesity disorders and resistance to insulin. Since this research is one of the first studies on the effects of circuit resistance training on plasma levels of nesfatin-1 among obese men, more research is needed to analyze more profoundly the mechanisms affecting nutrition and changes of nesfatin-1 related to the action of glucose and insulin after trainings with more intensity and longer period.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

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FINANCIAL DISCLOSURE

None.

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