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ORIGINAL ARTICLE

Changes in the Level of Asprosin as a Novel Adipocytokine after Different Types of Resistance Training

Mohammad Jahangiri[1], Shahnaz Shahrbanian[*1], Anthony C. Hackney[2]

[1] *Department of Sport Science, Faculty of Humanities, Tarbiat Modares University, Tehran, Iran*

[2] *Department of Exercise & Sport Science, and Department of Nutrition, School of Public Health, University of North Carolina, Chapel Hill, NC 27599, USA*

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KEYWORDS

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ABSTRACT: Obesity is at epidemic proportions in the world. Evidence supports increased physical activity and exercise are efficacious in controlling obesity, in part due to altering select adipocytokine levels. The present study aimed to compare the effect of 12 weeks of three resistance training methods (traditional, circular and interval) on the levels of the adipocytokine asprosin and body composition in sedentary men with obesity. Forty-four sedentary men with obesity, who were randomly divided into the 4 equal groups: traditional, circular, and interval resistance training as well as a control group. Results showed that there was a significant interaction between the type of training used and time on asprosin levels (F (1,40)= 13353.03, P= 0.001, ES= 0.99). All types of resistance training decreased asprosin levels and improved body composition parameters in comparison to the control group (F (3, 40) = 34.60, P = 0.001, ES= 0.77). Interval resistance training had the greatest effect on reducing asprosin levels and improving body composition related outcomes (body mass: P=0.001, ES=0.633, body mass index: P=0.001, ES=0.632, percent body fat: P=0.001, ES=0.647, waist to hip ratio: P=0.001, ES=0.786). The results of the present study support the benefits of resistance training as a non-pharmacological approach in reducing asprosin levels and improving body composition in individuals with obesity.

INTRODUCTION

Obesity, an abnormal accumulation or excessive body fat, is a major health risk that negatively affects human physiological function and threatens public health [1]. Excessive consumption of high-energy and high-calorie foods, globalization of food systems, nutrient-poor diets, as well as reduced physical activity due to technological development and mechanization of life have been identified as major causes of the obesity [2-4]. Obesity increases the risk of a variety of metabolic diseases such as diabetes [5], metabolic syndrome, hypertension, cardiovascular disease [5, 6], cancers [7], musculoskeletal disorders [8] and decreased mental health [9] leading to reduced quality of life, reducing work productivity and increased costs of health care treatment.

The prevalence of obesity has increased since 1980, with almost a third of the world's population now classified as overweight or obese [10]. The increase in obesity over the past few decades has reached epidemic proportion [11].

*Corresponding author: sh.shahrbanian@modares.ac.ir (Sh. Shahrbanian)
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Researchers estimate that if the current trend continues, nearly 60% of the world's population will be overweight or obese by 2030 [12].

Metabolic diseases such as diabetes, obesity, polycystic ovary syndrome (PCOS) and cardiovascular diseases are mainly attributed to disturbances in the normal process of metabolism [13]. Recent studies have shown that the adipokine asprosin plays a critical role in metabolism and metabolic diseases [13]. Asprosin is a novel glycogenic adipokine that was discovered in 2016 [13] and is involved in regulating appetite, glucose metabolism, insulin resistance and cellular apoptosis [14]. Asprosin is release mainly by white adipose tissue and can serve as a biochemical marker for the diagnosis of diabetes and unstable angina pectoris as well as a therapeutic target for the treatment of diabetes, obesity, diabetic cardio-myopathy and ischemic cardio-myopathy [13].Studies report increased asprosin concentrations in obese humans and mice [15-17].

Regular physical activity or exercise is the best non-pharmacological treatment for the prevention and management of obesity, as it leads to a negative energy balance and weight loss [18, 19]. Aerobic exercise in moderate intensity has been shown to significantly reduce asprosin levels in men with obesity as well as those with normal weight [20]. In contrast, resistance training has been reported to significantly increase female asprosin levels [21]. Some studies also have found no significant change in asprosin levels in sedentary women with obesity, and also in men and women with obesity who exercised recreationally using anaerobic exercise [22].

Following weight gain and adipose accumulation, body composition will change. Exercise has been proven to be one of the most important factors in improving body composition [23]. Resistance training can affect total daily energy expenditure and fat metabolism and help in the process of reducing the percent body fat (PBF) and body mass (BM)[24]. Resistance training has different effects on body composition variables such as BM, body mass index (BMI), PBF, and waist to hip ratio. Studies have shown that resistance training can reduce BM [25], BMI [26], PBF [26, 27] and waist to hip ratio [25]. Although the literature on this topic is not in total agreement [26-29].

Increasing BMI along with and increase PBF leads to elevations in asprosin in saliva and blood [28]. Optimal effectiveness of resistance training in reducing BMI, PBF and Waist circumference, which can affect the improvement of asprosin levels. However, there are only a limited number of studies examining the effect of exercise on asprosin levels in human specimens, and the complexity of the role of asprosin in metabolism. Therefore, investigating the effects of different types of exercise on this adipocytokine is a potential goal. Resistance training leads to a decrease in PBF by increasing the total daily energy expenditure. Since the physiological responses of adipokines to exercise, including resistance training, vary [29], and these responses can vary depending on the intensity and duration of the exercise, the recovery time between sets, and the state of the resistance training [30].Therefore, different types of resistance training may have different effects on adipokines levels. It has been reported that asprosin can be differentially modified by exercise as resistance training increases asprosin level, while endurance training decreases it. Therefore, for the purpose of this study we queried to determine the effects of resistance training among sedentary men with obesity, specifically we wanted to see what type of resistance training increases plasma asprosin levels to use it as a potential therapeutic target in clinical setting.

MATERIALS AND METHODS

Research Methods and Participants

This research is semi-experimental in terms of method and applied in terms of purpose and has been done with pre-test and post-test design. The sample of the present study included men with obesity - who volunteered to participate in the study by responding to public announcements published in administrative centers and included 44 obese male who met the inclusion criteria and volunteered to attend the study.

Inclusion criteria were a) obese young men aged 18 to 32 years with a BMI of 30 to 40, b) no consumption of tobacco, drugs and alcohol, as well as not losing more than 5% of their body weight in the last two months were amongst other ones, and c) not being afflicted with metabolic diseases such as diabetes, metabolic syndrome, cardiovascular diseases, and kidney problems, musculoskeletal disorders and thyroid and rheumatic diseases. A physician had to confirm independently that the participants did not have any restriction to participate in the sports activities. The participants were randomly divided into 4 groups by distributing sealed envelopes. The groups included: Traditional Resistance Training (TRT, n = 11), Circular Resistance Training (CRT, n = 11), Interval Resistance Training (IRT, n = 11) and Control Group (no resistance exercise or any other physical activity; n = 11) (see following section for training details).

Procedure

First, a coordination meeting was held with potential subject and a written consent form was obtained from volunteers. After the examination by the physician, the participants completed the personal and medical information questionnaires. They were then randomly divided into 4 groups. Investigators collected data 48 hours before and 48 hours after the end of the resistance training period.

Blood Sampling and Biochemical Analysis

Resting blood samples were taken from the antecubital vein of the right hand in the same standard conditions after one night of fasting and 48 hours before and 48 hours after the 12-week period at 8 to 10 A.M. Intravenous blood samples were poured into special tubes containing EDTA to prepare plasma and centrifuged at 10 rpm for 10 minutes. Isolated plasma was frozen and stored at -70 ° C to measure asprosin levels. Analysis of asprosin levels was performed according to the manufacturer's protocol using ELISA commercial kits (Cat. No. ab275108, ELISA sandwich kit, abcam, USA).

Body composition

Anthropometric variables included height, BM, PBF, BMI and waist to hip ratio. Height and BM, used to calculate BMI, were measured using SEKA wall gauge and SEKA standard scales. Waist and hip circumference were obtained using a tape measure, then waist to hip ratio was calculated [31]. Slim Guide caliper (Creative Health Inc., USA) was used to evaluate the thickness of skin folds [32] at 3 points (mid triceps, suprailliac and abdomen) and Jackson and Pollack formula were used to determine men's PBF [33]. The thickness of the participants' skin folds was measured on the right side of the body.

Training Protocol

In the present study, three types of resistance training were compared. TRT is the most common form of resistance training and consist of using devices, dumbbells, barbells and bodybuilding tools with different intensities and with rest intervals between sets and movements [34]. CRT involves a set of resistance exercises in which all movements are performed in a circle (consecutive stations with a short break just to go from one station to another) [35]. IRT is also a set of resistance exercises in which all movements are performed consecutively with active rest periods between sets and movements. The active rest period in IRT is the same movement with the same number of repetitions but with less intensity than the previous set. Details of all three resistance training protocols are shown in Table 1.

Table 1. Comparison of three different types of resistance training protocols used in the present study

Volume & Intensity	TRT	CRT	IRT
Session per week	3	3	3
Sets	3	3 circles	2
Repetitions	14	14	14
Rest time between exercises	30 seconds	15> seconds	Active rest with 25% of 1RM and 14 repetitions
Rest time between each set	90 seconds	180 seconds	
Intensity	50% of 1RM	50% of 1RM	50% of 1RM

TRT: Traditional resistance training; CRT: Circular resistance training; IRT: Interval resistance training; 1RM: 1- repetition maximum

All resistance training protocols consisted of three main parts: I) Warm up: walking, jogging and dynamic stretching for 5-10 minutes. II) Main body of the exercise: 10 exercises of back squats, lat pull-down, leg press, chest press, leg extension, lateral raise, leg curls, biceps curl, standing calf raise, and triceps push-down. III) Cooling down: walking and static stretching movements for 5 to 10 minutes. The resistance training programs were based upon several programs that were used in previous published studies [36-38].

One week before the start of the resistance training program, a training session was held to familiarize participants with how to perform the movements correctly. The training period was set for 12 weeks with a frequency of 3 sessions per week. We used the Brzycki equation of one-maximum repetition (1RM) to determine and control the intensity of resistance training during the training period [39]. Before beginning the training course, to determine the intensity of training, a 1RM test was performed on the participants and then the intensity of training for the first month was determined. At the end of each training month, participants were retested for 1RM and the intensity of training for the following month was adjusted to the new 1RM. To increase the reliability and reduce the error in comparing the effect of three types of resistance training protocols (TRT, CRT and IRT), the volume and intensity of all training protocols were controlled. For this purpose, the intensity of all movements was considered 50% 1RM. We also used the Baechle formula to determine the volume of training [40] in order to make the volume of all three resistance training protocols the comparable.

Data analysis

Data were analyzed using SPSS software version 26. Descriptive statistics was used to describe the characteristics of the participants. Shapiro-Wilk of normality and Levene test of homogeneity of variance were used to evaluate the normality of data distribution and to establish between groups homogeneity of variance, respectively. Mixed-design ANOVA with repeated measure (2 Times X 4 Groups) was used to examine the differences between and within groups. In addition, Fisher LSD post hoc test was used to evaluate the differences between pairs of groups. Significance level was considered to be equal or less than 0.05.

RESULTS AND DISCUSSION

As it is presented in Table 2, participants in different groups did not differ statistically in demographic characteristics from one another ($P > 0.05$). In addition, at the beginning of the study, no significant differences were observed between the groups in terms of BM, PBF, BMI and waist to hip ratio ($P > 0.05$); however, a significant decrease in them was seen after the 12 weeks of the 3 types of resistance training ($P<0.05$)

Table 2. Demographic characteristics of the participants

Variable	Group	N	Pre-test	Post-test	P- value
			Mean ± SD	Mean ± SD	
Age (year)	TRT	11	25.71 ± 2.67	-	0.94
	CRT	11	26.36 ± 4.15	-	
	IRT	11	26.54 ± 2.73	-	
	C	11	26.54 ± 2.33	-	
Height (cm)	TRT	11	169.19 ± 2.76	-	0.32
	CRT	11	167.28 ± 2.61	-	
	IRT	11	168.22 ± 1.71	-	
	C	11	168.99 ± 3.17	-	
Body mass (KG)	TRT	11	92.92 ± 2.85	90.85± 1.81	0.026 *
	CRT	11	92.41 ± 1.93	88.82 ± 1.65	0.003 *
	IRT	11	93.77 ± 1.91	87.07 ± 2.15	0.001 *
	C	11	93.87 ± 2.05	93.00 ± 2.20	0.252
Body mass index (kg m^{2-1})	TRT	11	32.48 ± 1.40	31.74 ± 0.83	0.027 *
	CRT	11	33.03 ± 1.28	31.76 ± 1.27	0.003 *
	IRT	11	33.14 ± 0.75	30.77 ± 0.99	0.001 *
	C	11	32.90 ± 1.44	32.60 ± 1.49	0.260
Percent body fat (%)	TRT	11	29.65 ± 0.79	28.53 ± 0.80	0.017 *
	CRT	11	29.90 ± 1.14	27.26 ± 0.80	0.001 *
	IRT	11	30.40 ± 1.06	26.80 ± 1.00	0.001 *
	C	11	30.55 ± 1.00	30.56 ± 1.12	0.982
Waist-hip ratio (cm)	TRT	11	1.02 ± 0.05	0.92 ± 0.03	0.002 *
	CRT	11	1.00 ± 0.03	0.80 ± 0.03	0.001 *
	IRT	11	1.00 ± 0.04	0.79 ± 0.02	0.001 *
	C	11	1.02 ± 0.06	1.06 ± 0.03	0.215

TRT: Traditional Resistance Training; CRT: Circular Resistance Training; IRT: Interval Resistance Training; C: Control; SD: Standard Deviation; * Significant at level P<0.05

The results revealed that there was a significant interaction between the type of resistance training used and the time in asprosin level (F (1,40) = 13353.03, P = 0.001 , ES = 0.99).

In addition, the levels of asprosin were significantly reduced after the 12 weeks of training period in comparison to pretest in resistance training groups (Figure 1). Results further indicated that there was a significant difference between all resistance training groups from the control group in asprosin (F (3, 40) = 34.60, P = 0.001, ES = 0.72). The result of fisher LSD post hoc analysis further showed that the pairwise comparison of the levels of asprosin was significantly different among the three type of resistance training. IRT has the greatest effect on reducing asprosin levels, followed by CRT and TRT, respectively (Table 3).

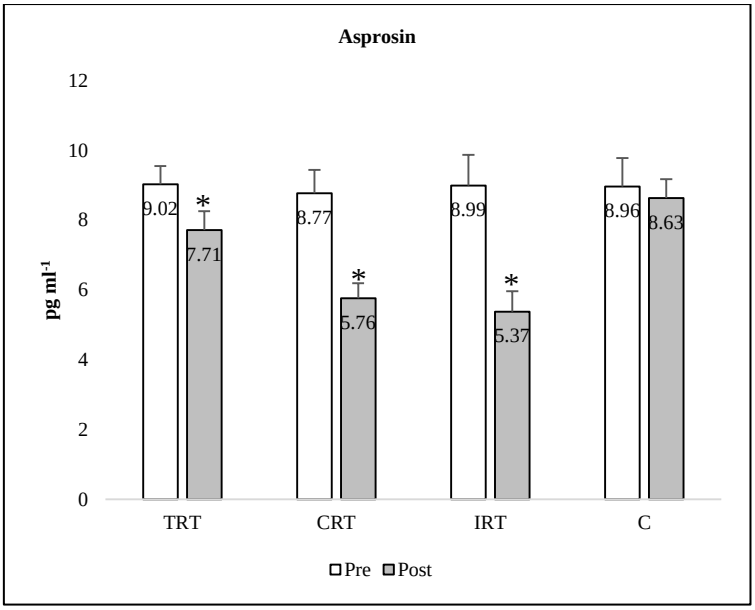

Figure 1. Intragroup changes in asprosin level in pretest and posttest. * Significant at level P<0.05.
TRT: Traditional Resistance Training; CRT: Circular Resistance Training; IRT: Interval Resistance Training; C: Control

Table 3. Results of Fisher LSD post hoc analyses.

Variable	(I)groups	(J)groups	Mean difference (I-J)	P value	95% Confidence interval	
					Lower bound	Upper bound
Asprosin	C	TRT	**0.43**	**0.030 ***	0.04	0.82
		CRT	**1.53**	**0.005 ***	1.14	1.92
		IRT	**1.61**	**0.005 ***	1.22	2.00
	TRT	C	**-0.43**	**0.030 ***	-0.82	-0.04
		CRT	**1.10**	**0.005 ***	0.70	1.49
		IRT	**1.18**	**0.005 ***	0.79	1.57
	CRT	C	-1.53	**0.005 ***	-1.92	-1.14
		TRT	-1.10	**0.005 ***	-1.49	-0.70
		IRT	0.08	0.677	-0.30	0.47
	IRT	C	-1.61	**0.005 ***	-2.00	-1.22
		TRT	-1.18	**0.005 ***	-1.57	-0.79
		CRT	-0.08	0.677	-0.47	0.30

C: Control; TRT: Traditional Resistance Training; CRT: Circular Resistance Training; IRT: Interval Resistance Training;* Significant at level P<0.05

The aim of the present study was to compare the effect of 12 weeks of three resistance training methods (TRT, CRT and IRT) on blood level of asprosin and body composition in sedentary men with obesity. Asprosin is associated with obesity and it is proposed to cross the blood-brain barrier and activate the agouti-related protein (AgRP) neurons via a cyclic adenosine monophosphate (cAMP)-dependent pathway, leading to a feeling of hungry and increased appetite ultimately leading to excessive energy absorption and risk of obesity [15]. Asprosin is an orexigenic hormone with a central effect similar to ghrelin, which in addition to activating AgRP neurons, disrupts the stimulation frequency of pre-opiomelanocortin (POMC) neurons and reduces appetite control (i.e., POMC neurons suppress appetite and induce satiety) [15, 41].

Resistance training increases protein synthesis and muscle mass, followed by increased energy expenditure at rest and during exercise, which (when appropriate levels are performed) can lead to a reduction in PBF and BMI [42]. As such, the resultant decreases in PBF and BMI due to resistance training can be a potential mechanism in reducing asprosin levels.

The results of the present study showed a significant decrease in asprosin levels following TRT, CRT and IRT in sedentary young men with obesity. IRT also had the greatest effect on reducing plasma level of asprosin compared to TRT and CRT. Consistent with the results of the present research, a recent study examined the effect of moderate-intensity acute aerobic exercise (55-59% HRM) at different times (morning and evening) on asprosin levels in obese men and normal weight. In both groups, exercise significantly reduced asprosin levels [20]. In another study, researchers examined the effect of 60 minutes of aerobic running at a speed of 20 meters per minute on a treadmill at a frequency of 4 sessions per week for 8 weeks in diabetic male rats and reported a significant reduction in asprosin levels [43]. Furthermore, it has been shown that 8 weeks of continuous and interval swimming exercises significantly reduced asprosin levels in male rats with metabolic syndrome; however, no significant differences were observed between training groups (continuous and interval) [44]. In contrast, Wiecek et al., examined changes in asprosin levels after a period of resistance training (20 seconds of speed cycling) in men and women. The results showed a significant increase in asprosin levels at 15, 30 and 60 seconds and 24 hours after exercise (only in women) [21].

The results of the present study showed that all 3 type of resistance training (TRT, CRT and IRT) led to a significant reduction in BM, PBF, BMI and waist to hip ratio (although, IRT had the greatest effect on reducing BM, BMI, PBF and waist to hip ratio). This suggests that all types of interventions had significant impacts on body composition variables confirming that all types of intervention programs had suitable intensity and frequency to affect participants. These findings are in agreement with previous literature [26, 29 and 44]. In contrast, some studies have reported conflicting findings to the results of the present study [34, 45].

Based upon the results of previous studies that have so far investigated the effect of exercise on asprosin levels, perhaps the most important reason for the discrepancy in the results of the different studies is the intensity and type of exercises used. It seems that short- and long-term aerobic exercise with moderate or sub-maximal intensity can reduce asprosin levels, but intensive exercise has not been able to significantly reduce asprosin levels. Therefore, it is suggested that future studies examine the effect of different type of aerobic and anaerobic exercise intensities, and resistance training in the short and long term, among healthy, overweight, obese and diabetic and metabolic syndrome individuals.

One specific of the limitations of the present study is sex. Participation to this study was limited to sedentary young men with obesity, so the generalizability of the study results goes back to non-athlete young men with obesity. Therefore, it is suggested that future studies include female participants, and examine the effect of gender differences on asprosin levels in response to exercise. Additionally, we acknowledge the sample sizes in the respective groups was small, therefore limiting the statistical power of our outcomes. Furthermore, the lack of calorie control (diet) during the study was also a limitations of the present study. It is suggested that future studies investigate the effect of exercise on asprosin levels while calorie intake is controlled.

In summary, asprosin is a new factor in the development of obesity, diabetes, metabolic syndrome, PCOS, and cardiovascular disease. Due to the important role of BMI, PBF in changes in asprosin levels, it is recommended that men with obesity, in addition to using healthy diets, use various types of resistance training (TRT, CRT and IRT), as an effective and low-cost treatment strategy, to improve body composition, increase health and also prevent diseases originating from the accumulation of adipose tissue and obesity.

CONCLUSIONS

Resistance training (TRT, CRT and IRT) can significantly reduce plasma asprosin levels and improved body composition (BM, PBF, BMI and waist to hip ratio) in sedentary men with obesity. The results of the present study support the benefits of resistance exercise as a non-pharmacological approach in reducing asprosin levels

and improving body composition in men with obesity. IRT has the greatest effect on reducing asprosin levels and improving body composition, followed by CRT and TRT, respectively.

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ETHICAL CONSIDERATION

Study protocol and procedures were approved by the ethics committee of Faculty of Medicine, Tarbiat Modares University; informed consent was obtained and signed by all participants on the day of testing (Ethic code: IR.MODARES.REC.1399.166).

Conflicts of interest

Authors declare that there is no financial or other relationships that might lead to a conflict of interest.

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