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Post-Resistance Exercise Response of Vaspin Adipocytokin and its Relation to Insulin and Glucose Levels in Overweight Women

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Abstract: Vaspin is considered as a novel adipokine with potential insulin-sensitizing properties, which may associated with blood glucose concentration. The aim of the present study was to investigate post-resistance exercise response of vaspinadipocytokin and its relation to insulin and glucose levels in overweight women. Ten overweight woman (25<BMI<30) randomly selected and performed a bout of circuit resistance exercises consist of 3 circuits of 10 repetitions of the 6 exercises; with a workload corresponding to 70% of 1RM. 2 min rest interval was set between the circuits and 30s between exercises. Blood samples collected before, at the end, 30 and 60 min after exercise and levels of vaspin, insulin, glucose and insulin resistance index (HOMA-IR) were measured. The Analysis of Variance with repeated measures (group × time) was used to analyze of data, followed by post-hoc Bonferroni test. The level of significance was set at p#0.05. Compare to pre-exercise values, vaspin and glucose levels presented no significant change after exercise, but insulin levels and HOMA-IRindex significantly increased at all measured times.Serum vaspin did not correlate with insulin and glucose at any measurements times. In conclusions,it seems that a bout of resistance exercise has no effect on post-exercise vaspin concentration. No relations were observed between serum vaspin concentrations with insulin and glucose. Vaspin may not be an important regulator of glucose metabolism.

Key words: Resistance exercise % Vaspin % Insulin % Overweight

INTRODUCTION

Overweight and obesity is a major public health problem worldwide. The World Health Organization (WHO) reported that the global prevalence of overweight and obesity in adults, defined as a body mass index (BMI) $25 kg/m^2, is approximately 2 billion and by the year 2015, will increase to approximately 3 billion [1, 2]. Obesity clusters with several other risk factors for CVD and diabetes in what is known as the metabolic syndrome. Hence, interventions for obesity should target multiple cardiovascular and metabolic risk factors [3, 4].

Adipose tissue predominantly visceral adipose tissue (VAT) releases a variety of bioactive adipocytokines that modulating hemostasis, blood pressure, lipid and glucose metabolism, inflammation and atherosclerosis [5, 6]. However, VAT accumulation induces adipocytes dysfunctions which were supposed to be involved in the pathogenesis of insulin resistance and abnormal glucose metabolism [6]. Vaspin is a new adipocytokine which is predominantly secreted from visceral adipose tissue in a rat model of type 2 diabetes [7] and humans [8]. Vaspin expression was shown to decrease with worsening of diabetes and body weight loss, whereas vaspin serum levels could be normalized by exercise or treatment with insulin and the insulin sensitizer thiazolidinedione, each of which improves hyperglycemia. Furthermore, administration of vaspin to obese mice improved glucose tolerance, insulin sensitivity and altered gene expression of candidate genes for insulin resistance [9]. Therefore, it has been suggested that vaspin related to systemic insulin resistance and thereby, likely contributing to the pathogenesis of diabetes. However, the relationship between vaspin and diabetes is still controversial [6]. In human beings, vaspin mRNA or serum concentration was reported to be associated with

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blood glucose concentration [10, 11], insulin sensitivity [7, 11] and body mass index (BMI) or percent body fat [7, 8]. It seems that induction of vaspin mRNA expression in human adipose tissue could represent a compensatory mechanism associated with obesity, severe insulin resistance and type2 diabetes [8, 12]. On the other hand, although both exercise training and metformin consumption improve insulin sensitivity, but serum vaspin concentrations decreased by metformin treatment in subjects with polycystic ovary syndrome while increased by exercise training [13, 14]. Therefore, the role of vaspin in human metabolic regulation is unclear at present [15]. Youn*et al*. [7] reported that elevated vaspin serum concentrations are associated with obesity and impaired insulin sensitivity, whereas type 2 diabetes seems to abrogate the correlation between increased circulating vaspin, higher body weight and decreased insulin sensitivity. More research is needed to determine the role of vaspin on glucose metabolism. Oberbach *et al*. [16] observed significant reduction in serum vaspinconcentrations after a 1-hour acute exercise bout as well as after 4 weeks of training in healthy young men and concluded that vaspin serum concentrations decreased by exercise-induced oxidative stress, but not by exercise-associated improvement in insulin sensitivity. To our knowledge, there has been no study to date which investigated the effect of an acute bout of resistance exercise on vaspin levels and there are not definitive conclusion about the relationship between resistance exercise and vaspin. Thus, the aim of the present study was to investigate post-resistance exercise response of vaspinadipocytokin and its relationto insulin and glucose levels in overweight women.

MATERIAL AND METHODS

Subjects: Ten overweightwomen volunteered to participate in this study. None of the participants had medicalhistoryof digestivedisorders, liver dysfunction and diabetes. Complete advice about possible risks and discomfort was given to the participants and all of them give their written informed consent to participate. Their characteristics are shown in Table 1.

Procedures: All procedures were in accordance with the Declaration of Helsinki and the study was approved by the Islamic Azad University, Kermanshah branch Ethics Committee.

Before initiating the tests, the participants underwent an anamnesis, a clinical evaluation and weight, height, body mass index and body fat mass measurements.

Table 1: Formal measurements of the subjects

Variables	Mean±SD
Age (y)	23.7±1.5
Weight (kg)	75.7±6.3
Height (cm)	161.7±2.0
BMI (kg/m^2)	29.0±2.5
Body Fat (%)	35.3±2.4
FFM (kg)	48.8±2.7

Then all of them underwent familiarization sessions and participated in 1RM test. Afterwards, participants carried out experimental session. Pre- and post-exercise blood samples collected after12h overnightfastingand values of vaspin, insulin, blood glucose and Insulin resistance were measured and analyzed.

Anthropometric Measurements: Anthropometric measurements were taken with participants in light clothing and without shoes. Height and weight were measured by an automatic height–weight scale, to the nearest 0.1 cm and 0.1 kg, respectively. BMI was calculated by dividing weight (kg) by the square of the height (m^2). To estimate the amount of subcutaneous fat in the body, skin fold thickness was measured (Lafayette Caliper) at four sites (biceps, triceps, subscapular and suprailiac) in the right of body. All the measurements were made with the subject in standing position and in accordance with Pollack and Wilmore [17].

1RM Test: Three days prior to the experiment, participants underwent 1RM test in the bench press, leg press, lat pull-down, biceps curl, knee flexion and knee extension. The 1RM was recorded as the maximum resistance that could be lifted throughout the full range of motion using good form once. To estimate the 1RM, at first subjects performed 4-5 repetitions with a relatively light load (~40-60% of maximum load) and after 1 min rest, performed 3-5 repetitions with a heavier load (~60-80% of maximum load). If the weights were lifted with the proper form, the weights were increased and the subject performed another attempt after 3-5 min rest. This process continued until the maximum effort was performed [18].

Before the 1RM test, participants underwent familiarization session and familiar with standard exercise techniques.

Exercise Protocol: Experimental session was consisted of general warm up (10 min), specific warm up (3-5 min) and circuit resistance exercise, stretching exercise and cool down. In this session, participantsperformed 3 circuits of

10 repetitions of the 6 exercises; with a workload corresponding to 70% of 1RM. 2 min rest interval was set between the circuits and 30s between exercises.

Measurements of Variables: Blood samples were collected in the morning after 12h overnight fasting, pre-exercise and at the end, 30 and 60 min after exercise, while the volunteers remained seated in a comfortable chair. Serum insulin concentrations were determined by ELISA (Mercodia, Uppsala, Sweden). Serum glucose concentrations were determined by enzymatic, colorimetric methods (Pars Azmoon, Iran). Serumvaspin levels were assayed using a sandwich ELISA kit (AdipoGen, Seoul, Korea) according to the manufacturer's instructions [7]. Insulin resistance was determined by calculating the homeostasis model assessment of insulin resistance ($HOMA_{IR}$) score, using the formula [19]:

Fasting serum insulin (µU/ml) × fasting plasma glucose (mg/dl)/405

Statistical Analysis: All data were expressed as mean±SD and were analyzed using SPSS software (v. 16.0). The Analysis of Variance (ANOVA) with repeated measures (groups × times) was used to analyze of data and when the difference was significant, the Bonferroni post-hoc test was used for multiple comparisons. The relation between variables was assessed using Pearson's method. The level of significance was set at p#0.05.

RESULTS

Pre- and Post-exercise Levels of Variables: Pre- and post-exercise values of vaspin, insulin, glucose and $HOMA_{IR}$indexwere shown in Table 2. There was no significant difference between all measured times in vaspin and glucose levels, but insulin levels increased and significantly differed between all measured times.Compare to pre-exercise values, $HOMA_{IR}$ indexsignificantly increased at the end, 30 and 60 min after exercise.

Vaspin Relationships with Insulin and Glucose: Vaspin correlation with insulin and glucose were shown in Table 3. Serum vaspin concentrations did not correlate with insulin and glucose at any measurements times in pre- and post-exercise.

DISCUSSION

The aim of the present study was to investigate post-resistance exercise response of vaspinadipocytokin and its relationto insulin and glucose levels in overweight women. Our results shown that after an acute bout of resistance exercise vaspin and glucose levels did not differ but insulin levels and $HOMA_{IR}$index increased significantly. Also serum vaspin did not correlate with insulin and glucose at any measurements times.

Table 2: Pre- and post-exercise variables levels

	Vaspin (ng/ml)	Glucose (mmol/l)	Insulin (µUI/ml)	$HOMA_{IR}$index
Pre	0.58±0.08	5.2±0.5	6.6±1.5	1.5±0.3
at the end	0.7±0.13	4.6±0.5	22.7±3.3*	4.7±1.0*
Post- 30	0.65±0.11	4.7±0.5	16.8±3.4*#	3.5±0.8*#
Post- 60	0.6±0.08	5.2±0.5	14.2±2.5*#†	3.2±0.5*#

*Significant difference in compare to Pre values (p#0.05)

#Significant difference in compare to the end values (p#0.05)

†Significant difference in compare to thePost 30 min values (p#0.05)

Table 3: Vaspin correlation with insulin and glucose

		Insulin		Glucose	
		Pearson's coefficient	P value	Pearson's coefficient	P value
Vaspin	pre	0.122	0.737	-0.324	0.361
	at the end	0.201	0.578	-0.136	0.708
	Post-30	0.055	0.88	0.492	0.149
	Post-60	-0.004	0.992	-0.422	0.224

Vaspin Changes: Vaspin is a novel adipokine that expressed in human adipose tissues and its expression has been shown to be higher in obese than in non-obese subjects [8]. Vaspin circulating levels are likely to reflect its expression in the adipose tissue [20]. Circulating vaspin concentrations have been reported to be sex-dependent and to be related to BMI and parameters of insulin sensitivity and glucose metabolism in humans [19]. Elevated serum concentrations of vaspin are associated with obesity and impaired insulin sensitivity [19]. Youn *et al*. [7] reported that physical training for 4 weeks in untrained individuals (men and women) causes increased serum vaspin concentrations with weight loss. On the other hand Oberbach *et al*. [16] observed significant decrease of serum vaspin concentrations after 4 weeks of training in healthy young men. Also, in study conducted by Lee *et al*. [21], obese children vaspin levels significantly decreased after seven days intensive lifestyle modification including physical activity, dietary modification and behavioral modification education. The results of the present study shown that vaspin levels increased at the end of exercise and then decreased and returned to the rest values after 60 min, but these changes were not statistically significant. Based on previous studies, the data about response of vaspin after an acute bout of exercise, particularly resistance exercise, is still scarce and it is difficult to make comparisons. To our knowledge, only Oberbach *et al*. [16] has investigated response of vaspin after an acute bout of exercise. In contrast to the results of the present study, these authors reported significant reduction in serum vaspin concentrations after a 1-hour acute aerobic exercise bout in healthy young men and concluded that vaspin serum concentrations decreased by exercise-induced oxidative stress. It seems that the differences between the results found in the present study and those reported by Oberbach *et al*. [16] may be related to the type of exercise (resistance vs. endurance) and this suggest that vaspin serum concentrations decreased by exercise-induced oxidative stress, confirmed by present study. However, more studies are required to understand the responses of vaspin after an acute bout of exercise and particularly resistance exercise.

Insulin Resistance, Insulin and Glucose Changes: Insulin resistance can be defined as a subnormal biological response to normal insulin concentrations [22] and mainly refers to the regulation of glucose metabolism by insulin at the whole-body level.Physical activity has a beneficial effect on insulin sensitivity in normal as well as insulin resistant populations [23-25]. It is well established that endurance training improves insulin sensitivity [26]. Because muscle contractions transiently increase glucose uptake and skeletal muscle mass provides a metabolic sink for glucose disposal. Earlier studies suggested that resistance training, similar to endurance training, could lead to improvements in insulin resistance as well [27]. A distinction should be made between the acute effects of exercise and training effects.The effects of acute exercise on insulin resistance are not well described. It is reported thatup to two hours after exercise, glucose uptake is in part elevated due to insulin independent mechanisms, probably involving a contraction-induced increase in the amount of GLUT4 associated with the plasma membrane and T-tubules [23]. However, a single bout of exercise can increase insulin sensitivity for at least 16 h post exercise in healthy as well as NIDDM subjects [23]. Recent studies have accordingly shown that acute exercise also enhances insulin stimulated GLUT4 translocation. Increases in muscle GLUT4 protein content contribute to this effect and in addition it has been hypothesized that the depletion of muscle glycogen stores with exercise plays a role herein [23].

The results of the present study show that after an acute bout of resistance exercise insulin resistance and insulin levels significantly increased and glucose concentration remained unchanged. In the study conducted by Jürimäe *et al*. [28] observed no changes of insulin concentrations after 6,000 m rowing ergometer test in highly trained male rowers, While glucose values were significantly increased and decreased to the pre-exercise level after the first 30 min of recovery. In another study, Jamurtas *et al*. [29] reported that after 45 min sub-maximal aerobic exercise with 65% of maximal oxygen consumption, overweight males insulin sensitivity increased and insulin concentration decreased significantly only immediately after exercise. Sari *et al*. [30] showed that at the end of 45-minute walking at 60–80% of maximum heart rate, HOMA-IR was lower than baseline in obese women.

Some of the differences in these outcomes may stem from differences in subject characteristics and exercise type, intensity and duration, as well as the method and time of assessment of insulin sensitivity. There are reports that compared with men, women may benefit less from acute endurance exercise within approximately four hours from exercise cessation [31] whereas the reverse may be true the next morning (~ 16 hours later) based on the HOMA index [32]. The duration and intensity of exercise required eliciting an enhancement in insulin sensitivity in

the long term remains uncertain [33] and there is no consensus in this issue [34, 35]. Also there is considerable inter-individual variability in the metabolic response to acute exercise and the concomitant changes in glucose and insulin dynamics [36]. Despite the heterogeneity of available evidence, insulin-resistant subjects appear to be more prone to the acute endurance or resistance exercise-induced enhancement in insulin sensitivity [37, 38], although some investigators found similar responses to those seen in healthy subjects [39].

According to the results of this study, it appears that a bout of resistance exercise has no beneficial effect on post-exercise insulin concentration and insulin resistance in obese women, but by elevating glucose uptake due to insulin independent mechanisms, it can help to control of plasma glucose.

Vaspin Relationships with Insulin and Glucose: It has been reported that obesity and insulin resistance increase vaspin expression in abdominal fat as well as its concentration in the serum. This increase in vaspin levels might represent a compensatory response against the obesity- and insulin resistance-stimulated expression of yet to be identified proteases. The former proteases are synthesized in abdominal fat but also in other tissues and appear to suppress the action of insulin. Therefore, the induction of vaspin expression might represent a defense mechanism against insulin resistance [40]. Some studies observed that physical training and weight loss [7, 19, 21] are associated with a reduction of circulating vaspin, insulin and insulin resistance (HOMA-IR). Also it has been suggested that poor control of diabetes and therefore increased glucose levels have been associated with increased vaspin [7]. In the present study serum vaspin concentrations did not correlate with insulin and glucose at any measurements times in pre and post-exercise. In study conducted by Giomisi *et al*. [20] vaspin was not correlated to serum insulin levels, or insulin sensitivity index in either pregnant or non-pregnant women and concluded that vaspin, may not be an important regulator of glucose metabolism and cannot serve as a biomarker of insulin resistance in either group. Also Oberbach *et al*. [16] reported that vaspin serum concentrations change with exercise-induced oxidative stress, but not with exercise-associated improvement in insulin sensitivity. In contrast, youn *et al*. [7] suggested that vaspin is as a circulating biomarker for interventions, which improve insulin sensitivity and represents a new biomarker for obesity and impaired insulin sensitivity. Tan *et al*. [10] showed that mRNA expression and protein levels of vaspin in omental adipose tissue and its serum vaspin level were significantly associated with glucose concentrations in obese polycystic ovary syndrome women. Also Ye *et al*. [6] have found that serum vaspin level was increased in diabetic patients and significantly associated with glucose concentrations. The results of studies about vaspin correlation with glucose and insulin are inconsistent and further studies are needed to learn about the role of vaspin in glucose metabolism. However, our data suggest that vaspin, may not be an important regulator of glucose metabolism and cannot serve as a biomarker of insulin resistance in obese women.

In conclusion, we found that afteran acute bout of resistance exercise,no significant changeof serum vaspinand glucose concentrations and significant increase in insulin levels and insulin resistance occurred in overweight women. It seems that a bout of resistance exercise has no beneficial effect on post-exercise insulin concentration and insulin resistance in this group.Noassociations between changes in serum vaspin concentrations and changes in insulin and glucoseshowed that vaspin may not be an important regulator of glucose metabolism.

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