

## Effects of 8 weeks combined resistance and endurance training on A-FABP in obese middle age men

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### Abstract

*Introduction:* Adipocyte fatty acid-binding protein (A-FABP) is a plasma biomarker recently associated with obesity related diseases such as type 2 diabetes. Exercise training may effective to improved type 2 diabetes by decreases A-FABP concentrations; therefore the aim of this study was to investigate A-FABP concentrations in middle-aged men after 8 weeks combined resistance and endurance training.

*Material & Methods:* Twenty two sedentary obese middle-aged men (aged:  $46.7 \pm 2.4$  years and body mass index (BMI):  $32.6 \pm 2.0$  kg/m<sup>2</sup>;  $\pm$ SD) volunteered to participate in this study. The subjects were randomly assigned to training group ( $n = 11$ ) or control group ( $n = 11$ ). The training group was

performed combined resistance and endurance training 3 days a week for 8 weeks.

*Results:* The results showed that the body weight, body mass index and body fat percent were decreased in the training group compared to the control group ( $P < 0.05$ ). After 8 weeks, the training group resulted in a significant decrease ( $P < 0.05$ ) in the A-FABP and fasting glucose, fasting insulin and insulin resistance in compared with the control group.

*Conclusions:* The results suggest combined resistance and endurance training decreases A-FABP concentrations and enhanced insulin resistance in obese middle-aged men.

**Key words:** Combined training, A-FABP, Obesity, Insulin resistance

## 1. Introduction

Fatty acid-binding proteins (FABPs) are members of the superfamily of lipid-binding proteins. So far 9 different FABPs, with tissue-specific distribution, have been identified: L (liver), I (intestinal), H (muscle and heart), A (adipocyte), E (epidermal), Il (ileal), B (brain), M (myelin) and T (testis). The primary role of all the FABP family members is regulation of fatty acid uptake and intracellular transport (1). The adipocyte fatty acid-binding protein (A-FABP), also known as aP2 or FABP4, is predominantly expressed in the adipose tissue, and it is one of the most abundant proteins in the cytoplasm of adipocytes and macrophages (2).

A-FABP has been shown to affect insulin sensitivity, lipid metabolism, and inflammatory responses associated with atherosclerosis (2-4). In addition, A-FABP levels have been suggested as a predictor of type 2 diabetes and metabolic syndrome development, independent of obesity and insulin resistance (5,6). Although Exercise training is a useful therapy for improving insulin sensitivity and obesity, the effects of exercise training on FABP concentrations are not well known. A little study exploring the effects of exercise on circulating A-FABP levels have resulted inconsistent findings. Choi et al. (2009) and Lázaro et al. (2012)

reported that A-FABP decrease after a period of exercise (7,8); on the other hand, Moghadasi et al. (2013) reported that they failed to find such an effect after 8 weeks high intensity endurance training in female athletes (9). We hypothesized that exercise training would reduce the body fat mass and insulin resistance and decrease A-FABP concentrations; therefore, we investigated the effects of 8 weeks combined resistance and endurance training on A-FABP in obese middle-aged men.

## 2. Materials and methods

### *Participants*

Twenty two sedentary obese middle-aged men with a mean ( $\pm$  SD) body mass index of  $32.6 \pm 2.0$  kg/m<sup>2</sup>, volunteered to participate in a 8-week intervention. All the subjects were asked to complete a personal health and medical history questionnaire, which served as a screening tool. The subjects were given both verbal and written instructions outlining the experimental procedure, and written informed consent was obtained. Our participants were not engaged in any systematic exercise programs at least 6 months before the study, none of them had any disease or had been consuming any drugs that could affect bone metabolism. The subjects were randomly assigned to one of the training group ( $n = 11$ ) or control group ( $n = 11$ ). The study was approved by the Yasuj branch, Islamic Azad University Ethics Committee.

### *Study design*

Following familiarization, subjects were asked to report to the laboratory for an additional test session designed to determine one-repetition maximum (1-RM) for 8 exercises involving the upper and lower body. Maximal strength was determined using a concentric, 1-RM (10), as previously described (11). The warm-up consisted of riding a stationary bicycle for 5 min, two sets of progressive resistance exercises similar to the actual exercises utilized in the main experiment, and 2-3 min of rest accompanied by some light stretching exercises. After the warm-up, subjects performed the 1-RM test, and the heaviest weight that could be lifted once using the correct technique was considered as 1-RM for all the exercises and used to calculate the percent of resistance. On the separate

day,  $VO_{2max}$  was determined by Rockport One-Mile Fitness Walking Test. In this test, an individual walked 1 mile (1.6 km) as fast as possible on a track surface. Total time was recorded and HR was obtained in the final minute (12).  $VO_{2max}$  was calculated by following formula:

$$VO_{2max} = [139.68 - (0.388 \times \text{age (year)})] - [0.077 \times \text{body mass (Pb)}] \\ - [3.265 \times \text{time (min)}] - [0.156 \times \text{HR}]$$

### *Exercise training*

Two familiarization sessions were designed to habituate subjects with the testing procedures and laboratory environment. The main aim of these sessions was to familiarize subjects with different resistance exercises using weight-training machines and also to familiarize them with performing the 1-RM test. During the familiarization sessions, it was ensured that all the subjects used the correct techniques for all exercises prior to taking part in the main test sessions. Subjects were performed 30 min endurance training with 70% of their maximum heart rate and then performed eight resistance exercises selected to stress the major muscle groups in the following order: chest press, leg extension, shoulder press, leg curls, latissimus pull down, leg press, arm curls, and triceps extension. RT consisted of 50-60 min of circuit weight training per day, 3 days a week, for 12 weeks. This training was circularly performed in 8 stations and included 2-4 sets with 8-12 maximal repetitions at 65-80% of 1-RM in each station. Each circuit and set was separated by 2-3 min and 30 s rest respectively. General and specific warm-up were performed prior to each training session, as explained for the 1-RM determination, and each training session was followed by cool-down.

### *Measurements*

#### *Anthropometric and body composition measurements*

Height and weight were measured, and body mass index (BMI) was calculated by dividing weight (kg) by height ( $m^2$ ). Waist circumference was determined by obtaining the minimum circumference (narrowest part of the torso, above the umbilicus) and the maximum hip circumference while standing with their heels together. The waist to hip

ratio (WHR) was calculated by dividing waist by hip circumference (cm) (12). Body fat percent was assessed by skinfold thickness protocol. Skinfold thickness was measured sequentially, in triceps, suprailiac, and thigh by the same investigator using a skinfold caliper (Harpenden, HSK-BI, British Indicators, West Sussex, UK) and a standard technique (12).

### *Biochemical analyses*

Fasted, resting morning blood samples (10 ml) were taken at the same time before and after 8 weeks intervention. All the subjects fasted at least for 12 hours and a fasting blood sample was obtained by venipuncture. Plasma obtained was frozen at  $-22^{\circ}\text{C}$  for subsequent analysis. The plasma A-FABP levels were measured in duplicate using an enzyme-linked immunosorbent assay (ELISA) kits (Casabio Biotech Co. LTD.; China). The sensitivity of kit was 0.156 ng/ml. Serum glucose was determined by the enzymatic (GOD-PAP, Glucose Oxidase-Amino Antipyrine) colorimetric method (Pars Azmoun, Tehran, Iran). The intra and inter-assay coefficients of variation for glucose were  $<1.3\%$  and a sensitivity of 5 mg/dl. The serum insulin level was measured by an electrochemiluminescence immunoassay (ECLIA) and the insulin resistance index was calculated according to the homeostasis model assessment (HOMA-IR) which correlates well with the euglycemic hyperinsulinemic clamp in people with diabetes (13).

### *Statistical analysis*

Results were expressed as the mean  $\pm$  SD and distributions of all variables were assessed for normality. Differences among groups were assessed by using analysis of covariate (ANCOVA) test. The level of significance in all statistical analyses was set at  $P\leq 0.05$ . Data analyses were performed using SPSS software for windows (version 17, SPSS, Inc., Chicago, IL).

## **3. Results**

### *Changes in anthropometric variables*

Anthropometric and body composition characteristics of the subjects at baseline and after training are presented in Table 1. Before the

intervention, there were no significant differences in any of variables among the two groups. Body weight, body mass index and body fat percent decreased ( $P < 0.05$ ) after 8 weeks resistance training compared to the control group, while no significant changes in the WHR were found after the training.

**Table 1.** Anthropometric and body composition characteristics (mean  $\pm$  SD) of the subjects

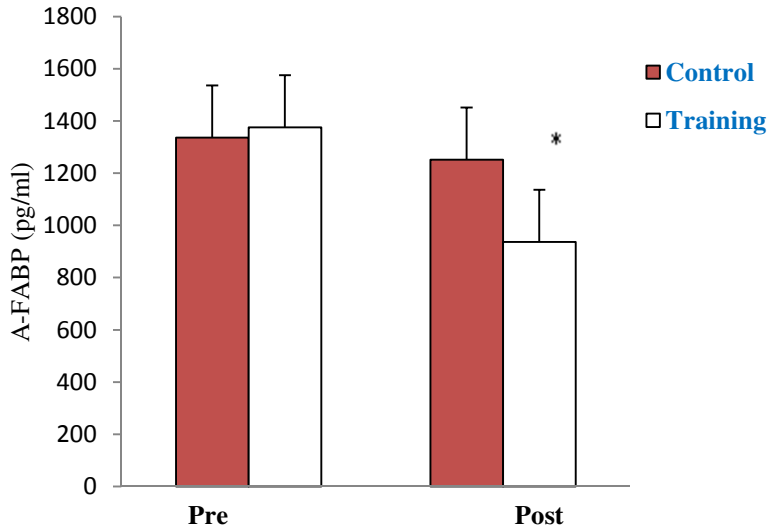
	Control (mean $\pm$ SD)		Training (mean $\pm$ SD)	
	Pretraining	Posttraining	Pretraining	Posttraining
Body weight (Kg)	100.8 $\pm$ 9.4	100.7 $\pm$ 9.1	96.8 $\pm$ 3.5	93.7 $\pm$ 3.7 <sup>a</sup>
BMI (Kg/m <sup>2</sup> )	33.0 $\pm$ 2.3	33.2 $\pm$ 2.2	32.2 $\pm$ 1.7	31.2 $\pm$ 1.6 <sup>a</sup>
Body fat (%)	27.7 $\pm$ 4.5	27.8 $\pm$ 4.5	28.5 $\pm$ 4.6	24.6 $\pm$ 5.6 <sup>a</sup>
WHR	1.0 $\pm$ 0.05	1.0 $\pm$ 0.05	0.99 $\pm$ 0.04	0.97 $\pm$ 0.06

a  $P < 0.01$  for between-group differences.

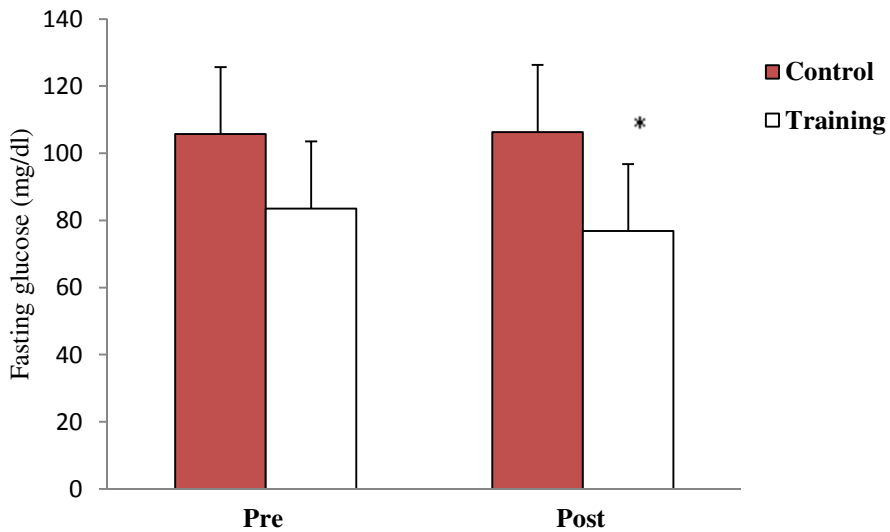
b  $P < 0.01$ , pretraining *vs.* posttraining values.

### *Changes in biochemical variables*

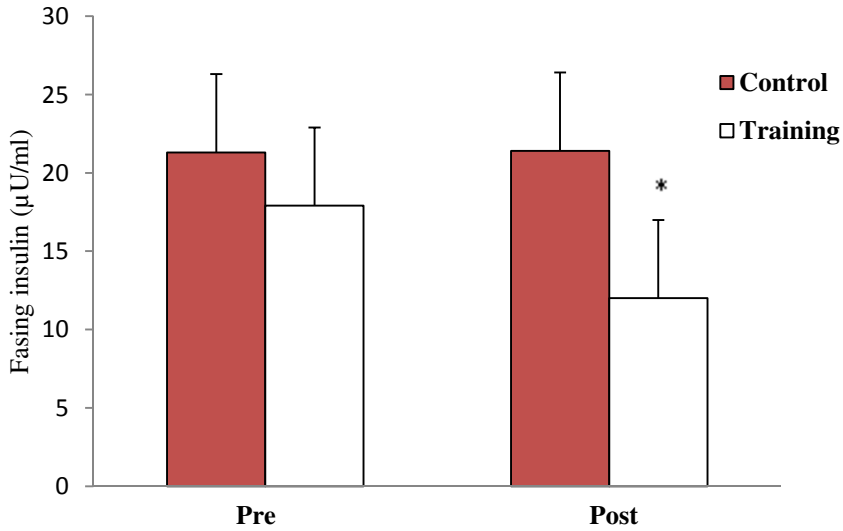
Results showed that A-FABP levels, fasting glucose and insulin and insulin resistance determined by HOMA-IR decreased ( $P < 0.05$ , 31.8%, 8.0%, 32.9% and 37.85% respectively; Figure 1-4) after 8 weeks resistance training compared to the control group. The plasma A-FABP decrease after training was associated with the decrease of HOMA-IR, body weight and body fat percent ( $P < 0.05$ ).



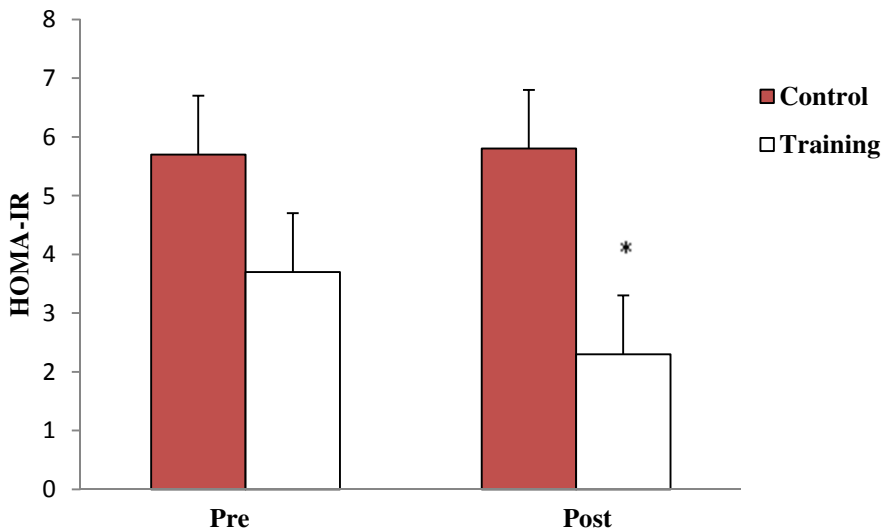
**Figure 1.** Mean ( $\pm$ SD) Changes in A-FABP levels in control and exercise group before and after 8 weeks training.  
(\*  $P < 0.05$  for between-group differences)



**Figure 2.** Mean ( $\pm$ SD) Changes in fasting glucose levels in control and exercise group before and after 8 weeks training.  
(\*  $P < 0.05$  for between-group differences)



**Figure 3.** Mean ( $\pm$ SD) Changes in fasting insulin levels in control and exercise group before and after 8 weeks training. (\*  $P < 0.05$  for between-group differences)



**Figure 4.** Mean ( $\pm$ SD) Changes in HOMA-IR in control and exercise group before and after 8 weeks training. (\*  $P < 0.05$  for between-group differences)



#### 4. Discussion

Excessive levels of free fatty acids are toxic to cells. The human body has evolved a defense mechanism in the form of small cytoplasmic proteins called fatty acid binding proteins (FABPs) that bind long-chain fatty acids, and then refer them to appropriate intracellular disposal sites (oxidation in mitochondria and peroxisomes or storage in the endoplasmic reticulum) (1,14). It is postulated that FABPs play an important role in the pathogenesis of metabolic diseases. Elevated levels of A-FABP have been found in the pericardial fat tissue and were associated with cardiac dysfunction in obese people (14). In addition, recent studies have shown that circulating A-FABP levels predict the development of the metabolic syndrome (6) and type 2 diabetes (5). A-FABP levels decrease after the intervention. Choi et al. (2009), also reported that A-FABP level decreased in obese women after 12 weeks moderate exercise training (7). Recently Lázaro et al. (2012) reported that A-FABP decrease after moderate aerobic exercise in patients with cardiovascular risk (8). We hypothesized that combined resistance and endurance training would reduce the body fat mass and decrease A-FABP concentrations. Our results demonstrated that body fat percent and A-FABP concentrations decrease ( $P < 0.05$ ) after 8 weeks training in obese middle-aged men. On the other hand, correlation coefficient showed a negative relationship between plasma A-FABP levels with body weight and body fat percent ( $P < 0.05$ ). Thus it seems that improved in body composition is one of the mechanisms for reduce the A-FABP levels in response to combined resistance and endurance training in obese men.

Previous studies indicated that A-FABP levels are a predictor of type 2 diabetes and there is a positive relationship between A-FABP and insulin resistance (5,6). The results showed that fasting glucose and insulin and insulin resistance (HOMA-IR) decreased after the intervention ( $P < 0.05$ ). The plasma A-FABP decrease after training was associated with the decrease of HOMA-IR; thus it seems that improves in insulin resistance might reduce the A-FABP in this study. Moghadasi et al. (2013) noted that the other mechanisms such as exercise *per se*, decrease of the inflammatory markers such as IL-6, TNF- $\alpha$  and hs-CRP and decrease of the triglyceride and total cholesterol levels might decrease A-FABP concentrations (9). Choi et al. (2009) showed that A-FABP levels were

associated with hsCRP, triglyceride and total cholesterol levels. The research results showed that exercise training program decreased A-FABP levels along with changes of body composition and metabolic parameters, including triglyceride and total cholesterol levels (7). Additional research is needed to examine these mechanisms.

### Conclusion

In summary, resistance training-induced change in body composition and insulin resistance decreases A-FABP concentrations in obese middle-aged men.

**Conflict of interests:** No conflict of interests amongst authors.

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