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The effect of aerobic exercise on serum ferritin levels in untrained middle-aged women

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Abstract

Background: Recent studies suggest that an elevated serum ferritin concentration is considered a dependent factor associated with increased risk cardiovascular disease. The aim of this research is finding of the effect of six months aerobic exercise on serum ferritin levels in untrained middle-aged women.
Methods: Nineteen healthy female middle-aged were selected by convenience sampling method and were randomly divided into two experimental (n=11) and control (n=8) groups. The exercise protocol included aerobic exercise training lasted for 6 months and 3 sessions per week and every session lasted for 60 minutes and with intensity of 55-65 percent of maximum heart rate reserve (MHR). Blood samples were taken to measure serum ferritin before and after aerobic training period. General linear- Repeated measures (GL-RM) was used to comparing of within, Interactive and between means groups. The level of significance was set at $P< 0.05$.
Results: Weight, BMI, body far percent, WHR in exercise group towards the end of period of the training, but this changes was not significantly. Results showed a variance between group WHR is significant ($P<0.05$). In addition, during the training, there was no significant change in serum Ferritin levels in both groups.
Conclusion: Six months of aerobic exercise does not induce significant change in serum levels of Ferritin, while these levels reduced in middle-aged women. We believe that prolong exercise, due to reduce in serum ferritin. Although more research, as well as basic research and large-scale epidemiological studies, is required to totally assess the association between Ferritin concentrations and prolong exercise.

***Keywords**: Ferritin, Physical activity, untrained middle-aged women

Introduction

Many epidemiologic studies reported over the past 50 years have confirmed nearly consistently an association of elevated blood serum ferritin level with cardiovascular disease, though not all have found that the relation is independent of other risk factors (Manfroi et al., 1999). Ferritin is an iron-phosphorus-protein complex that is an index of body iron stores. Iron is very important for oxygen transportation to tissues and major functions in cellular oxidation mechanisms (Dorland, 1994). Elevated serum iron leads to increased serum ferritin concentration (Jehn et al., 2007; Yamanishi et al., 2007).
Ferritin level serves as a biomarker for evaluating body iron contents. Tissue and organ damage happens once iron concentrations are elevated (Ikeda et al., 2006) because increased iron accumulation or serum ferritin concentration may be a cause for the risk of heart attack (Rasmussen et al., 2001). Hence,

according to the epidemiologic research on this hypothesis may be divided into studies of the association of CHD risk with 1) blood serum ferritin; 2) other measures of body iron stores, less correct than blood serum ferritin, eg, heterozygous hemochromatosis; blood donation and transferring saturation (Sempos, 2002). Studies reported in literature on the effect of exercise on serum ferritin have been conflicting and inconsistent.

Recent studies reported that physical activities play an important role in reducing serum ferritin concentration (Furqan et al., 2007; Liu, et al., 2003). An increase in physical activity decreased serum ferritin concentration (Furqan et al., 2007), and a decrease in serum ferritin concentration was shown to depend on duration and frequency of physical activity (Lakka et al., 1994). Naimark et al., (1996) found a similar pattern for performance and ferritin concentration. The mean serum ferritin reduced considerably once twenty four weeks in those who walked five days for each week, but not in those who walked three days per week. Furqan at al., (2007), reported moderate physical activity to be more important in lowering serum ferritin than vigorous activity. Bartfay et al., (1995), Demonstrated regular exercise could decrease serum ferritin concentrations. Lakka and colleagues, (1994) reported mean ferritin concentration to be 16.8% lower in individuals with the highest quartile of physical activity as compared to those with the lowest duration of activity, and to be 19.9% lower in individuals with the highest category of physical activity frequency (>3 sessions per week) as compared to those with the lowest activity frequency (<1 session per week). Salonen et al., (1992) were the first to report a significant association between serum ferritin concentrations and risk of heart attack. They found that Finnish men with a serum ferritin concentration ≥ 200 µg/L had an ≈2-fold higher risk of heart attack than did men with a concentration < 220 µg/L. They also reported finding a significant linear association between serum ferritin and risk of heart attack. However, the majority of prospective epidemiologic research found no association between serum ferritin (Manttari et al., 1994; Stampfer et al., 1993), or other measures of iron level (Baer et al., 1994; Sempos et al., 1994), and CHD.

The conflicting results about the effects of exercise on serum ferritin in conducted studies along with the lack of sufficient evidence in examining the effects of sports activities on serum ferritin levels and also the better discovery of physiological conditions of individuals during the prolong activity have made researchers conduct some comparison research on the effects of aerobic exercise on serum ferritin in untrained middle-aged. Therefore, the aim of this prospective study was therefore to determine the effect of six months aerobic exercise on serum ferritin levels in untrained middle-aged women.

Materials and Methods

Subjects

This study was semi-experimental. Furthermore, it plan was confirmed by Research Assembly of Physical Education and Sport Sciences Faculty of Ferdowsi University of Mashhad. During first stage, the subjects of this study were nineteen healthy and inactive female who randomly assigned into the experimental (n=11) and control (n=8) groups. Before starting the program, written informed consents were taken from all subjects. The levels of health and physical activity of the subjects were determined using general practice physical activity questionnaire, physical activity readiness questionnaire and medical survey (including electrocardiogram and blood pressure tests) by a specialist physician (Shephard, 1991). The subjects were nonsmokers, received no drugs and had no metabolic disease and physical impairment affecting their performance. During the second stage, their height was measured in centimeters using a height determiner and their weight was calculated using a digital scale produced by a German company called Beurer (PS07-PS06). The percent of body fat (PBF) was calculated using a body compound determiner (model In-body-720 made in Korea) and based on a method called bioelectrical impedance. All of these measurements were carried out while the volunteers had stopped eating or drinking 4 hours prior to their test, and their bladder, stomach, and bowels were empty.

Exercise protocol

The exercise protocol included aerobic exercise training lasted for 6 months and 3 sessions per week and every session lasted for 60 minutes and with intensity of 55-65 percent of maximum heart rate reserve (MHRR). According to the MHRR for every single athlete was respectively calculated based on Karvonen

equation (1) and was also controlled during exercise by a heart rate monitor (made in Finland–Polar)(Robbert & Landwehr, 2002).
Equation [1]: Target heart rate= [%60 or %70+ [(age-220) - (resting pulse]] + Resting heart rate

Blood sampling

During the study period, blood (about 2.5 ml) for determining whole blood indices and for biochemical assays in serum was withdrawn from the antecubital vein in the morning (700-730) after overnight fasting for 8 consecutive days, always after staying at least 15 min in sitting position.
Blood samples in all related studies were collected by venepunction from forearm vein after at least 15 minutes of sitting at rest or in the supine position. Blood sample were poured into a tube containing K2EDTA and mixed for 15 min before analysis. After centrifuging samples in plastic capillary tubes using Haemato Spin Centrifuge device.
The following assays were conducted in blood serum: ferritin concentration by using immunoenzymatic commercial kits (BioSource, Belgium).

Statistical analysis

All statistical analyses were performed with SPSS version 15. The average and standard deviation of data were calculated after checking the data distribution normalcy using Kolmogorov-Smirnov test and Homogeneity of variance method. The comparison of between means groups and Homogeneity of groups examined using Independent t-test. Repeated measure for comparison of variance within the group, interaction (groups × phases) and between group was used. The level of significance was set at P< 0.05.

Results

Table 1: Mean ± standard deviation and Independent t-test for normality of two groups

.	Group (s)	M±SD*	Independent t-test	
			t	*P*-value
Age (years)	Exercise	41.27±3.74	1.242	0.231
	Control	43.25±2.91		
Height (cm)	Exercise	155.36±5.48	-0.044	0.966
	Control	155.25±5.77		
Weight (kg)	Exercise	64.85±5.83	-1.34	0.191
	Control	61.37±7.84		
BMI (kg/m2)	Exercise	26.94±2.84	-1.25	0.232
	Control	25.44±2.69		
PBF (%)	Exercise	36.27±5.62	-0.404	0.706
	Control	35.31±6.14		
WHR (cm)	Exercise	0.84±6.50	-2.806	0.281
	Control	0.76±6.64		
Ferritin (ng/mL)	Exercise	32.18±6.11	-0.485	0.634
	Control	27.06±9.22		

†A significant level *P*<0.05 *Data presented as mean ± standard deviation

According to the (Table 1), before the onset of the exercise, there were no significant differences between groups in age, height and body composition variables including: weight, BMI, PBF and WHR. Also, there were no significant differences between groups in the levels of Ferritin.

Table 2: Comparison of within group variance, interaction and between group of body composition, serum Ferritin in Untrained Middle-Aged Women

Variables	Group (s)	Pre-test M±SD*	Post-test M±SD*	Variations: Within groups		Interaction (group × phase)		Between groups	
				F	*P*-value	F	*P*-value	F	*P*-value
Weight (kg)	Exercise	64.85±5.83	64.70±5.76	1.25	0.27	1.25	0.27	1.70	0.20
	Control	61.37±7.84	61.36±7.84						
BMI (kg/m^2)	Exercise	26.94±2.84	26.43±2.58	0.59	0.44	20.1	0.06	0.99	0.32
	Control	25.44±2.69	25.67±2.51						
PBF (%)	Exercise	36.27±5.62	36.02±5.54	0.05	0.82	9.72	0.00	0.09	0.76
	Control	35.31±6.14	35.52±6.20						
WHR (Cm)	Exercise	0.84±6.50	0.83±7.86	1.70	0.20	0.00	0.99	6.96	0.01†
	Control	0.76±6.64	0.76±6.36						
Ferritin (mg/dL)	Exercise	32.18±6.13	28.82±4.64	2.180	0.158	0.235	0.634	2.86	0.109
	Control	27.06±9.22	25.36±6.42						

†A significant level *P*<0.05 *Data presented as mean ± standard deviation

According to the (Table 2), our results show decrease in weight, BMI, body far percent, WHR in exercise group towards the end of period of the training, but this changes was not significantly. Interaction variance (groups × phases) was not significant. Results showed a variance between group WHR is significant (*P*<0.05). In addition, during the training, there was no significant change in serum Ferritin levels in both groups.

Discussion and Conclusions

In the present study, no statistically significant difference was observed in the body mass index of exercise group subjects' body weight, body mass index and body fat presented. This finding was supported by researchers (Bouhlel et al., 2008; Pérusse et al., 1997).

In this study, although ferritin concentration reduced but not significant changes were observed in ferritin levels in both groups, which was consistent with Furqan at al., (2007), Bartfay et al., (1995), Moosavi Zade (2011) and Furqan at al., (2007) reported moderate physical activity to be more important in lowering serum ferritin than vigorous activity. Bartfay et al., (1995) demonstrated regular exercise could decrease serum ferritin concentrations. Moosavi Zade (2011) reported that eight weeks aerobic training which including 40 minutes running twice a week with%60 to%65 reserve heart rate caused decrease in serum iron, serum ferritin and transferrin concentration and serum ferritin in girls. Probably reason of decreasing of RBC and consequently decreasing of HB is due to decreasing of iron serum. Whereas the concentration of iron serum is reduced body will use from transferrin as reserving iron which can be probably reason of decreasing of transferring concentration percent. Decreasing of serum ferritin may be excreting iron in training and may be non- from nutrition. The reason of distinction of results of this research with other researches could also be the variables such as sex, age, training intensity, training period length, samples diffusion from point of view of social situation, economic nutrition. Serum ferritin concentration has been positively associated with body mass index (BMI), alcoholic intake, triglyceride levels, and diastolic and systolic pressure (Galan et al., 2006; Milman et al., 1999). Particularly in those with type 2 diabetes, blood serum ferritin concentration has been significantly related to plasma oxidized LDL, but not with LDL cholesterol (Ikeda et al., 2006). Meanwhile, other researchers have reported a significant association between ferritin concentration and cholesterol (Galan et al., 2006; Hedley et al., 2002).

While, other investigations have reported opposing findings, Schumacher et al, (Schumacher et al., 2002), Rocker et al., (2002). Schumacher et al, (2002), who attributed a increase in serum ferritin concentration after the laboratory tests for trained and untrained subjects and after prolonged aerobic exercise in male cyclists in thirty nine subjects. Rocker et al, (2002) concluded that the amount of hemoglobin, serum ferritin and transferrin values were increased after the endurance race. Due to the differences in the results of the studies can be related to the different volume and intensity and duration of the training.

In conclusion, it seems that more researches are required for evaluating the effects of prolong aerobic exercise on serum ferritin and there are yet many unanswered questions in this relation. We believe that prolong exercise, due to reduce in serum ferritin. Although more research, as well as basic research and large-scale epidemiological studies, is required to totally assess the association between iron concentration and risk of CVD, although the results to date supporting the iron and coronary heart disease hypothesis are weak and inconsistent.

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