THE EFFECT OF AEROBİC EXERCİSE ON HS-CRP AND BODY COMPOSİTİON İNDEXES İN NON-ACTİVE OBESE MEN WİTH EMPHASİS ON RAMADAN FASTİNG

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ABSTRACT

Introduction: The purpose of this study was to evaluate the effect of aerobic exercise and Ramadan fasting on the high-sensitivity C-reactive protein as a marker of inflammation in non-active obese men. **Methods and Materials:** In this study, 18 obese men aged 40-50 with a BMI over 30 kg per square meter as a public call among the 70 subjects were selected randomly and after they were divided in to fasting (N=9) and fasting and exercise (N=9) groups. Then while the first group would do only fasting, fasting and exercise group in addition to the intervention fasting group, exercise to be carried out in 27 sessions. Also, for check the desired changes in the month of Ramadan, blood samples were taken from four different times. Finally, using repeated measures analysis of variance in the level of $p < 0.05$ theories were put to the test. **Results:** Ramadan fasting significantly decreased the high-sensitivity C-reactive protein ($p < 0.05$) as well as aerobic exercise significantly were reduced high-sensitivity C-reactive protein ($p < 0.05$) in both groups. **Conclusion:** aerobic exercise and Ramadan fasting has a beneficial effect on the reduction of low-grade inflammation.

Key Words: high-sensitivity C-reactive protein, aerobic exercise and Ramadan fasting

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INTRODUCTION

Ramadan is the holiest month in the Islamic calendar. Fasting in this month is one of the five pillars of Islam. Fasting is obligatory for all adults and healthy Muslims during the day hours for the whole month every year. Ramadan month occurs 11 days earlier every year due to the difference between the solar and lunar years, and may occur in any of the four seasons, making the length of fasting hour's variable from 11to 18 hours in tropical countries (Sakr, 1975). Ramadan is the month during which Muslims refrain from food, fluids and tobacco smoking during daylight hours and eat a main meal after sundown. Free eating is allowed from sunset to dawn. Ramadan teach Muslims self –restraint and remind them of the feelings of the impoverished. Ramadan is observed by over 400 million of Muslims who spread across the globe; and live under various geographical, climatic, social, cultural and economic conditions. This provides a unique opportunity to study the hematological and biochemical changes over Ramadan time.

Arterial inflammation has emerged as central to the progression of atherothrombosis (Ross, 1999). One of the markers of inflammation, the high-sensitivity C- reactive protein (hs-CRP) is the most studied, with evidence that it may also play a direct pathogenic role in atherosclerotic lesion formation (Ridker *et al*., 2000; Chew *et al*., 2001; Pasceri *et al*., 2000; Zwaka *et al*., 2001; Fichtlescherer *et al*., 2000; Yasojima *et al*., 2001; Tomai *et al*., 2001 and Torzewski *et al*., 2000). CRP, at concentrations known to predict adverse cardiovascular outcomes, directly inhibits the production of nitric oxide (NO) and angiogenesis, which could impair the response to ischemia (Verma *et al*., 2002). Serum CRP measured by a highly sensitive assay has become an important marker of vascular inflammation and predictor of atherosclerosis (Ridker *et al*., 2000; Ridker *et al*., 1997; Ridker *et al*., 2001; Van *et al*., 2002 and Hashimoto *et al*., 2001). Recent data suggest that hs-CRP is as important a predictor of atherosclerosis as circulating LDL-C (Ridker *et al*., 2002). Thus inflammation may be potentially as important as cholesterol in contributing to atherosclerosis. High levels of hs-CRP in obesity also predict development of diabetes later (Han *et al*., 2002). Endothelium plays a vital role in vascular homeostasis, vascular tone regulation, vascular smooth muscle cell proliferation, trans-endothelial leukocyte migration and thrombosis and thrombolysis balance. In response to various mechanical and chemical stimuli, endothelial cells synthesize and release a large number of vasoactive substances, growth modulators, and other factors that mediate these functions (Quyyumi, 1998). Endothelial dysfunction is now regarded as an early pivotal event in atherogenesis and has been shown to precede the development of clinically detectable atherosclerotic plaques in the coronary arteries (Mano *et al*., 1996). This event was important in the development of microvascular complications in diabetes (Tooke, 1995). This stimulus provokes the endothelium to release nitric oxide (NO) with subsequent vasodilatation (index of vasomotor function). There has been much contention about the effect of Ramadan fasting on health men (Hamdy et al., 2008; Azizi, 2002; Azizi, 1978; El-Ati ,1995; Ramadan, 1994). The majority of Muslims fast from dawn to sunset during the whole month of Ramadan. Ramadan is the ninth month in the lunar calendar. The daily fast (neither food nor drink) lasts about 12-19 hours depending on the season in which Ramadan falls and on the geographic location of the country. So, the purpose of this study was to evaluate the

effect of aerobic exercise and Ramadan fasting on the high-sensitivity C-reactive protein as a marker of inflammation in non-active obese men.

MATERIALS AND METHODS

We recruited 18 obese men with non-insulin dependent type 2 diabetes mellitus who were recently discovered (less than 3 years). None of our patients had documented coronary artery disease or history of myocardial infarction. There were 18 (age range 40-50 years) obese men. None of our patients were hypertensive and none of our patients were smokers. This study was performed during Ramadan of May – July 2011 (Hijri year 1433) and was conducted in Faculty of Physical Education and Sport Sciences in Ferdowsi University of Mashhad, IRAN.

Test samples were collected from all patients five and one week before Ramadan fasting and then one week after the beginning of Ramadan so that patients acted as their own control. Ethical Committee in the hospital approved the study. All patients were educated about medications, hypoglycemia and hyperglycemia complications. They were asked to fill out a questionnaire about their meals, quantity, quality and they were advised to avoid the common practice of overfeeding with sweets. They were asked to adopt a protein-low fat- energy restricted three meals before fasting (Iftar at sunset and Sahar before dawn). They were suitably monitored by a dietician. We measured the waist circumference at the narrowest point (between the highest point of iliac crest and the lower costal margin) by analyzer of body composition (made in South Korea, model: In body 720). High sensitivity C-reactive protein was processed with the use of latex- enhanced immune nephelometric assays (Date Behring, Newark, Del) (Ridker, 2001). In patients without known cardiovascular disease, the range of hs-CRP for the subjects with the lowest (quintile 1) to the highest (quintile 5) vascular risk were 0.01 - 0.069, 0.07 - 0.11, 0.12 - 0.19, 0.2 - 0.38, and more than 0.38 mg/dl respectively. A risk estimate appears to be linear across the spectrum of inflammation and these sequential quintiles considered in clinical terms represent individuals with lowest, mild, moderate, high, and highest relative risks of future cardiovascular diseases.

This study was performed during Ramadan of May – July 2011 (Hijri year 1433). The project was approved by the Ethics Committee for Scientific Research at the Academy of Physical Education in Ferdowsi university of Mashhad, IRAN. Venous blood was taken one week before Ramadan (T1), second week of Ramadan (T2), and last week of Ramadan (T3), and two week after of Ramadan (T4) after an average fast of eight hours. Anthropometric measurements were performed at the same time of blood sampling. Blood was collected in plain and EDTA tubes. Serum was obtained by low speed centrifugation at 1000g for 15 minutes, and samples were immediately separated into aliquot and stored at -20C until analysis. All serum samples were analyzed in a single batch to avoid day-to-day laboratory variation. Hematological and biochemical measurements took place in the Research Laboratory for the department of medical laboratories at The Hashemite University. Fresh EDTA blood was used to determine hematological parameters using Cell – Tac α (Nihon-Kohden, Japan) Serum total cholesterol (TC) and high density lipoprotein–cholesterol (HDL-C) were measured by an enzymatic colorimetric method using cholesterol oxidase, perioxidase, and the chromogen 4-aminophenazone/phenol (Allain *et al*., 1974). Serum triacylglycerols (TAGs) levels were determined by an

enzymatic colorimetric method using lipoprotein lipase glycerokinase, glycerphosphate oxidase, and the chromogen 4-aminophenazone/N-ethyl-N (3-sulphopropyl)-nramisidine (Fossati and Prencipe, 1982). Low-density lipoprotein – cholesterol (LDL–C) was calculated using Friedwald et al. equation (Friedewald *et al*., 1972).Urea, Serum albumin and uric acid were quantitatively estimated in serum by enzymatic colorimetric test for survey of renal functions. Creatinine was determined using JAFFE method by commercially provided kits provided by Biocon diagnostic for survey of renal functions (Germany).

All data were expressed as mean ± standard deviation (SD). Paired t-test was used to compare pre and during Ramadan fasting variables. ANOVA was used to analyze repeated measures. Differences were considered significant when Probability values were less than 0.05. All analysis was performed using the statistical package (SPSS) version 18.0 (Chicago, IL, USA).

RESULTS

In the fasting group, the waist to hip ratio was significantly reduced after the Ramadan fasting (0.994 ± 0.02 Vs 0.928 ± 0.033, p < 0.004, mean ± SD) (table 1). Also significant difference was found between all anthropometric measurements at after Ramadan vs. one week pre fasting in fasting group (p< 0.05) (table 1). In the fasting and exercise group, the waist to hip ratio was reduced significantly after the Ramadan fasting (0.992 ± 0.04 Vs 0.958 ± 0. 041, p < 0.024, mean ± SD) (table 1). Also significant difference was seenbetween all anthropometric measurements at after Ramadan vs. one week pre fasting in fasting group (p< 0.05) (table 1). In addition, fat mass was significantly reduced after the Ramadan fasting in both groups (38.61 ± 11.5 Vs 26.3 ± 7.3 for Fasting group and 39.22 ± 14.2 Vs 29.57 ± 13.7 for fasting and exercise group, p < 0.000, mean ± SD) (table 1)

Table 1- Differences between variables and Differences within variables for anthropometric and hematological indexes in fasting group (n=9) and fasting and exercise group (n=9)

anthropometric indexes	Groups	Stages*				Differences between variables†		Differences within variables†	
		T1	T2	T3	T4	F	P	F	P
Weight (kg)	**F**	99.84 ± 15.4	94.96 ± 12.3	86.11 ± 10.32	86.47 ± 11.49	3.46	0.035	382.7	0.000
	F-E	105.5 ± 19.4	88.66 ± 14.7	93.8 ±17.65	90.28 ±17	4.45	0.013		
BMI (kg.m $^{-2}$)	**F**	34.87 ±5.4	32.1 ±6.23	28.93 ±4	28.333 ±2.9	3.7	0.028	311.93	0.000
	F-E	35.59 ±7.11	30.3 ±5.17	32.24 ±7.25	30.8 ±5.96	3.33	0.036		
Fat mass (kg)	**F**	38.61 ±11.5	33.16 ±13.7	27.41 ±8.7	26.3 ±7.3	2.92	0.058	75.28	0.000
	F-E	39.22 ±14.2	27.55 ±10.7	32.02 ±14.4	29.57 ±13.7	3.32	0.037		
Waist to hip ratio	**F**	0.994 ±0.02	0.949 ±0.04	0.934 ±0.04	0.928 ±0.033	6.41	0.004	4567.4	0.000
	F-E	0.944 ±0.02	0.947 ±0.55	0.954 ±0.06	0.958 ±0.041	3.74	0.024		
WBC (1000/µl)	**F**	7.31 ±2.27	7.18 ±1.55	6.8 ±1.58	7.66 ±2.45	1.268	0.311	131.01	0.000
	F-E	6.96 ±1.42	6.33 ±1.12	7.444 ±2.08	6.75 ±1.14	1.969	0.146		
Hematocrit (%)	F	46.03 ±2.27	48.28 ±2.65	45.53 ±1.73	47.43 ±2.79	3.68	0.028	3998.6	0.000
	F-E	48 ±2.97	46.96 ±2.21	45.62 ±1.95	46.84 ±1.69	4.781	0.009		

* Data was Mean ± SD. † significant level accepted at p<0.05. F; fasting group and F-E; fasting and exercise group. T1: one week before Ramadan, T2: second week of Ramadan, T3; last week of Ramadan, and T4: two week after of Ramadan.

The serum levels of high-sensitivity C-reactive protein (Hs-CRP) in fasting group ($F_{3, 24}$= 0.906) and fasting and exercise group ($F_{3, 24}$= 2.359) were significantly decreased. Also, Differences between variables in both groups were significant ($F_{1, 16}$= 8.462; p=0.023) (Figure 1).

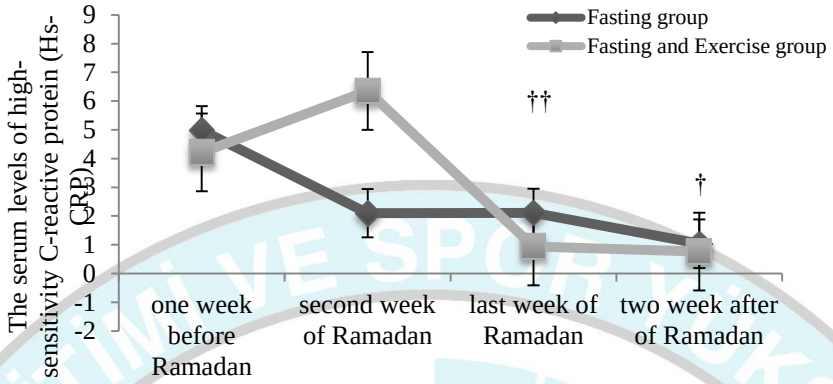

Figure 1- The serum levels of high-sensitivity C-reactive protein (Hs-CRP) during one week before Ramadan, second week of Ramadan, last week of Ramadan, and two week after of Ramadan in both fasting and fasting and exercise groups. † Significant level accepted at p<0.05 for Differences within variables and †† Significant level accepted at p<0/05 for Differences between variables

DISCUSSION

During the fasting month of Ramadan, Muslims are obliged to fast during daytime hours and restrict food and drink intake to the period after sunset. Long lasting modifications in the circadian distribution of the eating and sleeping schedule result in various changes in metabolism. This will provide a unique opportunity to study the effect meal frequency reduction on hematological and biological indices.

Studies reported in literature on the effect of Ramadan fasting on various hematological indices have been conflicting and inconsistent. In this study, red blood cells count, hemoglobin and hematocrit remained unchanged, which was consistent with (Azizi and Rasouli, 1986; Sarrafzadegan *et al*., 2000 and Azizi, 2002) (table 1). But, other studies were showed a slight degree of hemoconcentration (El-Hazmi *et al*., 1987). Conversely, other studies showed a significant decrease in hemoglobin and hematocrit (Dewanti *et al*., 2006). These controversial results may be due to geographical, climatic, economical, and nutritional variations. This study not showed a significant reduction in the platelets count (table 1), which was consistent with Ramadan et al (1994), this may due to deficit or redistribution of specific micronutrients (iron and vitamins) that may account for reduction in platelets count (Ramadan *et al*., 1994). Many previous studies have been published on the effect of Ramadan fasting on serum creatinine and urea in healthy individuals and reported small changes that were statistically not significant. The results of this study were consistent with the previous studies (El-Hazmi *et al*., 1987; sliman and Khatib, 1988; Mafauzy *et al*., 1990 and Aksungar *et al*., 2005).

The effect of fasting and exercise in Ramadan month on the waist to hip ratio in both groups (table 1), as a reflection of abdominal adiposity, were in agreement with majority of studies (Soliman, 1987; Azizi, 1978 and Takruri, 1989) who reported a significant decrease in body weight during Ramadan fasting. The

decrease in body weight was due to efficient utilization of body fat during fasting. In a one study (El- Ati *et al*., 1995) reported that overweight persons lose more weight than normal or underweight subjects during the Ramadan. As inflammation began to be recognized as a major contributor to the pathogenesis of atherosclerosis, cardiologists started to ask whether markers of inflammation could be used to predict the clinical outcome. Our study results revealed that fasting and exercise during the Ramadan month significantly reduces the level of Hs- CRP (4.98 ± 0.811 Vs. 1.04 ± 0.88 for fasting group and 4.22 ± 2.10 Vs. 0.76 ± 0.42 for fasting and exercise group, $p < 0.05$ post-Ramadan Vs pre-Ramadan, mean ± SD) (Figure 1). These findings compare well with the one study (Pasceri *et al*., 2000) who studied the direct pro-inflammatory effect of CRP in human endothelial cells, and reported that CRP has a significant pro-inflammatory effect in both umbilical vein and coronary artery endothelial cells, inducing high levels of expression of ICAM-1, VCAM–1 and E-selectin. Our findings compare well with the results of a study (Ridker *et al*., 1997), who reported that even small increments in serum levels of CRP are associated with higher risk of atherosclerosis and ischemic heart disease in apparently healthy subjects. Lowering of CRP levels may have beneficial effect on the evolution of atherosclerosis and may reduce the risks of coronary events. In our study, this was achieved only by fasting and exercise in Ramadan month with a non-pharmacological intervention. In the study (Ridker *et al*., 1999) found that the reduction of serum CRP by statins was associated with a better clinical outcome after acute myocardial infarction (Hamdy *et al*., 2008).

CONCLUSION

We observed that fasting and exercise during the Ramadan month had a favorable effect on inflammatory function. It also reduced the direct pro-inflammatory effect of CRP on human endothelial cells as well as waist to hip ratio which is a measure of abdominal adiposity. Hence, Ramadan fasting and execute of exercise in the Ramadan month can affect the link between atherosclerosis, inflammation and adiposity with a non-pharmacological intervention in non-active obese men. These favorable effects have occurred in spite of the short period of fasting (29-30 days per year). We, therefore, suggest that a systematic fasting of one to two days and exercise of three to four days per week even after the Ramadan period would serve as an excellent part of healthy lifestyle.

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