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The Effects of Ramadan Fasting and Physical Activity on Body Composition and Hematological-Biochemical Parameters

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ABSTRACT

Introduction: Hunger and reduction in regular energy intake can lead to a number of problems based on their intensity. For instance, low energy level can cause blood cell production to decline or it may pose a higher risk of anemia. It can also weaken the immune system and platelet aggregation or negatively affect clot formation. This study aimed to have a closer look at fasting and regular physical activity and their impacts on body composition and blood hematological-biochemical parameters among professional wrestlers.

Method: In this semi-experimental study, 9 subjects were selected by convenience sampling. The selected training program included participation in this exerciseprogram, 90 min per session, 6 times per week for a period of one month. Blood samples were obtained four times: before the start of Ramadan, 2 weeks after the start, during the last week and 2 weeks after the end of Ramadan. To make intra-group comparison, repeated measure analysis of variance was used. For all statistical comparisons, the level of significance was considered at $P<0.05$.

Results: Body weight and red blood cell count (RBC) dropped significantly at the end of Ramadan (Respectively P= 0.001 and P=0.034). However, the number of white blood cells (WBC) and circulating platelets (PLT) significantly increased during fasting (Respectively P= 0.048 and P=0.042). As a matter of fact, PLT and WBC were the only factors which dramatically increased during fasting. Intra-group variations of tetracycline (TC), low-density lipoprotein (LDL), LDL: high-density lipoprotein (HDL), triglyceride (TG): HDL and TC: HDL reduced at the end of Ramadan. However, HDL levels drastically increased during fasting ($P\leq0.05$).

Conclusion: Based on the results of the research, despite being a regular activity and fasting has beneficial effects on lipid profile in athletes, however, they can with tangible changes in hematological factors may lead to weaken the immune system of athletes.

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Introduction

Fasting during Ramadan is a religious tradition which is a major obligation upon every healthy Muslim who has passed puberty. Fasting is not synonymous with food poverty or receiving inadequate portions of food. The purpose of the mechanism is to improve the adaptability of human body and also decrease the oxidation of fats and carbohydrates (1-2). Thus, Ramadan with its special features leads to certain changes in lifestyle. The amount of food and water consumed per person declines, the number of meals per day drops, and thus daily physical activities and sleep cycle alter (3).

Certain food components and increased fat consumption accounts for approximately 36 percent of the required energy for the body is provisioning from the consumption of polyunsaturated fatty acids (4). As a result, in the first week of Ramadan, the response is an outcome of multiple metabolic disorders. However, within the last week of the month the body reaches a level of compatibility (5). In the fasting month of Ramadan, significant changes appear in lifestyle; for instance, there are fewer numbers of meals per day, shorter night sleep, reduced physical activity and increased overall exhaustion (6-7).

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Moreover, in most of the sports, the body is likely to be massively dehydrated while fasting. Naturally, it can deteriorate the athlete's performance (8). In this context, depending on the athlete's physical condition, fasting could lead to physiological defects such as Hematology, biochemical and body composition (9-10). The evidence indicates that fasting among judo athletics, who prefer to train mildly during Ramadan, can equally reduce the body mass (11). Furthermore, the body weight, among both active and non active lifters who fast, declined (12).

However, in a study on distance runners the body weight and composition did not seem to change significantly during the Ramadan (13). Generally, doing sports and physical activities during Ramadan is known to facilitate body metabolism. It also slows fat accumulation in the body. As a result, the athletes during Ramadan fasting are less prone to digestive problems and undesirable changes in the blood sugar (14).

In this regard, with changes such as lower levels of calories and less amount of energy, it is expected that people who fast might experience a drop in their cholesterol level within the first days. However, this returns to normal after a few days. Increased cholesterol levels and low density lipoprotein cholesterol (LDL-C) has been reported in some articles, which may be associated with weight loss during Ramadan (15-16). Nevertheless, there are other studies which state that while fasting, the cholesterol level could remain unchanged or sometimes decrease(17). Another remarkable finding indicates that after Ramadan, high-density lipoprotein cholesterol (HDL-C) can go up as well (1). However, In relation to the effect of fasting on the above variables, there are contradictory results.

Hence, Hejazi et al. (2013) noted a significant reduction in the levels of hematocrit, RBC, TC, LDL, HDL, LDL:HDL, TC:HDL and VLDL at the end of Ramadan compared to the beginning of the month (9). Attarzadeh and colleagues (2012) investigated the effects of Ramadan fasting and physical activity on 19 male students who took part in some aerobic exercises. The experiment lasted14 sessions (three sessions per week). At the end of the experiment, they recorded their heart rate sat a range of 50-75% in 45 to 60 minutes. What they concluded was that weight, body mass index, waist-to-hip ratio (WHR) and body fat percentage significantly declined (18). Farshidfar et al. (2006) stated that a significant reduction in the levels of hemoglobin, glucose and urica cid occurs on the third and fifteenth days of Ramadan (19).In contrast, in a study conducted by Azizi and colleagues they came to the conclusion that the number of blood cells and hematocrit were normally set at the end of Ramadan (20). However, Dewanti et al. (2006) who show anon-significant reduction in levels of hemoglobin, RBC and Packed Cell Volume (PCV) at the end of Ramadan (21). Bouhlel et al. (2006) had previously reported that a dramatic increase happens in hemoglobin and Hematocrit levels by the end of Ramadan in a rugby team (22). Saada et al. (2010) proved that there is no considerable change in the body mass index between fasters and non-fasters in Ramadan. However, glucose level and HDL-C experienced a noticeable growth. For another thing, TG, TC, very low density lipoprotein (VLDL), hemoglobin and total cholesterol levels saw a decline in three weeks (23).

With many people fasting during Ramadan all around the world, a natural problem is upon athletes. Sport events do not stop during Ramadan and there are many matches going on. Thus, not to eat and drink directly affects the athletes' diet and access to food. Therefore, many trainers and doctors believe that fasting can lead to certain difficulties for athletes during their exercises. It should be noted that the amount of exercise in professional athletes is rather higher than that of the people who exercise only leisurely. Interruption of exercise leads to the complete or partial loss of physiological compatibility and functionality of athletes. The importance of fasting, especially fasting along with sports activities, as well as a better understanding of physiological conditions of athletes during the holy month of Ramadan have made researchers conduct some comparison studies on the effects of Ramadan and regular sports activities on biochemical and hematological serums of male athletes (elite wrestlers).

Materials and Method

Volunteers

The present research was semi-practical, and it was done by doing repetitive tests on

professional male athletes. This research took place in Ramadan of 2014, which corresponded with the summer months of July/August (24). Nine subjects were participated in this study and were fasted the holy month of Ramadan with average duration of fasting of about 16 hours. The sample group was made up of professional male wrestlers with the average age of 22.55±1.87 years, weight of 71.15±10.81 kg and body mass index (BMI) 24.27±3.03 kg/m2 volunteered to participate in this study. The sample rate for this test was 9 and these were athletes with a minimum of eight years of consistent training experience. The sample for this research was designated by the "choice sampling technique".

Study Design

During this research, the health and medical history of the sample group were established through questionnaires. After agreeing on taking part in the research, the sample group was given further information on the methods and procedure which had to be followed in the research tests. They were also given instructions on observing vital points regarding physical exercise, diet, any possible use of medication, smoking habits and any possible use of sports supplements. The samples were then given a blood test following a 12-hour period of starvation. The blood samples were taken from the arm and between 8-10 AM at Dr. Madjid Sezavaran laboratory base in Mashhad, lran.

Training Protocol

The exercise program used for this research was the same as the last one which was used for the professional national wrestling champions. This comprised of a one-month period; six days per week and two wrestling sessions, two sessions of review for wrestling techniques and one session of aerobic exercise and one of weightlifting. A) The Saturday to Wednesday exercises included a general rule of a 15-minute warm-up and 10-15 minutes of specialized warm-up. Three times of three minutes of real wrestling practice with a 30 second break between each session. Then two 30- second rounds at the ground mode, 4 minutes of rest before the start of the next episode, three 2-minute drill wrestling with a 30-second timeout for wrestlers to cool down. Then again, two times of 30-second rounds at the ground mode and for 5 to 10 minutes of cool-down. B) For Sunday's timetable, aerobics was practiced for 45 minutes with an intensity of 60-80% in the form of continuous or interval methods. C) On Monday and Thursday, the wrestlers spent 45 minutes reviewing techniques with medium intensity. Tuesday included weightlifting exercises; for example two-stage lifting 3×10, chest press 3×10, squat 3×10, Shoulder blade 3×10 and lifts 3×10 respectively.

The intensity of the exercises was increased by 5% after the first week and followed the same trend during the second, whilst they were decreased by 10%in the third week due to the start of Ramadan. The amount of exercises, however, remained unchanged. The intensity and amount of the exercises in the fourth week continued in the same fashion whilst the fifth week saw a 5% increase in the exercise intensity. On the other hand, the exercise amount remained unchanged. There was yet another increase of 5% in the sixth week along with keeping the amount as much as the previous weeks. There was another 5% increase in the exercise intensity in the seventh week; the exercise intensity was controlled using the "Borg Scale" (25).

Obtaining blood sample

All the variables associated with this research (serum Hematological-Biochemical Parameters and body composition) were carried out in four stages 1) Three days before the start of Ramadan 2) After 14 days of fasting 3) After 28 days of fasting 4) Two weeks after the end of Ramadan in identical sampling conditions.

Measurements of parameters

We used an auto-analyzer system of ERMA and SINNOWA for the blood samples to examine their value of the complete blood count (CBC), as well as their Serum TC, TG and fast blood sugar (FBS) concentration which were closely examined as mg/dl by using Pars-Azmun kits. Fast blood sugar were determined by flame photometry (glucose oxidase method; coefficient of variation (CV), CV=1.97%) using auto analyzer unit (CRONIX 801). HDL and LDL were measured by the enzymatic method technique, using Man kit (CV), CV<10%., Tehran, Iran Hemoglobin and hematocrit concentration

were analyzed by system K-4500 automated hematology analyzer.

Statistical Analysis

The SPSS software version 15 was used at the end of the experiment to analyze the given data. After ensuring that the data was not corrupt and was deemed logical (statistical Shapiro Wills) and upon checking the variances (Leven analysis), the repeated measure was used to compare the various changes that occurred within each group and were specified for use with the results of levels (P<0 05).

Results

According to Table 1, our results show a noticeable weight loss (P=0.001) by the end of Ramadan. However, the WHR and body fat percentage (BFP) reduced at the end of this period. Nonetheless, these changes were not statistically significant (P>0.05).

At the end of Ramadan, RBC levels saw a remarkable reduction compared to the beginning of the month (Table 2). On the other hand, among all the variables, only WBC and PLT values increased dramatically while fasting. Although, HGB and HCT levels at the end of Ramadan declined, the variations were not statistically significant.

According to Table 3, our results indicate considerable reduction of serum TC, LDL, LDL: HDL, TG: HDL and TC: HDL values after Ramadan compared to that of before Ramadan. However, a drastic increase in HDL–C was observed. Also, the FBS levels rose at the end of Ramadan, but these changes were not statistically significant.

Discussion

The aim of this study was to investigate fasting and physical activities and the impaction

Table 1. Changes in anthropometric indicators elite wrestlers During Different Stages and Changes in Means of Within Group

Variables	Stages				Variations	
	3 day before Ramadan (Mean ± SD)*	Day 14 of Ramadan (Mean ± SD)*	Day 28 of Ramadan (Mean ± SD)*	Two Weeks after Ramadan, (Mean ± SD)*	F	P Value**
Weight (Kg)	71.15±10.81	70.64±10.86	71.21±10.59	70.70±10.54	0.999	0.001‡
BMI (Kg/m2)	24.27±3.03	24.11±3.12	24.40±3.82	24.24±3.84	0.009	0.999
Body fat (%)	10.63±3.86	10.12±3.51	10.30±3.78	10.05±3.43	0.043	0.988
WHR (Cm)	1.17±1.01	0.83±4.46	0.84±3.96	0.79±0.11	1.19	0.361

*Data presented as mean ± standard deviation ** P Value within group
‡The mean difference is significant at the 0.05 level.

Table 2. Changes in hematological indices elite wrestlers During Different Stages and Changes in Means of Within Group

Variables	Stages				Variations	
	3 day before Ramadan (Mean ± SD)*	Day 14 of Ramadan (Mean ± SD)*	Day 28 of Ramadan (Mean ± SD)*	Two Weeks after Ramadan, (Mean ± SD)*	F	P Value**
White blood cell count (x 106/mm3)	5922.22±618.01	5811.11±686.37	6455.55±634.64	6611.11±732.19	3.05	0.048‡
Red blood cell count (x 106/mm3)	4.98±0.22	5.12±0.27	4.87±0.31	4.97±0.19	3.41	0.034‡
Hemoglobin (gm/dl)	14.98±1.60	15.12±1.37	14.96±1.29	14.80±1.28	0.897	0.457
Hematocrit (%)	49.35±16.97	44.91±3.24	44.62±22.81	44.65±4.74	0.253	0.859
Platelets (1000)	222.66±26.39	217.55±33.81	231.77±27.96	209.88±27.64	3.173	0.042‡

*Data presented as mean ± standard deviation ** P Value within group
‡The mean difference is significant at the 0.05 level.

Table 3. Changes in biochemical variables elite wrestlers During Different Stages and Changes in Means of Within Group

Variables	Stages				Variations	
	3 day before Ramadan (Mean ± SD)*	Day 14 of Ramadan (Mean ± SD)*	Day 28 of Ramadan (Mean ± SD)*	Two Weeks after Ramadan, (Mean ± SD)*	F	P Value**
FBS (mg/dl)	87.88±9.86	93.77±11.93	95.33±13.20	93.33±13.24	1.21	0.327
TG (mg/dl)	110.00±59.11	114.11±70.61	87.56±45.02	88.77±33.33	1.27	0.306
TC (mg/dl)	144.11±19.13	143.22±21.07	133.66±16.34	137.00±14.39	3.48	0.031‡
LDL (mg/dl)	72.22±12.90	72.55±10.69	66.22±12.55	66.77±11.44	3.40	0.034‡
HDL (mg/dl)	42.77±12.18	46.77±13.04	49.33±10.39	49.55±9.40	3.30	0.037‡
LDL:HDL (mg/dl)	1.77±0.48	1.65±0.51	1.38±0.44	1.40±0.44	5.42	0.005‡
TG:HDL (mg/dl)	2.75±1.57	2.62±1.73	0.79±0.24	1.90±0.93	6.50	0.002‡
TC:HDL (mg/dl)	3.53±0.84	3.20±0.75	2.79±0.58	2.85±0.63	5.90	0.004‡

*Data presented as mean ± standard deviation ** P Value within group
‡The mean difference is significant at the 0.05 level.

the body composition and Hematological-biochemical factors in elite wrestlers. According to these results, the overall weight of subjects experienced a gradual decline toward the end of Ramadan. However, WHR and body fat percentage decreased only slightly, and these changes were not statistically significant, which seems to be in accordance with others studies (26-27). Evidently, there is controversy in the results obtained by Saada and colleagues (2010) and Chennaoui et al. (2009) (13, 23). Ziaee, et al. (2006) In a study conducted on 81 male and female subjects, concluded that at the end of Ramadan, weight and body mass index (BMI) in both male and female subjects dropped (26). Salehi and colleagues (2007), noted an ample reduction in weight, BMI, blood glucose and cholesterol levels after a period of fasting in Ramadan (27). Chennaoui et al (2009) examined the effects of Ramadan fasting on physical performance and metabolic, hormonal, and inflammatory parameters in middle-distance runners, concluding that weight and body fat percentage barely changed during Ramadan (13). Saada et al (2010) exhibited no changes in weight and BMI. However, the levels of glucose, HDL-C, urea, creatinine and protein had increased remarkably. On the other hand, the amount of hemoglobin, total cholesterol, triglycerides, LDL-C and VLDL-C reduced greatly during the third week of the month (23).

Reduced body weight during Ramadan can be a direct result of decreased body water supplies that are associated with glycogen and decreased body tissues, along with certain degrees of hypo-hydration and volume concentration of the extracellular (28). It is also noteworthy that weight loss caused by fasting in overweight people was more perceptible than in those with an average body weight (29). The reduction in the energy intake leads to a slower energy consumption since the amount of physical activities, as we elaborated, drops greatly (30). Therefore, it is likely that the observed loss of weight is majorly due to dehydration. However, it is a matter of question whether chronic dehydration actually occurs in Ramadan (30-31). It goes without saying that regarding the negative balance of water and energy during this month, it is vital not to undermine the health of fasting (30).

Cutting on the number of meals per day, might be a cause of altered body composition. The reason is the role that food intake pattern play in the body's metabolic activity (32). Gluconeogenesis usually begins 6-4 hours after the last meal and with the liver glycogen depletion, it reaches the maximum activity. In this process, gluconeogenic amino acids and fatty acids through lipolysis are the main suppliers of body's required energy. These factors help reduce weight and body fat mass (even in aiso caloric dietor very low energy intake) (33). Disparity in the results of the aforementioned studies may be due to the temperature, climate, fluid intake and amount of exercise.

In our study, white blood cell count and platelet value increased enormously after Ramadan compared to before Ramadan. It can be seen that several studies are conflicting on the effects of Ramadan fasting on hematological levels. This finding was supported by Ziaee et al (2007) (34). However, other investigations have reported opposing findings (35-36)

One of the important factors which can clearly be seen while exercising is leukocytosis (increased number of white blood cells in circulation). The number of white blood cells in the circulation may be compared at the time of the break-up has increased quadruple. After cessation of exercise, it remained high for several hours (37).

In general, it seems that the intensity and duration of exercise has a direct influence on the amount of leukocytosis and reversely affects the amount of the individual's readiness.Thus, the length of exercise might by far be the most important factor here. In addition, leukocytosis may be influenced by the factors that regulate the body's hormonal response to exercise (37). The release of corticosteroids which confirms the central role of these hormones on how to distribute immune cells to follow the exercise (38). An increase in the number of white blood cells during and immediately after exercise is mostly due to the frequency of Neutrophils and less lymphocytes. The number of Monocytes may also increase (39).

In this study, RBC levels decreased significantly by the end of the Ramadan while the levels of Hgb and HCT declined. These changes did not prove to be statistically significant. The findings of the present study were consistent with Bouguerra et al. (2003) (40).

However, our findings are not in accordance with the one conducted by Ziaee and collogues (2007) (34). Ziaee and collogues (2007) indicated that there was a noticeable elevation in serum RBC levels and a significant decrease was observed in MCV and MCH levels (34). One of the other reasons for the reduction of hemoglobin synthesis, myoglobin and electron transport chain proteins is the reduction of the concentration of ferritin. It will lead to the overall decline of iron in athletes and non-athletes. So, certain issues are likely to emerge due to the lack of iron consumed in a diet or a change in the distribution of iron in the body. This also causes a change in protein bonding to iron synthesis during fasting (41-42). Reduction of the level of serum iron is related to the decrease of the total iron binding capacity (TIBC), the level of reduction is not due to the decline of iron reserves, but it can be caused by the changes of the plasma proteins (43).

Our study showed a significant increase in HDL by the end of Ramadan. Also, TC, LDL, LDL: HDL, TG: HDL and TC: HDL serum levels experience a considerable reduction by the end of Ramadan compared to the beginning. The findings of the present study were consistent with Attarzadeh et al. (2013), Chaouachi et al. (2008) (11, 44). There is controversy in the results obtained by Saleh et al. (2005) (45). Endurance training may lead to the increased lipoprotein lipase (LPL). Thus, this enzyme plays the major role in the conversion of VLDL to LDL.Furthermore, it is specified that the aerobic exercise can result in the heightening of the Lecithin-cholesterol acyltransferase (LCAT) enzyme. LCAT eventually elevated the etherification of cholesterol in the muscle to HDL, which is another reason for HDL levels to rise (46).

Heightened HDL-C after exercise is a similar condition to lower triacylglycerol due to accumulation and disappeared them. The relationship between these conflicting changes could be defined as follows. The increase in the activity of LPL accelerates the glycerol in the VLDL and removes the bit of the lipoprotein. As a result, the excess fat in the cortex (free cholesterol and phospholipids) has to be transferred to HDL-C. Additionally, the exercise gives rise to the lecithin cholesterol acyltransferase resulting in the feeding of the particle of HDL-C (47). Lecithin cholesterol acyltransferase synthesis occurs in the liver and moving into the plasma and its bulk is joined in the HDL.

This enzyme helps to produce Cholesteryl ester transfer protein (CETP), transfer it to the VLDL or sometimes LDL-C. Lecithin cholesterol acyltransferase along with apolipoprotein A cofactor, esterifies free cholesterol. The deficiency in this enzyme may be due to genetic abnormality or deficiency of the apolipoprotein A (Apo A.) The LCAT enzyme causes a decrease in Cholesteryl ester transfer protein (CETP) and HDL-C. The chylomicron residue that contains cholesterol, cholesterol ester, phospholipids and apoproteins is absorbed by endositos and they separate from each other in the liver.

Consequently, fatty acids which are derived from food or are synthesized in the liver can come in the form of triacylglycerol form a clutter of VLDL particle along with cholesterol and Cholesteryl ester, finally entering the bloodstream (42, 46).

Conclusion

The effects of Ramadan fasting on lipid profile is different in published articles and this may be due to changes in diets, less amounts of physical activities and some cultural parameters. The findings of this study showed apart from the spiritual enrichment which happens through Islamic fasting in Ramadan, it can be physically beneficial through watching the regular diet. For instance, making changes in the number and time of meals and observing the precondition to receiving appropriate calories-especially in Active individuals–can result in favorable adjustments in blood biochemical indices.

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