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THE EFFECT OF RAMADAN FASTING ON SOME BASIC COMPONENTS OF BLOOD AMONG FEMALE STUDENTS OF COLLEGE OF SPORTS SCIENCES AT THE UNIVERSITY OF JEDDAH

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Abstract

Aim: The aim of our study is to highlight the influence of fasting on the variations of physical, anthropometric and biochemical parameters among young female students of Jeddah University.
Method: Twenty-four female students with ages ranging from 20 to 26 years consented to taking part in our study. They were tested on 3 occasions: before, during, and after the month of fasting. To this end, we took blood samples, anthropometric measurements, and an exercise test.
Results: The analysis and interpretation of the results showed no significant change in the anthropometric parameters despite the variations observed during the month of fasting ($P > 0.05$). However, we could mention significant decreases in biochemical and physical parameters to later result in an increase, testifying to a phenomenon of adaptation by the organism after a month of fasting ($P < 0.05$).
Conclusions: Fasting has no negative effects on the different parameters studied. Thus, fasting seems to be a beneficial means for the health of the human organism.

Keywords: fasting, biochemical parameters, physical parameters, female students, immune system

1. Introduction

The fast during Ramadan is defined as a short fast of about 11 hours in winter and 17 hours in summer. This month is characterized by a change in dietary rhythms reflected primarily by the taking of a main meal at the break of the fast at sunset and a change in the sleep-wake cycle with a more pronounced nightlife (Chiha, 2008). Perpetual concerns arise every year with the advent of Ramadan in the world of sports. Is practicing intermittent fasting during Ramadan compatible with the practice of sports? Everyone makes use of his or her beliefs, ideas and experience in interpreting the effects of fasting on the body. The opinions of Muslim scholars, doctors, athletes, coaches and officials tend to differ. Some advocate the obligatory aspect of fasting during Ramadan and do not tolerate any postponement, since duty takes precedence over the athletes' activities. For others, they justify the exemption of fasting for health reasons. From the point of view of doctors and coaches, many state that fasting poses a great risk for the individual performing intense activities (Hakoumi, 2016), while others state the complete opposite (Zerguini et al., 2007). So everyone adapts, in the sense that international sporting organizations do not take into account

the month of Ramadan in the programming of international events, to the effect that for athletes, the fasting of Ramadan presents a real dilemma.

The repercussions of fasting on the different physical, anthropometric and biochemical parameters are still very much being debated, while the scarcity of studies in this country incites us to try to bring some answers and to better understand how the physical data vary. In addition, what are the blood parameters like during Ramadan fasting among athletes?

The effects of fasting are controversial according to the various studies. A reduction in weight has been found in some studies (Husain et al., 1987; Bouhlel et al., 2006; Ziae et al., 2006; Al Hourami, 2007), while others have reported weight gain gain (Yucel et al., 2004; Siddiqui et al., 2005; Girard et al., 2011). Others reported no significant change in the body weight or body composition (Ramadan, 2002; Karli et al., 2007; Chiha, 2008; Meckel et al., 2008).

Body fat decreases during the fasting period period (Bouhlel et al., 2006; Chaouchi et al., 2009). While Güvenç (2011); Maughan et al. (2008); Zerguini et al. (2007), have reported an increase in the fat mass. Norouzy et al. (2013); Bouhlel et al. (2016), have shown a significant decrease in weight, BMI, and lean body mass between one week before and one week after the Ramadan fasting. At the same time, , Syam et al. (2016) , have reported a decrease in fat while protein mass remained the same. Similarly, Aybak et al. (1996), recorded an elevation in the total protein level.

Similar contrasting variations were found in studies on biochemical parameters (Ibrahim et al., 2008; Lamri-Senhadji et al., 2009; Ziae et al., 2006; Maughan et al., 2008). Indeed, Nomani et al. (1989); Whitley et al. (1989); Hangdoost and Pooranjbar (2009), detected a decrease in blood glucose levels. On the other hand, an increase was reported by other authors (Ba et al., 2004; Bouhlel et al., 2006). Moreover Rocky et al. (2004); Chiha (2008), found stability in the blood glucose level. Resting serum glucose levels decreased during Ramadan fasting in moderately trained runners (Aziz et al., 2010), soccer and basketball players (Aziz et al., 2012), and runners (Faye et al., 2004), but not elite rugby players (Bouhlel et al., 2006), and active men (Haghdoost, PoorRanjbar, 2009; Trabelsi et al., 2012).

As to the impact of Ramadan fasting on physical performance, the results so far are unconfirmed (Chaouachi et al., 2012), due to the fact that performance is affected by several factors such as food and fluids (Souissi et al., 2007), lack of sleep, and insufficient training (Chaouachi et al., 2009; Mujika et al., 2010). Given the changes in the biological rhythm, it implies that fasting should theoretically affect physical performance in a negative way (Mourgin et al., 1991). However, physical performance, according to various studies, improved significantly after the third week and the following two weeks. This decrease is very clear in the first two weeks with a return to normality and stabilization thereafter, testifying to the phenomenon of adaptation by the body (Khalfallah, 2004). Some authors also reported that fasting has no negative effects on performance (Chaouchi et al., 2009; Abdul Rashid et al., 2011; Güvenç, 2011).

Indeed, several results pointed to the important benefits brought about by this mode of fasting which, since a long time, has been used for its dietetic and therapeutic virtues. A diet of several days would indeed allow

the body to regenerate itself, to purify the skin or to improve one's well-being, provided that some rules are respected.

On the other hand, other results have reported an unfavorable variation on the human body and more particularly on the body of sports men and women. Questions can thus be asked. Does Ramadan fasting positively or negatively impact the body of athletes? Is it incompatible with the practice of sport as some authors have reported or does it contribute, among other risks, to putting the body in unfavorable energetic conditions for physical activities?

To answer these questions, we have as objectives to follow the dynamics of variations in some biochemical and anthropometric parameters among young sports men and sports women before, during, and after the fasting of Ramadan. More specifically, we need to study the variation sin these parameters during the Ramadan fasting period relative to the non-fasting period.

2 Methods

2.1 Subjects of the Study

The sample of our research includes (24) female students from the Department of Physical Activity of the College of Sports Sciences at the University of Jeddah. Their ages range from 20 to 26 years. All the subjects are healthy, non-smokers and have no contraindications for sports practice. They were reassured that the study data will be collected while respecting their confidentiality and anonymity. Each subject included in this study was informed about the purpose, protocol, and potential risks of the study, and then asked to sign a written consent.

The subjects participating in the study underwent anthropometric measurements, exercise testing, and blood sampling before, during, and after the month of fasting.

2.2 Conduct of the Study

Under the same climatic conditions of temperature and humidity, the anthropometric measurements, exercise test, and blood samples were performed during three periods; two weeks before the month of fasting, half of the fasting time (end of the second week of fasting), and two weeks after fasting. The study was conducted as follows:

2.2.1 Anthropometric measurements:

These concern the body weight (BW), height (H), body mass index (BMI), fat mass (FM), and lean weight (LB):

- ✓ The height (in cm) is measured with a measuring tape,
- ✓ the BW (in Kg) is measured with a scale (Kuhen and Fleichel),

- ✓ the adult body fat percentage (% BF) is calculated using the equations of Deurenberg (1991): % BF = (1.20×BMI) + (0.23×Age) - (10.8×Sex) - 5.4
  For women, the "Sex" value is equal to 0
- ✓ the MM is calculated from the body mass according to the equation:
  LB=BM-[BM× (% BF/100)],
- ✓ Anthropometric measurements are taken before the start of the exercise test.

2.2.2 Evaluation of maximal oxygen consumption: VO2max

The VO2max is evaluated from the shuttle run test with one-minute increments (test of Leger et al. 1982) (Leger et al., 1984): this is a test that indirectly evaluates the VO2max expressed in ml/Kg/min and by a linear function of the Maximum Aerobic Speed (MAS) (Astrand and Ryhming,1954).

The test is chosen because it is recognized by its manufacturers as valid, accurate and precise (Gerbeaux et al., 1991), and has a high degree of correlation with the direct test (Leger et al., 1984), especially because it is easy to perform and accessible to all (Edgard Hill and Raymond Thomas,2000).

The test is of the maximal and progressive type: the subjects run as long as possible until they can no longer keep up with the imposed speed, which starts at 8.5 Km/h with an increasing and progressive order of 0.5 km/h every minute. The subject is stopped when he/she is two successive times behind a sound signal broadcast on a magnetic tape used as an audiovisual support for the test. The test takes place in a sports hall at 2:30 pm during the 3 periods.

2.2.3 Analysis of biochemical parameters

Blood samples were taken by qualified personnel. It should be noted that these samples were taken under the same conditions for all study subjects in the morning (at 10:00 am). Each blood sample was 25 ml in a heparinized tube.

All analyses were performed via an automated process at the biochemistry laboratory of "*Yasser Medical Center*" in Jeddah (Saudi Arabia). The biological tests were performed in three periods: before, during, and after the month of fasting.

The biochemical assays concerned the following parameters: *blood glucose, White blood cells (Wbcs), Netrophil, Monocytes, Lymphocytes.*

2.3 Statistical Analysis

For the descriptive statistics, we calculated the arithmetic mean and the standard deviation. For the analytical statistics, we used the test of the Anova (F) to study the variations between the different periods, while the threshold of significance retained is ($p<0, 05$). The statistical exploitation was carried out on a computer with the help of the software SPSS 20.

3. Results

The results are presented in three parts: results of anthropometric parameters, results of biochemical parameters, and results of the performance achieved in the exercise test. All parameters are expressed in descriptive (mean± standard deviation) and analytical (comparison of results by F anova) results.

3.1 Anthropometric parameters

The mean values and standard deviations of anthropometric parameters as well as the result of statistical comparisons between measurement periods are shown in Table 1.

Table 1. variation of anthropometric parameters before during and after the month of fasting

	before fasting	**During Fasting**	**after fasting**	**F (anova)**
Weight BW (kg)	55,04±5,58	54,79±5,744	55,03±5,53	**0.01 NS**
BMI (kg/m2)	22,27±1,57	21,26±1,51	22,16±1,58	**0.04 NS**
fat mass FM (kg)	14,62±2,11	14,48±2,21	14,61±2,07	**0.03 NS**
lean weight LB (kg)	46,89±3,69	46,74±3,76	46,89±3,65	**0.02 NS**

*significant per 5%, NS: not significant

The results show that no significant changes were observed for the anthropometric parameters during the three periods of our study ($P > 0.05$). However, a decrease in values during the month of fasting and an increase upon resumption of a normal diet after the month of fasting were not significant ($P > 0.05$). This means that Ramadan fasting does not seem to affect the anthropometric parameters.

3.2 Analysis of biochemical parameters

Table 2. Biochemical variation of blood immune parameters before during and after the month of fasting

	before fasting	During Fasting	after fasting	F (anova)
Wbcs **(x10^6/mm^3)**	6,52±1,37	5,71±1,45	8,18±5,86	**2,98***
Neutrophils (%)	60,29±4.25	54,08±9,93	56,16±11,69	**2,53***
Monocytes (%)	2,25±1,25	3,5±1,91	3,83±1,94	**5,55***
Lymphocytes (%)	41,83±10,79	36,04±4,24	41,08±9,83	**3,08***

*significant per 5%, NS: not significant

Table. 2. shows the variations in the immune system during the three periods of measurements. The analysis of the results shows significant differences ($P < 0.001$). During the fasting period, we observe a decrease in the levels of the immune parameters of the blood and then a slight increase after the month of fasting, particularly: lymphocytes (36,04±4,24) vs (41,08±9,83); monocytes (3,5±1,91) vs (3,83±1,94); neutrophils (54,08±9,93) vs (56,16±11,69). Ramadan fasting affects the blood immune parameters.

Table 3. Blood glucose variation before during and after the month of fasting

	before fasting	during fasting	after fasting	F (anova)
Glycémie (gr/l)	101,12±15,09	99,61±4,85	102,32±8,15	**0,42 NS**

*significant per 5% , NS : not significant

The results show that no significant change was observed in blood glucose levels during the three measurement periods (P > 0.05). However, it should be noted that during the fasting period, the blood glucose levels are lower than before and during the fasting month where an increase is recorded (101.12 ±15.09 gr/l) vs (99.61 ±4.85 gr/l). After the month of fasting, the blood sugar level seems to settle towards the state before the month of fasting. This means that there is no variation in the blood glucose level during the fasting month.

3.3 Performance parameters

Analysis of the results of physical performance parameters shows significant differences for the three measurement periods (P < 0.01). Indeed, vo2max values decrease (24.97±1.97ml/Kg/min) during fasting, then increase significantly afterwards (26.11±2.45 ml/Kg/min). After the month of fasting, the values seem to regulate towards the state before the fasting (26.11±2.45 ml/Kg/min) vs (28.10±3.32 ml/Kg/min).

The same variations appear for the maximum aerobic speed VMA: decrease in the maximum speed during fasting (9.13 ± 0.48 Km/h) vs (9.82 ± 0.88 Km/h and 9.41 ± 0.61 Km/h) compared to both periods before and after the month of fasting.

Table 4. Physical performance variation before during and after the month of fasting

	before fasting	during fasting	after fasting	F (anova)
ύO2max (ml/Kg/min)	28,10±3,32	24,97±1,97	26,11±2,45	**8,65***
VMA (Km/h)	9,82±0,88	9,13±0,48	9,41±0,61	**6,17***

*significant per 5%, NS: not significant

4. Discussion and conclusions

4.1 Anthropometric parameters

Anthropometric parameters were measured three times: the first to have a baseline finding, serving as a control; the second to determine the effects of the fasting month; and the third to verify the complete recovery of these parameters. Our results confirm that the beneficial effects of the fasting month are transient, and despite the non-significant difference after the fasting month, the trend of increasing and recovering values after the fasting month can be observed (Norouzy et al., 2013; Sow et al.,2016). These

results are consistent with the work of El Ati et al. (1995), who found that after one month of fasting, and despite the non-significant differences, the anthropometric parameters measured before, during and after the month of fasting resume their initial levels.

Weight is an index that is highly influenced by the dietary factor and is very sensitive to it through its fat mass component and the quantity and quality of food (Sadiya et al., 2011; Attarzadeh et al., 2014; Norouzy et al., 2013). Despite fasting (no food and water intake), body weight did not change significantly. The stability of weight observed during fasting is consistent with the results of Graham, Belhadj and Balasekan (2007); Karli et al. (2007); Chiha (2008); Meckel et al. (2008); Kara et al. (2020), but contrasts those of Bouhelal et al. (2006); Ziae et al. (2006); Hussain et al. (1987); Sweileh et al. (1992); Al Hourami (2007), who observed a decrease in body weight, while Siddiqui Sabir and Subhan (2005); Girard (2012) , reported an increase in weight. A slight non-significant increase is noticed in the post-fasting period. This stability in weight could possibly be explained by the balance between energy intake and expenditure (Chiha, 2008).

Similarly, fat mass, the parameter most influenced by diet, did not change significantly despite the slight decrease noted during the fasting month which is attributed to the efficient use of body fat (El Ati et al., 1995; Nomani et al.,1989). In the fasting state, the body substitutes its energy source from glucose to fatty acids. Fatty acids are released from adipocytes, which may decrease body fat. These results are consistent with the work of several authors who found that there was no significant change in the body composition (El Ati et al., 1995; Ramadan, 2002; Graham, Belhadj and Balasekan, 2007; Karli et al., 2007; Chiha,2008; Meckel et al., 2008). In the same respect, the lean mass or active mass did not change during the three periods of measurements despite the variations recorded. Our results are fully consistent with the work of Ramdan (2002) and Fall et al. (2007), but are contrary to those of of Bouhlel et al. (2006) and Fakhrzadeh et al.(2003) , who reported in their studies a significant decrease in body components.

Generally speaking, the effects of fasting on anthropometric parameters are influenced by dietary habits, as well as socioeconomic, cultural and sleep-wake cycle differences (Syam et al.,2016).

4.2 Biochemical parameters

The study of the effect of fasting on the immune system shows significant fluctuations in performance according to the three periods of blood sampling. In the fasting state, we register a decrease in the levels of the immune system and then an increase. Our results are in perfect agreement with the work of Khazaei et al. (2014), who assert that fasting would have considerable benefits on health. Indeed, being deprived of food, the body tries to save up on energy expended and for this purpose recycles a large number of immune system cells that are not essential, especially those that are damaged. The body would force the bone marrow to produce white blood cells in large quantities, which have the function of fighting infections. "This gives the bone marrow the green light to rebuild the entire immune system," explains Valter Longo, a professor at the University of Southern California. "The good news is that the body gets rid of damaged or aged and ineffective parts of the immune system while young. Fasting cycles can help create literally, a new immune system" (Valter et al., 2014). The level of white blood cells thus varies according to the periods of fasting and feeding, decreasing and increasing according to the person's feeding rhythm (Rafael

et al.,2019). Recent studies on non-Muslims have proven the effectiveness of fasting on the immune system even in older people, and have shown that fasting helps the body to start producing new white blood cells, which stimulate the immune system to fight infections. As a result of these changes, the stem cells renew the cells of the immune system and the rate of white blood cells subsequently increases. (Raffaghello, et al,.2010).

For the evolution of blood sugar levels, it is usual to see a blood sugar imbalance at the end of the month of fasting because of the diet deviations often seen during this period. This trend was not observed in our study subjects. The results show no significant changes during the three measurement periods, despite the variations in the level observed during the month of fasting. The decrease in blood glucose recorded during Ramadan can be attributed to the physical effort, which goes in the direction of the consumption of blood glucose (Chiha, 2008); the stock of blood glucose is never the same as in the initial state. And probably also to a lack of carbohydrate intake in the nightly food rations, which may have led to a decrease in carbohydrate oxidation and an increase in fat oxidation (Trabelsi et al., 2011). After the month of fasting, there is a slight increase in blood glucose levels that is not significant, due to the effect of the rehabilitation period after the disruption of the biological rhythm, as found in studies by Dowod Tahm (2004). The results obtained are in line with those of Chiha (2008), who found a stability in blood glucose levels. On the other hand, an increase in blood glucose levels was reported by Ba et al. (2004); Bouhelel et al. (2006); Kamel et al. (2007). Resting serum glucose levels decreased during Ramadan in moderately trained runners (Aziz et al., 2010), soccer and basketball players (Aziz et al., 2012), but not elite rugby players (Bouhlel et al., 2006) and active men (Trabelsi et al., 2012).

4.3 Physical performance parameters

The analysis of the results obtained in the evaluation of parameters related to the exercise test allows us to ascertain that the average values of the VMA and the VO2 max, determining factors of the aerobic performance, underwent a certain fluctuation. The maximum values are obtained before the fasting of Ramadan, then regress during the fasting. This decrease in performance may be due to dehydration, decreased stroke volume and carbohydrate stores (El-Sahed, 1997). In addition, performing physical activity during fasting was the cause of significant psychological and physiological stress (Aziz et al., 2014).

On the other hand, after the fasting period, we recorded increases in values, but which remained below those obtained beforehand. This gain in performance upon resumption of a normal diet could be due to an overcompensation effect related to changes in training conditions during fasting (Hakoumi A, 2016). Our results corroborate those of Kirkendall et al. (2008); Abdul Rashid et al. (2011); Güven (2011); who showed an elevation of indices at the aerobic level. Some authors reported a decrease in VMA on the 7th day of fasting that continued three weeks later (Chennaoui et al., 2009). The same conclusion was listed in other studies (Meckel et al., 2008; Roy & Bandyopadhyay, 2015; Aziz et al. 2017).

The comparison of the data obtained and what has been reported in the scientific literature shows that it is difficult to transfer any insufficiency in the results to the effects of fasting. Cardio respiratory responses to exercise during Ramadan depend on the physical condition and activity level of the individual (Ramadan,

2002; Ramadan et al., 1999). In this context, the fluctuation in performance from one period to the next during the tests would probably be due to the increase in training load that was crescendo. Similarly, when the training program is maintained regularly, the diet is balanced; and when there is sufficient sleep, the aerobic capacity results are not altered (Karli et al., 2007).

The literature review has allowed us to understand the mechanisms and effects of fasting on the body, but the results by the different studies remain controversial, and it seems that socio-economic, cultural and geographical differences may influence dietary practices and daily habits, thus contributing to the inconsistency of the results in the different studies. Our work is based on a study that aimed to highlight the influence of fasting on variations in physical, anthropometric and biochemical parameters among young female students at the University of Jeddah. In light of the results obtained at the end of our experiment, we came to the following conclusions:
There is no disturbance as far as body components are concerned despite the variations observed during the month of fasting. The anthropometric parameters do not seem to be affected by the Ramadan fasting.

On the other hand, no impact was recorded on the biochemical and physical parameters during the fasting period. Almost all results show either stability or improvement in performance after the fasting month.

Due to changes in the biological rhythm, fasting affects the biochemical and physical parameters. This decrease is very clear in the first two weeks, with a return to normal and stabilization thereafter, testifying to a phenomenon of adaptation by the body. Fasting has no negative effects on the biochemical and physical parameters. Thus, fasting seems to be a beneficial means for the health of the human organism.

This study is limited to certain anthropometric, physical and biochemical elements in a reduced number of subjects, thereby opening up the opportunities for more detailed perspectives. Further investigation of hematological, urinary, lactate, enzymatic, hydric, hormonal and other parameters would provide more information on the specificities of various metabolisms in the context of fasting.

A wider range of discipline-specific tests (physical, technical, tactical) would certainly be of considerable value.

Dietary surveys over several days would allow for objective planning of the athlete's diet in terms of quantity, quality, and also water.

The interactions and interdependencies between the different parameters and their impact on the body could be elucidated by correlations.

The use of a larger sample and if possible with young and non-young athletes, as well as a comparison between athletes and sedentary people, will clarify certain metabolic variations.

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