The Effect of Ramadan Fasting on Hematological Parameters

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A R T I C L E I N F O	A B S T R A C T
	Background & Objectives: Ramadan fasting, which entails abstention from eating and drinking for one month, is an obligation for the Muslims around the world. This practice has different medical and physiological effects, such as reduced blood pressure, lipid profile, blood glucose level, and body weight. It has been hypothesized that Ramadan fasting induces some changes in the hematological parameters. Regarding this, the present study aimed to investigate the effect of Ramadan fasting on blood cell count and erythrocyte sedimentation rate (ESR). **Materials & Methods**: This study was conducted on 59 adult healthy individuals (i.e., 34 males and 25 females), who had completed one month of Ramadan fasting. Fasting blood samples were analyzed for ESR, hemoglobin (Hb) levels, hematocrit (Hct) levels, white blood cell (WBC), platelet count (PLT), mean corpuscular volume (MCV), and mean platelet volume (MPV) in four phases (i.e., one day before Ramadan, on the second and last weeks of Ramadan, as well as one month after Ramadan) **Results**: As the results indicated, the participants had an age range of 15-24 years. The means of ESR significantly increased within the four phases (except for the phase IV in comparison to phase III). Additionally, the mean Hb and Hct levels were significantly greater in the phase III than those in the phase I (P<0.001). Furthermore, the mean of mean corpuscular volume decreased significantly within the phases of the study (P<0.001). Although the MPV decreased in the phase II, it returned to the baseline in the phase IV (P=0.028). The mean WBC count decreased during all phases of the study significantly (P=0.003). On the other hand, the mean platelet count mildly increased during this period (P<0.001). **Conclusion**: According to the findings of the study, Ramadan fasting has statistically significant effects on hematological parameters, which were within the normal range.

Introduction

Ramadan fasting is an obligatory practice for all adult Muslims around the world, which requires the individuals to abstain from eating, drinking, smoking, and sexual intercourse from dawn to dusk for one month. This change in the diet, sleep pattern, and life style of the individuals may have significant medical and physiological effects on the body (1).

Some studies have reported favorable effects of Ramadan fasting, including reduced body mass index, positive effects on blood glucose level, blood pressure, and serum lipid profiles, including increased low density lipoprotein (LDL); in addition to, decreased high density lipoprotein (HDL) and triglyceride (2-5). Others have demonstrated that the reduction of body weight and serum glucose levels may be regained after Ramadan (6, 7). However, some studies have reported reverse results or no changes in the serum lipid profiles and blood sugar levels (8, 9).

In addition to the above-mentioned issues, Ramadan fasting is proposed to be associated with a number of complications in some patients, including those suffering from diabetes mellitus,

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anemia, and cardiac diseases. It is suggested that these patients take specific precautions regarding Ramadan fasting (10, 11). According to the literature, some other controversial effects have also been reported in terms of the serum levels of vitamins, blood pressure, cardiac parameters, etc. (12). Nevertheless, no adverse effects have been revealed on other organs, such as heart, lung, and liver (13, 14).

Similarly, the investigation of changes in the hematological parameters during and after Ramadan have rendered controversial results in the literature. Some studies have reported increased white blood cell (WBC), red blood cell (RBC), and platelet count (PLT) (15). On the contrary, other studies have reported decreased WBC, RBC, hematocrit (Hct), and platelet aggregation responses (16, 17,18).

Due to the disagreements regarding the effect of Ramadan fasting on serum biochemical and hematological parameters, we aimed to investigate the effect of Ramadan fasting on blood cell count, and erythrocyte sedimentation (ESR) in an Iranian population.

Material and methods
Study design
In the present study, 116 healthy adult subjects were selected from the seminary students of Shahrekord Seminary School, who completed one month of Ramadan fasting. This study was carried out in the month of Ramadan in September 2006- November 2006. The participants were selected from the seminary students for ensuring that the participants would continue fasting for the entire month. Any participants diagnosed with hematological or inflammatory diseases affecting ESR or WBC during the first blood sampling or those who were pregnant or lactated were excluded from the study.

The four phases of the study included one day before Ramadan (phase I), the second (phase II) and last weeks of Ramadan (phase III), as well as one month after Ramadan (phase IV). In each phase, 5 ml of fasting venous blood sample was taken from each participant in the sitting position from the left hand's medial cubital vein in the morning. The blood samples were sent to the laboratory in two citrated tubes, and they were analyzed for erythrocyte sedimentation rate (ESR), hemoglobin (Hb) levels, Hct levels, WBC, PLT, mean corpuscular volume (MCV), and

mean platelet volume (MPV). The blood cell count was performed using Colter device (Sysmex KX21, made in Japan). ESR was calculated using the Western-Green method.

Ethical considerations
The protocol of the present study was approved by the Shahrekord University of Medical Sciences. The design and objectives of the study were explained to all the participants and the written informed consent was obtained from those who were willing to participate in the study. Additionally, they were clarified about the possibility to leave the study whenever they wished to. They were also ensured that their data will be kept confidential and analyzed anonymously.

Statistical analysis
The quantitative variables were presented as mean and standard deviation. Furthermore, the continuous variables were compared using t-test and one-way repeated measures ANOVA. For the statistical analysis, SPSS version 11.5 (SPSS Inc., Chicago, IL) was employed. P-value of 0.05 or less was considered statistically significant.

Results
Out of the 116 participants included in the first phase of the study, 70 were male (age range: 15-24 years). Mean ages of the female and male participants were 21.32 ± 1.39 and 17.35 ± 2.25 years, respectively (P<0.001). The number of the subjects who participated in the three phases of the study reduced to 70 cases. This number lessened to 59 participants in the last phase (phase IV), 34 cases of which were male.

The means of ESR were 4.14 ± 1.94, 6.65 ± 5.12, 11.19 ± 8.71, and 9.96 ± 5.90 mm/h, in the first, second, third, and fourth phases of the study, respectively. As indicated in these results, the ESR gradually increased significantly in all the phases (P<0.001), except in phase IV as compared to that in phase III (P=0.36). The increasing trend of ESR was significantly higher in the females than the male participants (P<0.001) (Figure 1).

The means of Hb were 14.53 ± 1.73, 14.75 ± 1.64, 15.7 ± 1.58, and 16.43 ± 2.68 g/dL, in the first, second, third, and fourth phases of the study, respectively. This value gradually increased (P<0.001); however, it was not statistically significant in the second and fourth phases,
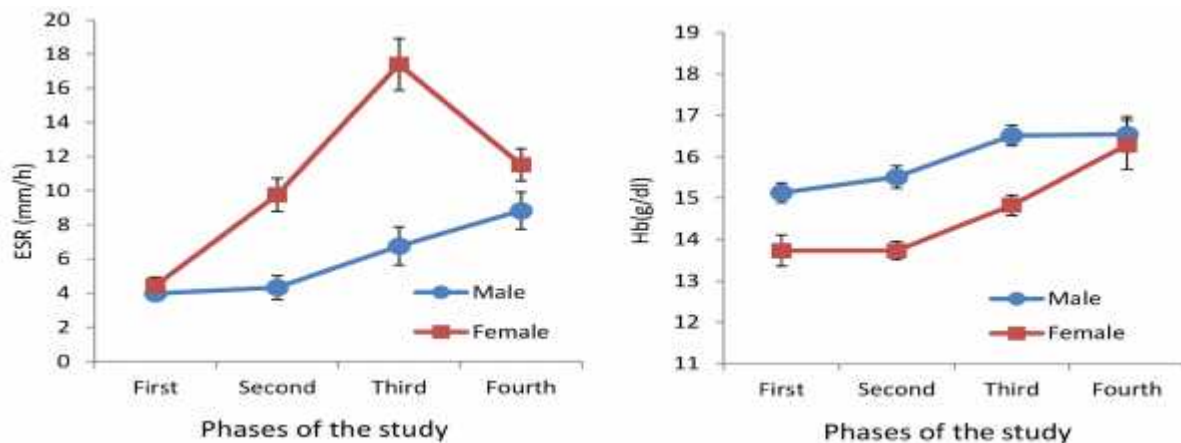
Figure 1. Mean changes of erythrocyte sedimentation and hemoglobin levels at four phases of the study based on the gender of the participants

compared to those in the first and third phases (P=0.184, P=0.061, respectively). On the other hand, this variable was significant in the third phase as compared with that in the first phase (P<0.001). The changes in the Hb were significantly higher in the female participants than those in the males (P=0.045) (Figure 1).

The means of HCT were 40.5±3.68, 42.86±3.58, 42.59±3.27, and 44.79±5.81% in the first, second, third, and fourth phases of the study, respectively. As can be seen, this value gradually increased in all the phases (P<0.001), except for the third phase as compared with that in the second phase (P=0.15). The increasing trend of HCT was significantly higher in the females than the males (P<0.001) (Figure 2).

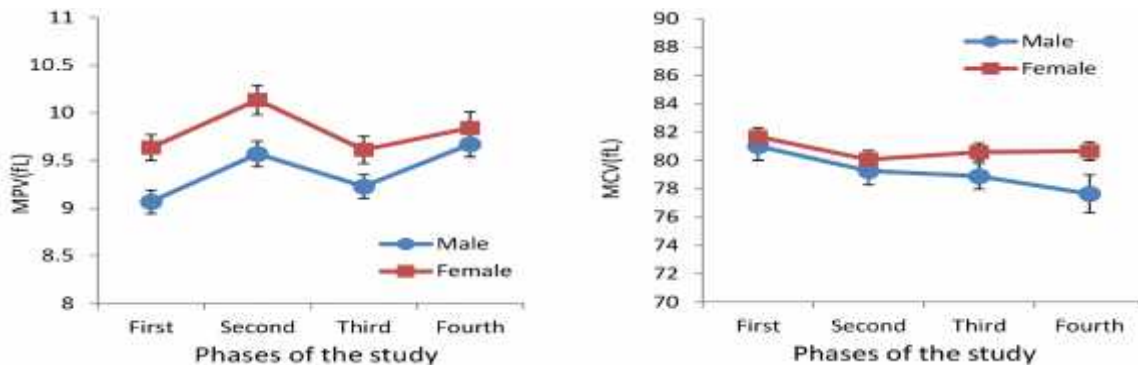The means of mean corpuscular volume (MCV) were 81.28±4.88, 79.59±4.81, 79.6±4.56, and 78.9±6.36 fL, in the first, second, third, and fourth phases of the study, respectively. According to

these results, this value gradually decreased within the four phases of the study (P=0.001), which was statistically significant (P<0.001). The changes in the MCV were not significantly different between the female and male participants (P=0.071) (Figure 3).

The means of MPV levels were 9.31±0.71, 9.8±0.80, 9.38±0.74, and 9.74±0.78 fL, in the first, second, third, and fourth phases of the study, respectively. As indicated in these results, the MPV levels decreased significantly in the second and third phases, compared to the first (P<0.001) and second phases (P<0.05), respectively. Nevertheless, the MPV levels were not significantly different between the third and first phases (P=0.289). In addition, the mean MPV was less in the males than that in the female participants (P=0.036). The trend of changes in the four phases was not associated with the gender of the participants (P=0.11) (Figure 3).
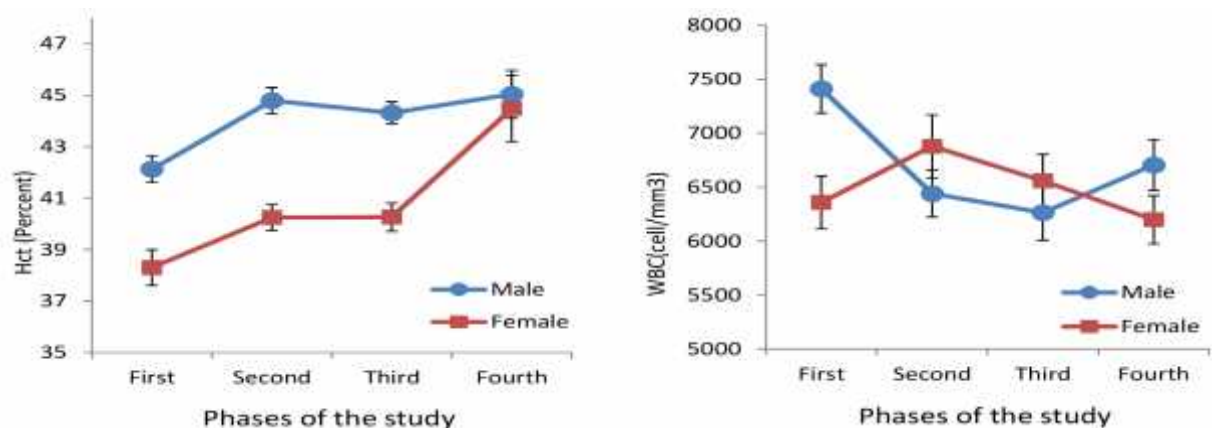

Figure 2. Mean changes of hematocrit and white blood cells at four phases of the study based on the gender of the participants

Figure 3. Mean changes of mean platelet volume and mean corpuscular volume at four phases of the study based on the gender of the participants

The means of WBC count were 6966±1364, 6627±1350, 6389±1377, and 6491±1291 cell/mm3 in the first, second, third, and fourth phases of the study, respectively. This value decreased significantly in the third and fourth phases of the study, compared to that in the first phase (P=0.003, P=0.026, respectively). Furthermore, the age (P=0.230) and gender (P=0.157) of the participants had no significant effect on the WBC levels. However, the trend of changes differed between the male and female participants (P=0.001) (Figure 2).

The means of PLT count were 191983±38430, 197491±40554, 238050±49368, and 171152±63188 cell/mm3 in the first, second, third, and fourth phases of the study, respectively. As indicated, this value changed significantly during Ramadan fasting (P<0.001); however, it was not significant in the second phase, compared to that in the first phase (P=0.14). Additionally, the age (P=0.799) and gender (P=0.808) of the participants had no significant effects on the PLT levels (Figure 4).
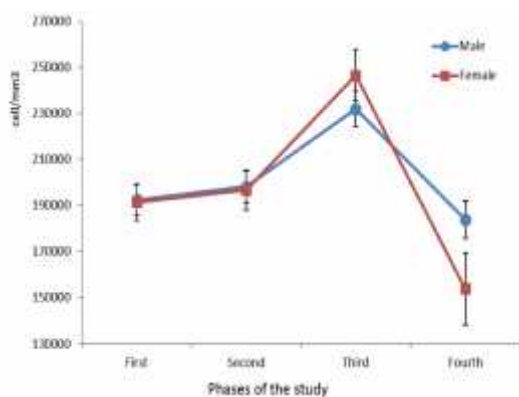
Figure 4. Mean changes of platelet at four phases of the study based on the gender of the participants

Discussion

Every year, millions of Muslims fast for one month; therefore, Ramadan fasting is an important health issue. As the findings of the present study indicated, there were an increasing trend in the Hb and Hct levels and a decreasing trend in the MCV and WBC count after Ramadan, compared to the previous measurements (i,e, before or in the middle of Ramadan).

Several studies have measured the serum biochemical and hematological parameters; however, they are difficult to be properly compared with one another due to the employment of different research conditions. The reduced WBC reported in the present study was found to be within the normal range, which decreases the clinical significance in this regard. These changes in the WBC count have been similarly reported by other researchers such as Dewanti et al. examining 100 male workers in Indonesia (19) and Hosseini and Hejazi investigating 26 healthy Iranian males (17).

Likewise, Ünalacak et al. investigated 20 obese and normal-weighted participants and reported decreased WBC in both groups after Ramadan, compared to the pre-Ramadan levels (16). However, some studies revealed no changes in the WBC count (11). Al Hourani et al. reported no significant changes in the WBC count in their study, which was conducted on 57 healthy females (4). Similarly, Sarraf-Zadegan et al. investigated 50 Iranian employees and reported no statistically significant change in this regard (20).

On the contrary, in a study carried out by Nematy et al., which evaluated 82 patients with cardiovascular disease and compared the serum parameters before and after Ramadan, an increased WBC was observed (15). This

discrepancy between the findings of different studies might be due to the employment of different inclusion and exclusion criteria in these studies. In the present study, we excluded any participant with inflammatory or infectious diseases based on the ESR and WBC obtained from the first serum examination.

However, other studies might have considered patients' self-reports or C-reactive protein levels (15), which may cause differences in the WBC changes among the studies. Yet, future meta-analysis studies can better evaluate the limitations of the already conducted studies and report the pure effect of Ramadan on WBC count.

In the present study, PLT increased in the third phase and decreased in the fourth phase. Although this change was statistically significant, it has little clinical importance as the changes were within the normal ranges. The changes in the PLT levels due to Ramadan fasting have also been investigated in the previous studies. Accordingly, Nematy et al. reported increased PLT (15); however, Al Hourani et al. investigated 57 healthy females and observed a reduction in the PLT (4).

In addition, Askari et al. evaluated 15 asthmatic patients and reported decreased PLT levels after Ramadan (21). As Al Hourani et al. have postulated, this difference might be due to the micronutrient deficiencies like iron and vitamin inadequacies that may be effective in the PLT reduction (22).

The increase in the Hb levels observed in the present study might be caused by dehydration during Ramadan. In consistent with our findings, some studies reported decreased Hb levels. In a study conducted by Dewanti et al. investigating 100 male workers in Indonesia, reduced Hb levels were reported (19). Likewise, Hosseini and Hejazi examining 26 healthy Iranian male participants reported reduced levels of Hb (17).

On the other hand, Al Hourani et al. indicated no significant changes in the Hb levels (4). This discrepancy might be due to the differences in the study population. While a number of studies, like the current one, included both males and females, some only included the male participants (17, 19), and others only considered the females (4). These variations may induce changes in the results regarding the fact that women do not fast during their menstrual period and lose blood within this period. Furthermore, they may consume oral contraceptives to delay their menstrual cycle in

order not to miss fast days. All of these conditions may affect the hematological parameters, including the ESR and Hb levels.

In the present study, the changes in the ESR was clinically insignificant as it was within the normal range and only dependent on female gender. On the other hand, the decrease in the MCV was clinically significant despite the fact that the changes in the MPV were within the normal range. In line with this finding, Nematy et al. reported a reduction in the MCV (15). As posited, the access of RBCs to iron and other nutrients may vary in different hours of fasting, which may change the shape of RBCs and cause changes in the MCV of RBCs.

Additionally, the results of the present study indicated increased Hct levels, which is similar to the findings of a study conducted by Schmahl and Metzler, who evaluated the Turkish Muslims in Germany observed an elevation in the Hct levels (23). In another study, Hosseini and Hejazi, showed opposing findings (17). However, in a study carried out by Al Hourani, no significant changes were observed in the Hct levels (4). The amount of fluids the participants take during Ramadan might play a role in this difference (22).

There is a great difference between the characteristics of the study populations employed in different studies. Accordingly, these populations may be different in terms of their physical activities, food consumption, and hydration, which could cause a great difference in the results of the serum hematological parameters (24, 25). As an example, the students in the present study had limited physical activities, while some studies considered participants with high physical activities (19). In addition, the season, in which Ramadan is placed is also important and may cause difference in the hematological parameters since the fasting hours vary in different years (26). Moreover, the foods the participants take during Ramadan plays a role in the discrepancy between the results of the studies, which might be very diverse among various nations and ethnic groups.

The strengths of the present study was the measurement of various hematological parameters within four phases. On the other hand, the present study included some limitations, such as high dropout rate, which might have affected the results of the study. In addition, the consideration of control group is very important to reduce the effect of confounders.

Conclusion

As the findings of the present study indicated, Ramadan fasting has statistically significant effects on the hematologic parameters, including a clinically significant increase in the ESR (in females) and decrease in the MCV. Additionally, other changes in the hematologic parameters were observed to be within the normal range.

Acknowledgments

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