

Effects of Ramadan Fasting on Some Physiological and Biochemical Parameters in Healthy and Hypertensive Subjects in Aurangabad District of Maharashtra, India

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| ARTICLE INFO | ABSTRACT |
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| <p><i>Article type:</i> Original article</p> <hr/> <p><i>Article History:</i> Received: 21 Dec 2013 Revised: 26 Jan 2014 Accepted: 28 Jan 2014 Published: 19 Feb 2014</p> <hr/> <p><i>Keywords:</i> Blood pressure Body weight Cholesterol Heart rate Packed cell volume Ramadan fasting Urea</p> | <p>Throughout the world, millions of Muslims fast daily during the month of Ramadan from sunrise (Sahar) until sunset (Iftar). Considering the impacts of environment on physiological functions, we performed this study in order to examine the effects of Ramadan fasting on some blood parameters of healthy volunteers and hypertensive patients. According to the results, there were no significant changes in the weight, heart rate (HR), blood pressure (BP), serum total cholesterol and packed cell volume (PCV) of volunteers before and after fasting ($P < 0.05$). However, considering hypertensive patients, blood urea significantly increased, while blood pressure (both systolic and diastolic pressures) significantly decreased during the fasting period ($P > 0.05$). Therefore, it can be concluded that hypertensive patients, while continuing their previous medications, can safely fast during the month of Ramadan.</p> |

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Introduction

Ramadan fasting is one of the most significant practices of Islam, and is the most important *act of worship* in this religion (1). It is essential for healthy adult Muslims to fast from dawn to dusk during the whole month of Ramadan (2). In this regard, Quran, the religious book of Muslims states, "O you who believe, fasting is prescribed to you as it was to those before you, so that you can learn self-restraint" (Al-Quran 2:183).

Fasting period is variable and depends upon the season in which it occurs (3). Fasting Muslims can have two meals per day- once before dawn, and once after the sunset; also, there is no need for any special diet or food

items during the fasting period. Fasting Muslims are not permitted to consume food, drink liquids, smoke, and perform sexual activities; moreover, using medications (orally, or through inhalation or injection) is impermissible for the fasting individuals (1).

Fluids and foods are consumed after sunset, and the quantity, frequency and type of the diet, along with sleeping time and duration, and daily physical activities alter during this month (4). These dietary and habitual changes can influence the body metabolism and may induce changes in physiological and biochemical parameters (5). These alterations are most

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probably due to the changes in eating and

Table 1. Effects of Ramadan fasting on various parameters in the control group (mean \pm SE of 30 volunteers)

| Parameters | Pre-fasting period | Post-fasting period | P-value |
|---------------------------|--------------------|----------------------|-----------|
| Body Weight (Kg) | 60.47 \pm 1.72 | 58.52 \pm 1.68 | 0.21 |
| Blood Pressure (mmHg) | 121/81 \pm 2.1 | 121/80 \pm 0.7.0.5 | 0.34/0.17 |
| Heart Rate (bpm) | 75 \pm 1.5 | 75 \pm 1.0 | 0.39 |
| Packed Cell Volume (%) | 44.57 \pm 1.12 | 44.80 \pm 0.83 | 0.43 |
| Urea (mg/dl) | 37.67 \pm 1.24 | 46.03 \pm 0.97 | 0.000018 |
| Total Cholesterol (mg/dl) | 175.67 \pm 4.41 | 166 \pm 5.66 | 0.092 |

drinking frequency and sleep timing (1, 6).

Despite the physicians' medical advice and Islamic prohibition against the fasting of unhealthy individuals (such as diabetic, hypertensive, and disabled patients, and those consuming oral medications), still a significant number of patients with various chronic diseases insist on observing this religious practice due to their personal beliefs and satisfaction (7). In these cases, physicians face a dilemma as to how they can offer clinical advice for their fasting patients.

There are many published studies on the effects of fasting on healthy as well as unhealthy subjects; however, the results are controversial (8-10). We believe that one of the responsibilities of the physicians is advising and helping patients with performing their religious practices, since this has a great influence on patients' recovery.

Very few studies have been conducted on the effects of Ramadan fasting on the health of individuals, especially in Maharashtra, Aurangabad, India, where a sizable Muslim population resides. Therefore, the objective of this study was to evaluate and to compare the effects of Ramadan fasting on blood pressure (BP), heart rate (HR), weight, packed cell volume (PCV), serum urea, and cholesterol in healthy and hypertensive individuals.

Materials and Method

Sample collection

In the current study, thirty (n=30) healthy and fifteen (n=15) hypertensive individuals were allocated to control and study groups, respectively; all these subjects fasted throughout Ramadan. The adult volunteers were randomly selected from the middle and lower-middle classes, and were within the age range of 35-65 years (mean=37 \pm 8.6 years);

therefore, there was no significant difference in their socioeconomic level.

Each subject acted as his/her own "control" by comparing the recorded parameter values of pre-fasting period (one day before Ramadan) with those of post-fasting period (the last day of Ramadan). The control subjects had no past medical history of diabetes mellitus, hypertension, and ischemic heart disease, while the study group included confirmed hypertensive patients. The patients who had other chronic diseases such as diabetes mellitus and liver conditions were excluded from this study.

Most of the study group subjects were undergoing one or more antihypertensive therapies. All the subjects were tested for BP, weight, HR, serum cholesterol, serum urea, and PCV; the tests were performed during the pre- and post-fasting periods. These participants were allowed to freely consume foods and drinks after fasting hours; however, they were not taking any medications, and avoided smoking and alcohol abuse.

Measurements

The BP measurements were performed twice in the sitting position (11), and the body weight (kg) was measured twice on a weighing machine. The HR was measured by palpating the pulsations of the radial artery at the wrist for one minute.

For blood parameter estimations, 2 ml of the blood sample was collected from the median cubital vein in a plain bulb, using the vacuum sampling method; the serum was separated within an hour of blood collection (5). Afterwards, the serum was analyzed for different variable measurements in hospital laboratories of the Government Medical College, using standard kit method.

Table 2. Effects of Ramadan fasting on various parameters in hypertensive patients (mean \pm SE of 15 subjects)

| Parameters | Pre-fasting period | Post-fasting period | P-value |
|---------------------------|---------------------|------------------------|---------------|
| Body weight (Kg) | 66.63 \pm 3.35 | 65.2 \pm 3.28 | 0.38 |
| Blood Pressure (mmHg) | 148/90 \pm 5.06/2 | 133/81 \pm 4.63/1.63 | 0.016/0.00059 |
| Heart Rate (bpm) | 75.2 \pm 1.80 | 74 \pm 1.69 | 0.32 |
| Packed Cell Volume (%) | 45.06 \pm 1.33 | 44.20 \pm 1.15 | 0.31 |
| Urea (mg/dl) | 43.64 \pm 3.70 | 52.50 \pm 4.51 | 0.07 |
| Total Cholesterol (mg/dl) | 187.33 \pm 7.46 | 186.66 \pm 7.78 | 0.48 |

Statistical analysis was performed using online t-test calculator. Quantitative data were reported as mean \pm standard error (SE), and were compared using the paired data, and two-tailed Student's t-test, with the assumption that the data is normally distributed. *P*-value less than 0.05 was considered statistically significant (Tables 1 and 2).

This study was performed in the Department of Physiology of Government Medical College & Hospital, Aurangabad, Maharashtra, India. All the patients and procedures were in accordance with the institutional guidelines for medical research, and informed consents were obtained from the participants.

Results

The mean \pm SE values of the parameters described in this study are shown in Tables 1 and 2. The mean weight of the control subjects was 60.47 \pm 1.72 kg and 59.52 \pm 1.68 Kg in the pre- and post-fasting periods, respectively; there was no significant difference between these values (*P*<0.05). Considering the hypertensive patients, the mean weight of the subjects was 66.63 \pm 3.36 kg and 65.20 \pm 3.28 kg in the pre- and post-fasting periods, respectively; there was no significant difference between these values for hypertensive patients (*P*<0.05).

The mean HR of the volunteers was recorded as 75.03 \pm 1.54 bpm and 74.53 \pm 0.95 bpm in the pre- and post-fasting periods, respectively; there was no significant difference between these values (*P*<0.05). In the case of hypertensive patients, the mean HR value was 75.2 \pm 1.803 bpm in the pre-fasting period and 74.00 \pm 1.69 bpm in the post-fasting period; there was no significant difference between these values for hypertensive patients (*P*<0.05).

The mean of hematocrit or PCV values in the

control subjects was 44.57 \pm 1.12% and 44.80 \pm 0.83% in the pre- and post-fasting periods, respectively; there was no significant difference between PCV values in the control group (*P*>0.05). In the case of hypertensive patients, the mean pre-fasting PCV value was 45.07 \pm 1.34%, and the mean post-fasting value was reported as 44.2 \pm 1.16%; thus, no significant effect of Ramadan fasting was observed on the values of PCV for hypertensive patients (*P*<0.05).

To observe the effect of fasting on renal function, we checked the blood urea levels during the pre- and post-fasting periods in the controls and hypertensive patients. The pre-fasting urea level in the controls was found to be 37.67 \pm 1.24 mg/dl, while in the post-fasting period, it was 46.03 \pm 0.97 mg/dl, which indicates a significant increase (*P*>0.05). However, for hypertensive patients, the urea level was 43.65 \pm 3.7 mg/dl and 52.65 \pm 4.51 mg/dl in the pre- and post-fasting periods, respectively, which shows that there was no significant difference between these two periods (*P*<0.05).

The pre-fasting serum cholesterol level in the control group was 175.67 \pm 4.41 mg/dl, while in the post-fasting period, it was reported as 166 \pm 5.66 mg/dl. The serum cholesterol levels in the hypertensive patients were 187.33 \pm 7.46 mg/dl and 186.67 \pm 7.79 mg/dl in the pre- and post-fasting periods, respectively. The statistical analysis showed that there was no significant difference between the serum cholesterol levels of pre- and post-fasting periods, in both control and study groups (*P*<0.05); however, the mean values of serum cholesterol seem slightly higher in hypertensive patients compared with the control subjects.

The pre-fasting systolic blood pressure (SBP) in the control group was 121.47 \pm 2.03 mmHg, while it was 120.6 \pm 0.67 mmHg in the

post-fasting measurement. Diastolic blood pressure (DBP) was 80.73 ± 0.93 mmHg and 79.73 ± 0.48 mmHg in the pre- and post-fasting measurements, respectively. Regarding the hypertensive patients, the pre-fasting SBP was 148 ± 5.07 mmHg, while during fasting it was 132.53 ± 4.63 mmHg, which shows a significant drop in SBP ($P > 0.05$). In the pre-fasting period, DBP was 90 ± 2.0 mmHg, while in the post-fasting period, it was reported as 81 ± 1.63 mmHg; this also indicates a significant drop in DBP ($P > 0.05$).

Discussion

In the current study, we investigated the effect of Ramadan fasting on multiple physiological and biochemical parameters among healthy volunteers and hypertensive individuals. Fasting and dietary habits constitute important states of physiological and biochemical adaptations. The present study demonstrates non-significant changes in the weight of the subjects, although the average pre-fasting values of healthy and hypertensive subjects were higher compared with the post-fasting values.

There are contradictory findings reported by various researchers regarding the effect of fasting on the weight of the subjects (8,9,12-14). It seems that body weight might decrease after Ramadan fasting; however, Frost and Pirani (15) observed that Ramadan fasting caused a significant increase in the body weight.

The fact that Muslims change the quality and pattern of their food and drink consumption during Ramadan is quite well-known (16). Traditionally, most of the Muslims consume a greater variety of foods and drinks in their meals. During this month, they prefer to consume more carbohydrates and sweet foods, and it is known that the intake of these nutrients at an unconventional time can alter metabolic functions in the body (14). Some researchers observed a decrease in the body weight and subcutaneous fat in both genders by the reduction of energy intake during fasting. These and other researchers (17,18) noticed that there was a significant increase in the calorie, fat, carbohydrate and protein intake during Ramadan, thereby causing a significant increase in weight during Ramadan. The researchers (14) who observed a decrease in the body weight

suggested that this is probably due to a decrease in the size of the adipose cells during and after fasting.

The present study group consisted of subjects from the lower-middle class. These subjects generally tended to eat more carbohydrate-rich foods along with sweet drinks after breaking their fast at sunset. It was not possible to standardize the diet during this study, since after fasting, each individual tended to eat according to his/her desire and will (19). The observed differences in the studies may be due to the difference in the socioeconomic status and the level of physical activity in different groups of various studies. This may also be due to the fact that our subjects were not suffering from prolonged starvation, because they were consuming more food at night and were also being rehydrated at the same time (3).

Our study demonstrated no significant changes in the HR in the control and hypertensive subjects. This again may be due to the fact that the subjects were not suffering from prolonged starvation as they were consuming food at night and were also being rehydrated at the same time. It has been proven that HR is very low in cases of prolonged starvation, and a reduction is observed in the HR of subjects with a greater decrease in males as compared to females. Mohmoud and Mansi (20) have observed a slight decrease in HR, though it was statistically non-significant after Ramadan fasting. Al-Kubati *et al.* (21) have confirmed that fasting during Ramadan has advantages in lowering BP and HR during the day and disadvantages in the evening and early morning, which could increase the risk for patients with uncontrolled hypertension, unstable angina pectoris, myocardial infarction, or heart failure.

Although, we observed insignificant changes in the SBP and DBP of the controls, there was a significant drop in both SBP and DBP of hypertensive subjects ($P < 0.05$); other researchers (22,23) have also reported similar results. Nematy *et al.* (14) have found that Ramadan fasting decreases SBP and not the DBP. In a recent report, Sayedda *et al.* (24) discovered that the mean blood pressure significantly decreased in the first half of Ramadan; however, it regained the pre-Ramadan values at the end of the month.

Trepanowski and Bloomer (3) noticed that resting HR and BP fell simultaneously with weight loss. They found a systematic correlation between weight changes and BP, and predicted a BP fall of 1.5 or 2.5 mmHg/ per kg of weight loss; therefore, our study results are in consistence with these findings. Fasting helps keep BP normal and control body weight, which is of high significance, especially for diabetic patients (25). In the present study, no changes were observed in serum cholesterol level in both control and study groups. Almost similar findings have been reported in previous studies (14, 23).

Marbut *et al.* (26) observed that if caloric intake is reduced during fasting, there is a significant decrease in blood HDL-C (high-density lipoprotein-cholesterol), though they found no changes in total serum cholesterol. Mohsen *et al.* (27) deduced that serum cholesterol increased during the fasting period, although it returned to the normal level as the fasting period ended. In addition, many researchers (9,28,29) have observed that HDL-C significantly decreased during Ramadan fasting, while Low-density lipoprotein-cholesterol (LDL-C) significantly increased. However, all of these researchers noted that no significant changes were observed in total cholesterol levels. The reason for the differences in these findings may be the variations in socioeconomic status of the subjects.

It also appears that the quality and quantity of fat intake during Ramadan may govern blood cholesterol level (6). The level of physical activity may also account for these findings. The subjects in these studies were residing in developed countries, whereas the subjects in our study were not only from a developing country, but also from an underdeveloped area of the country; therefore, the variations are justified.

In case of blood urea, again various researchers have reported some contradictory findings. El-Gendy *et al.* (30) concluded that blood urea had a significant increase during the fasting period, though it returned to the baseline by the end of the fasting month; they observed a significant rise in blood urea during fasting. These findings are comparable with the findings of the present study. The increase in serum urea

might be due to dehydration. The total body fluids including the plasma volume are reduced because of salt and water deprivation. However, as it has been previously stated, these changes are temporary and the serum level returns to the baseline as soon as the fasting period is over (22).

Regarding the PCV levels, no significant changes were observed in the control and study groups in the current study. The literature shows that few researchers have noted the effects of Ramadan fasting on PCV, and heterogeneous findings have been reported. Dewanti *et al.* (31) have observed a decrease in PCV after Ramadan fasting. Similar to ours findings, Mohsen *et al.* (27) and Al Hourani *et al.* (32) found that PCV, mean cell volume, mean corpuscular volume, and the mean corpuscular hemoglobin concentration showed an insignificant fluctuation in the study groups. This may be due to the fact that for any change in PCV, there must be severe and prolonged dehydration, whereas in Ramadan fasting, the subjects drink water and other fluids from dusk until dawn. This rehydration may prevent the blood from becoming any more viscous, and therefore, can hinder the increase in PCV; however, an increase in PCV was observed in some populations such as judokas (33).

Conclusion

According to the findings of the present study, there is a significant drop in BP during fasting only in hypertensive patients. Regarding other parameters (except the urea of the control subjects), the present study revealed no significant changes. Previous studies indicated many different and contradictory results (34). The variations in the results could be attributed to a number of factors, such as differences in study protocols, method of sampling, nutritional and socioeconomic status of the study subjects, diurnal variations, dietary habits and customs, geographical location, as well as seasonal and climatic differences in Ramadan. Therefore, it can be concluded that hypertensive patients, while continuing their previous medications, can safely fast during the month of Ramadan; moreover, fasting could also help them control their BP toward normal values.

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