

## Effects of Ramadan Fasting on Ambulatory Blood Pressure in Hypertensive Patients

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### ABSTRACT

**Introduction:** Previous studies have indicated that Ramadan fasting has beneficial effects on cardiovascular risk factors, specially blood pressure and heart rate (1). In the present study, the effect of Ramadan fasting on 24-hour ambulatory blood pressure and heart rate has been investigated.

**Method:** This prospective observational study was conducted on two groups of individuals. Six patients under hypertension treatment were allocated to the case group and 12 healthy individuals were selected as the control group. Twenty-four-hour blood pressure monitoring was carried out during four periods: prior to Ramadan, during the first ten days and the last ten days of Ramadan, and one month after it. All patients continued their medication, which was administered twice per day. Twenty-four-hour mean blood pressure, weight, body mass index (BMI), and waist circumference were compared among the groups.

**Results:** In the case group, there was a significant reduction in subjects' weight during the third period of the experiment; also, a significant improvement was observed in the heart rate during the second and third periods in the case group ( $P < 0.05$ , t-test).

**Conclusion:** This study indicated a significant improvement in the subjects' heart rate over second and third periods of measurements; also, no high-risk variations in blood pressure or heart rate were observed among the subjects.

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### Introduction

Ramadan is an Islamic month during which Muslims abstain from eating, drinking, and smoking from dawn to sunset. Cardiovascular diseases are considered the leading cause of mortality worldwide (2), and hypertension is one of the most common risk factors associated with increased risk of atherosclerotic cardiovascular disease or stroke (3).

During the month of Ramadan, repeated cycles of fasting and feeding, along with

alterations in the daily patterns of sleep and activities and medication timing might contribute to changes in blood pressure among hypertensive patients.

Studies on the effects of fasting on the blood pressure of hypertensive patients are scarce, and have provided inconclusive results (4, 5). However, previous studies have indicated that Ramadan fasting has beneficial effects on cardiovascular risk factors, specially blood

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**Table 1.** Effect of Ramadan fasting on systolic blood pressure in hypertensive patients (n=6)

Compression the Systolic blood pressure (SBP) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}^2_1 - \bar{x}^2_2$	P-value
1&2	mean SBP - before Ramadan	139.81±16.6	-5.14±14.9	0.437
	mean SBP - first period in Ramadan	134.67±21.2		
1&3	mean SBP - before Ramadan	139.81±16.6	-4.37±6.8	0.176
	mean SBP - last period in Ramadan	135.44±16.1		
1&4	mean SBP - before Ramadan	139.81±16.6	-6.77±12.0	0.228
	mean SBP - after Ramadan	133.04±17.1		
2&3	mean SBP - first period in Ramadan	134.67±21.2	0.77±12.2	0.884
	mean SBP - last period in Ramadan	135.44±16.1		
2&4	mean SBP - first period in Ramadan	134.67±21.2	1.63±12.2	0.758
	mean SBP - after Ramadan	133.04±17.1		
3&4	mean SBP - last period in Ramadan	135.44±16.1	2.40±5.2	0.317
	mean SBP - after Ramadan	133.04±17.1		

1= mean systolic blood pressure - before Ramadan

2= mean systolic blood pressure - first period in Ramadan

3= mean systolic blood pressure - last period in Ramadan

4= mean systolic blood pressure - after Ramadan

<sup>5</sup>SD=standard deviation

pressure and heart rate (1).

In the current study, the effect of Ramadan fasting on the ambulatory blood pressure of hypertensive patients has been investigated.

## Materials and Method

### Subjects

This prospective observational study was conducted on two groups of individuals. Six patients under hypertension treatment were allocated to the case group and 12 healthy individuals (without any diagnosed diseases) were selected as the control group. Hypertensive volunteers were recruited from outpatient cardiology clinics in teaching hospitals in Mashhad, Iran.

The diagnosis of primary hypertension was based on the cardiologist's clinical judgment. Medications were prescribed twice per day for all the patients under treatment (including  $\beta$  blockers, diuretics and ACE inhibitors); the subjects followed the prescription before sunrise and after sunset during Ramadan.

The patients who met the following criteria were excluded from the study: <45 or >75 years of age, previous history of smoking, secondary hypertension, diabetic mellitus, acute coronary syndrome and other systemic diseases, and fasting period less than 10 days. Patients' medical history, and history of smoking and drug abuse were obtained prior to the study.

This study was conducted according to the guidelines laid down by the Declaration of Helsinki. All procedures involving human subjects were approved by the Research Ethics Committee of Mashhad University of Medical

Sciences (approval number: 88201), and the written informed consents were obtained from all subjects. This study was conducted in the month of Ramadan in August 2011 in Mashhad, Iran.

### Data collection

Twenty-four-hour blood pressure monitoring was carried out over four periods: prior to Ramadan, during the first ten days and the last ten days of Ramadan, and one month after this month, using ABPM (mobile-o-graph NG, I.E.M company, Germany).

For monitoring the blood pressure, the cuff was placed on the non-dominant arm and removed after 24 hours. Calibration was checked by comparing the auscultatory results with a mercury sphygmomanometer, which were verified to be in close agreement (5 mm Hg). Blood pressure was measured once an hour during the 24-hr monitoring. Subjects were instructed to immobilize their arms during cuff inflation. The patients kept a diary of their daily activities, specifying every sleep period during the day and every awake period and mealtime at night.

Anthropometric parameters such as height, body weight and waist circumference were measured during all four phases, using standardized procedures.

### Data analysis

Statistical analysis was performed using SPSS version 11.5 (SPSS Inc. Chicago, IL). Twenty-four-hour average blood pressure, average awake and asleep blood pressures, as

**Table 2.** Effect of Ramadan fasting on systolic blood pressure in the control group (n=12)

Compression the Systolic blood pressure (SBP) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}_2 - \bar{x}_1$	P-value
1&2	mean SBP - before Ramadan	119.57±6.9	-4.20±7.9	0.096
	mean SBP - first period in Ramadan	115.37±5.0		
1&3	mean SBP - before Ramadan	119.57±6.9	-1.89±6.8	0.360
	mean SBP - last period in Ramadan	117.68±9.6		
1&4	mean SBP - before Ramadan	119.57±6.9	-0.03±4.2	0.976
	mean SBP - after Ramadan	119.54±7.0		
2&3	mean SBP - first period in Ramadan	115.37±5.0	2.30±9.6	0.427
	mean SBP - last period in Ramadan	117.68±9.6		
2&4	mean SBP - first period in Ramadan	115.37±5.0	4.17±7.9	0.096
	mean SBP - after Ramadan	119.54±7.0		
3&4	mean SBP - last period in Ramadan	117.68±9.6	1.86±7.0	0.381
	mean SBP - after Ramadan	119.54±7.0		

1= mean systolic blood pressure - before Ramadan      2= mean systolic blood pressure - first period in Ramadan  
 3= mean systolic blood pressure - last period in Ramadan      4= mean systolic blood pressure - after Ramadan  
<sup>5</sup>SD=standard deviation

**Table 3.** Effect of Ramadan fasting on diastolic blood pressure in hypertensive patients (n=6)

Compression the Diastolic blood pressure (DBP) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}_2 - \bar{x}_1$	P-value
1&2	mean DBP - before Ramadan	85.06±11.3	-0.95±6.8	0.747
	mean DBP - first period in Ramadan	84.11±6.2		
1&3	mean DBP - before Ramadan	85.06±11.3	-1.15±2.7	0.342
	mean DBP - last period in Ramadan	83.90±12.7		
1&4	mean DBP - before Ramadan	85.06±11.3	-1.95±3.8	0.268
	mean DBP - after Ramadan	83.11±11.6		
2&3	mean DBP - first period in Ramadan	84.11±6.2	-0.20±8.4	0.954
	mean DBP - last period in Ramadan	83.90±12.7		
2&4	mean DBP - first period in Ramadan	84.11±6.2	-1.00±8.6	0.790
	mean DBP - after Ramadan	83.11±11.6		
3&4	mean DBP - last period in Ramadan	83.90±12.7	-0.79±4.2	0.668
	mean DBP - after Ramadan	83.11±11.6		

1= mean diastolic blood pressure - before Ramadan      2= mean diastolic blood pressure - first period in Ramadan  
 3= mean diastolic blood pressure - last period in Ramadan      4= mean diastolic blood pressure - after Ramadan  
<sup>5</sup>SD=standard deviation

well as weight, body mass index (BMI) and waist circumference of the individuals in four periods of monitoring were compared. The Kolmogorov-Smirnov test was performed to assess the normal distribution, and the quantitative data were expressed as the mean±SD. For comparing data within the groups, (pre- and post-Ramadan measurements) paired Student’s t-test was used. P-value<0.05 was considered statistically significant for all tests.

**Results**

Duration of daily fasting in Ramadan 2011 ranged between 15 hrs and 59 min of the first day and 14 hrs and 50 min of the last day. The mean number of fasting days of the subjects was 29.11±1.74 days (range: 25-30 days).

Eighteen volunteers (8 males and 10 females) within the age range of 45-75 yrs, and the mean age of 56.44±6.8 yrs were divided to

two groups of individuals. Six hypertensive patients were allocated to the case group and 12 healthy (without any diagnosed diseases) individuals were selected as the control group.

**Blood pressure and heart rate**

There were no significant changes in systolic and diastolic blood pressures in the case and control groups over the 4 aforementioned periods (Tables 1-4) (P>0.05, paired t-test).

In the case group, there was a significant improvement in the heart rate during the second and third periods in comparison with the pre-Ramadan period (P=0.018, P=0.039, respectively); in addition, heart rate improved in the post-Ramadan period compared with the first period of Ramadan (Table 5) (P=0.019, paired t-test).

There was a significant reduction in the heart rate after Ramadan fasting in comparison

**Table 4.** Effect of Ramadan fasting on diastolic blood pressure in the control group (n = 12)

Compression the Diastolic blood pressure (DBP) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}^2, \bar{x}^1$	P-value
1&2	mean DBP - before Ramadan	78.50±8.9	-1.91±4.9	0.204
	mean DBP - first period in Ramadan	76.59±7.1		
1&3	mean DBP - before Ramadan	78.50±8.9	-0.79±4.6	0.567
	mean DBP - last period in Ramadan	77.70±10.6		
1&4	mean DBP - before Ramadan	78.50±8.9	-0.08±3.2	0.931
	mean DBP - after Ramadan	78.42±8.5		
2&3	mean DBP - first period in Ramadan	76.59±7.1	1.11±5.1	0.466
	mean DBP - last period in Ramadan	77.70±10.6		
2&4	mean DBP - first period in Ramadan	76.59±7.1	1.82±4.2	0.166
	mean DBP - after Ramadan	78.42±8.5		
3&4	mean DBP - last period in Ramadan	77.70±10.6	0.71±5.0	0.636
	mean DBP - after Ramadan	78.42±8.5		

1= mean diastolic blood pressure - before Ramadan

2= mean diastolic blood pressure - first period in Ramadan

3= mean diastolic blood pressure - last period in Ramadan

4= mean diastolic blood pressure - after Ramadan

<sup>5</sup>SD=standard deviation**Table 5.** Effect of Ramadan fasting on heart rate in hypertensive patients (n=6)

Compression the Heart rate (HR) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}^2, \bar{x}^1$	P-value
1&2	mean HR - before Ramadan	69.87±13.0	14.24±10.0	0.018
	mean HR - first period in Ramadan	84.11±6.2		
1&3	mean HR - before Ramadan	69.87±13.0	-1.37±8.1	0.695
	mean HR - last period in Ramadan	68.50±15.0		
1&4	mean HR - before Ramadan	69.87±13.0	-0.62±5.5	0.792
	mean HR - after Ramadan	69.25±13.2		
2&3	mean HR - first period in Ramadan	84.11±6.2	-15.61±13.8	0.039
	mean HR - last period in Ramadan	68.50±15.0		
2&4	mean HR - first period in Ramadan	84.11±6.2	-14.86±10.6	0.019
	mean HR - after Ramadan	69.25±13.2		
3&4	mean HR - last period in Ramadan	68.50±15.0	0.75±6.4	0.788
	mean HR - after Ramadan	69.25±13.2		

1= mean heart rate - before Ramadan

2= mean heart rate - first period in Ramadan

3= mean heart rate - last period in Ramadan

4= mean heart rate - after Ramadan

<sup>5</sup>SD=standard deviation**Table 6.** Effect of Ramadan fasting on heart rate in the control group (n=12)

Compression the Heart rate (HR) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}^2, \bar{x}^1$	P-value
1&2	mean HR - before Ramadan	76.20±6.4	0.39±6.9	0.848
	mean HR - first period in Ramadan	76.59±7.1		
1&3	mean HR - before Ramadan	76.20±6.4	-2.47±5.2	0.132
	mean HR - last period in Ramadan	73.72±7.5		
1&4	mean HR - before Ramadan	76.20±6.4	-3.21±3.4	0.008
	mean HR - after Ramadan	72.98±7.8		
2&3	mean HR - first period in Ramadan	76.59±7.1	-2.86±5.8	0.120
	mean HR - last period in Ramadan	73.72±7.5		
2&4	mean HR - first period in Ramadan	76.59±7.1	-3.61±7.9	0.142
	mean HR - after Ramadan	72.98±7.8		
3&4	mean HR - last period in Ramadan	73.72±7.5	-0.74±4.7	0.594
	mean HR - after Ramadan	72.98±7.8		

1= mean heart rate - before Ramadan

2= mean heart rate - first period in Ramadan

3= mean heart rate - last period in Ramadan

4= mean heart rate - after Ramadan

<sup>5</sup>SD=standard deviation

with the pre-Ramadan measurement in the control group (Table 6) ( $P=0.008$ , paired t-test).

#### Anthropometric parameters

There was a significant reduction in

**Table 7.** Effect of Ramadan fasting on the weight of hypertensive patients (n=6)

Compression the Body weight (w) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}^2_ - \bar{x}^1$	P-value
1&2	mean w - before Ramadan	73.33 ±11.4	-1.083±1.2	0.093
	mean w - first period in Ramadan	72.25±12.0		
1&3	mean w - before Ramadan	73.33 ±11.4	-0.250±1.3	0.673
	mean w - last period in Ramadan	73.08±11.8		
1&4	mean w - before Ramadan	73.33 ±11.4	0.083±1.5	0.618
	mean w - after Ramadan	73.42±12.0		
2&3	mean w - first period in Ramadan	72.25±12.0	0.833±0.5	0.011
	mean w - last period in Ramadan	73.08±11.8		
2&4	mean w - first period in Ramadan	72.25±12.0	1.167±1.5	0.128
	mean w - after Ramadan	73.42±12.0		
3&4	mean w - last period in Ramadan	73.08±11.8	0.333±1.5	0.618
	mean w - after Ramadan	73.42±12.0		

1= mean Body weight (w) - before Ramadan

2= mean Body weight (w) - first period in Ramadan

3= mean Body weight (w) - last period in Ramadan

4= mean Body weight (w) - after Ramadan

<sup>5</sup>SD=standard deviation

**Table 8.** Effect of Ramadan fasting on the weight of the control group (n=12)

Compression the Body weight (w) in 4periods		$\bar{x} \pm SD^5$	$\bar{x}^2_ - \bar{x}^1$	P-value
1&2	mean w - before Ramadan	67.46±12.3	-1.017±1.6	0.053
	mean w - first period in Ramadan	66.44±11.2		
1&3	mean w - before Ramadan	67.46±12.3	-0.042±0.7	0.857
	mean w - last period in Ramadan	67.50±12.3		
1&4	mean w - before Ramadan	67.46±12.3	-0.250±1.0	0.447
	mean w - after Ramadan	67.21±11.4		
2&3	mean w - first period in Ramadan	66.44±11.2	1.058±1.9	0.085
	mean w - last period in Ramadan	67.50±12.3		
2&4	mean w - first period in Ramadan	66.44±11.2	0.767±1.4	0.090
	mean w - after Ramadan	67.21±11.4		
3&4	mean w - last period in Ramadan	67.50±12.3	-0.292±1.1	0.409
	mean w - after Ramadan	67.21±11.4		

1= mean Body weight (w) - before Ramadan

2= mean Body weight (w) - first period in Ramadan

3= mean Body weight (w) - last period in Ramadan

4= mean Body weight (w) - after Ramadan

<sup>5</sup>SD=standard deviation

subjects' weight during the third period in comparison with pre-Ramadan measurement in the case group (Table 7, 8) (P=0.011, paired t-test).

**Discussion**

In the current study, there were no significant changes in systolic and diastolic blood pressures during the 4 periods of ambulatory blood pressure monitoring in the case and control groups. In the study by Harvest, a significant decrease of 1 mm Hg or less was observed in the average 24-h blood pressure between the two measurements performed with a 3-month interval (6); however, most of the reports have shown no significant difference between the average 24-h blood pressure before and during Ramadan fasting (4, 6, 7).

In the present study, in the case group, there was a significant improvement in the heart

rate during the second and third periods in comparison with the pre-Ramadan period; in addition, heart rate improved in the post-Ramadan period compared with the first period of Ramadan. Also, there was a significant reduction in heart rate during the post-Ramadan fasting period in comparison with pre-Ramadan measurement in the control group. To the best of our knowledge, there have been no reports of 24-hr heart rate monitoring during Ramadan fasting.

In the present study, weight was reduced by 0.830 kg during the third period in comparison with the pre-Ramadan period in the case group; this finding is similar to the weight decrease reported in previous studies (-1.4 kg) (1). Although the findings of most studies are similar to the present results (4, 8-11), according to a previous study, no change was observed in anthropometric parameters (5).

## Conclusion

This study showed a significant improvement in the heart rate over second and third periods of 24 hr monitoring in hypertensive patients. According to the results, no high-risk variations in blood pressure or heart rate were observed among the subjects. This finding suggested that fasting during the month of Ramadan, along with (previous) medication continuation might be useful and non-threatening for patients with essential hypertension, and free of complications.

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## References

1. Nematy M, inezhad-Namaghi M, Rashed MM, Mozhdehifard M, Sajjadi SS, Akhlaghi S, et al. Effects of Ramadan fasting on cardiovascular risk factors: a prospective observational study. *Nutr J*. 2012; 11:69.
2. World Health Organization. The global burden of disease: 2004 update. THE REPORT IN SECTIONS. Part 2: Causes of death. [Internet] [http://www.who.int/healthinfo/global\\_burden\\_disease/2004\\_report\\_update/en/index.html](http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html). (Accessed 11 November 2009).
3. Sarraf-Zadegan N, Boshtam M, Rafiei M. Risk factors for coronary artery disease in Isfahan, Iran. *European Journal of Public Health*. 1999; 9:20-6.
4. Perk G, Ghanem J, Aamar S, Ben-Ishay D, Bursztyn M. The effect of the fast of Ramadan on ambulatory blood pressure in treated hypertensives. *J Hum Hypertens*. 2001;15:723-5.
5. Ural E, Kozdag G, Kilic T, Ural D, Sahin T, Celebi O, et al. The effect of Ramadan fasting on ambulatory blood pressure in hypertensive patients using combination drug therapy. *J Hum Hypertens*. 2008; 22:208-10.
6. Palatini P, Mormino P, Canali C, Santonastaso M, De VG, Zanata G, et al. Factors affecting ambulatory blood pressure reproducibility. Results of the HARVEST Trial. Hypertension and Ambulatory Recording Venetia Study. *Hypertension*. 1994; 23:211-6.
7. Habbal R, Azzouzi L, Adnan K, Tahiri A, Chraibi N. [Variations of blood pressure during the month of Ramadan]. *Arch Mal Coeur Vaiss*. 1998; 91:995-8.
8. Adlouni A, Ghalim N, Benslimane A, Lecerc JM, Saile R. Fasting during Ramadan induces a marked increase in high-density lipoprotein cholesterol and decrease in low-density lipoprotein cholesterol. *Ann Nutr Metab*. 1997; 41:242-9.
9. Khatib FA, Shafagoj YA. Metabolic alterations as a result of Ramadan fasting in non-insulin-dependent diabetes mellitus patients in relation to food intake. *Saudi Med J*. 2004; 25:1858-63.
10. Yucel A, Degirmenci B, Acar M, Albayrak R, Haktanir A. The effect of fasting month of Ramadan on the abdominal fat distribution: assessment by computed tomography. *Tohoku J Exp Med*. 2004; 204:179-87.
11. Aybak M, Turkoglu A, Sermet A, Denli O. Effect of Ramadan fasting on platelet aggregation in healthy male subjects. *Eur J Appl Physiol Occup Physiol*. 1996; 73(6):552-6.