

# Effects of Ramadan fasting on glucose levels and serum lipid profile among type 2 diabetic patients

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Fasting from dawn to dusk is obligatory for all adult Muslim men and women in the Islamic month of Ramadan except for people who fulfill certain conditions. One of such conditions is the health of the subject. Some studies have discussed the biochemical changes among fasting patients both in non-diabetic subjects,<sup>1</sup> and diabetic patients.<sup>2-5</sup> This study was conducted to assess the effects of fasting on blood pressure (BP), fasting glucose (FG), cholesterol, triglyceride, high-density-lipoprotein (HDL), and low-density-lipoprotein (LDL) among diabetic type 2 patients.

One hundred and seventy-nine patients of type 2 diabetes mellitus (DM) on diet/oral hypoglycemic/insulin treatment of age group of more than 20 years were invited to participate in this study. The studied patients were selected from the National Institute of Diabetic and Endocrinology of Dow University of Health Sciences (DUHS), and some private clinics of one of the co-authors (Muhammad Z. Shaikh) of Karachi, Pakistan. The exclusion criteria were: patients with type 1 DM, pregnant women, seriously sick, renal failure, hepatic impairment, user of weight reducing agents, and subjects who fasted for less than 20 days. The patients were requested to visit the clinics 3 times during the study period. The visits were arranged in the last 10 days of Shaban (visit 1 [24 August to 01 September]), Ramadan (visit 2 [22 to 30 October]), and Shawwal (visit 3 [21 to 31 November]) of 2008. The Ethical Review Board of DUHS approved this prospective study. Informed consent was obtained from each participant. The patients who showed up in all the 3 visits were only 75. In all 3 visits, physical measurements (height, weight, waist and hips measurements), clinical measurements (systolic and diastolic BP), and blood sample were obtained (Table 1), along with an interview on a pre-designed Performa for demographic variables, and number of days of fasting (in the last visit) from each patient. The BP was measured 2 times, using digital BP apparatus. Blood was collected in a 10 ml syringe after 12 hours fasting and transferred in 2 tubes; one for blood glucose measurement, and other for serum separation. All the samples were analyzed for: FG, cholesterol, triglyceride, uric acid, HDL, and LDL cholesterol.

Analysis of variance (ANOVA) of repeated measure design with number of fasting days as co-variate was employed for data analysis. Least square difference was used as post-Hoc test to find the pair-wise difference

between visits. A  $p < 0.05$  was considered statistically significant.

The gender distribution was almost the same (male = 38; female = 37). The mean age of the participants was  $52.8 \pm 8.5$  years (range: 36-71 years). The mean duration of diabetes was  $5.6 \pm 5.3$  years (range: 9 months-18 years). The number of patients who have had a history of chronic liver diseases was 4%, hyperlipidemia - 29.3%, and hypertension - 52%. Seventy-eight percent of the patients indicated involvement in some physical exercises. The mean weight of the patients decreased from 70.4 - 69.5 kg from visit one to visit 2, and the difference was statistically significant ( $p = 0.002$ ). However, the mean weight increased again in visit 3 to 70.1 kg, and it was not statistically significant ( $p = 0.147$ ). Mean body mass index (BMI) of the patients decreased significantly from 27.7 - 27.1 kg/m<sup>2</sup> from visit one to visit 2 ( $p = 0.01$ ), however, it increased insignificantly to 27.5 kg/m<sup>2</sup> in visit 3 ( $p = 0.189$ ). There was no significant change in the mean hips measurements in the 3 visits ( $p > 0.05$ ). Similarly, waist measurements did not show any statistically significant differences ( $p > 0.05$ ). Mean systolic BP decreased significantly from 124.3 - 120.0 mm/Hg from visit one to visit 2 ( $p = 0.002$ ), however, it increased significantly from visit 2 to 124.1 mm/Hg in visit 3 ( $p = 0.039$ ). Mean diastolic BP also decreased significantly from 82.2 - 79.5 mm/Hg from visit one to visit 2 ( $p = 0.044$ ). However, it rose again in visit 3 to 81.1 mm/Hg, but it was insignificant ( $p = 0.157$ ). Mean fasting blood sugar decreased from 158.1 - 149.0 mg/L from visit one to visit 2 ( $p = 0.071$ ), and increased to 153.7 mg/L in visit 3 ( $p = 0.386$ ), and these differences were insignificant. Mean cholesterol level also decreased from 173.1 - 172.3 mg/L from visit one to visit 2, and then increased to 177.8 mg/L in visit 3, and the differences were not statistically significant ( $p > 0.05$ ). Mean triglyceride level decreased significantly from 240.0 - 207.1 mg/L from visit one to visit 2 ( $p = 0.018$ ), and kept decreasing to 159.3 mg/L in visit 3 ( $p < 0.001$ ). Mean HDL value decreased insignificantly from 40.9 - 40.3 mg/L from visit one to visit 2, and then increased significantly to 43.3 mg/L in visit 3 ( $p = 0.038$ ). Mean LDL value increased significantly from 105.2 - 112.2 mg/L in visit 2 ( $p = 0.012$ ), and then further increased to 119.0 mg/L in visit 3 ( $p < 0.001$ ). Mean ratio of total cholesterol to HDL continuously decreased from visit one to visit 3, but the significant difference was only the third to first visit. Uric acid analysis showed that the mean value of the visit one of 5.8 mg/L, decreased significantly to 5.5 mg/L in visit 2 ( $p = 0.003$ ). However, it increased again in visit 3 with a mean value of 5.6 mg/L.

**Disclosure.** This study was funded by the Research Facilitating Committee of Dow University of Health Sciences, Karachi, Pakistan.

**Table 1** - Mean  $\pm$  standard deviation of physical measurements and blood pressure in the 3 visits.

Variables	Visit 1	Visit 2	Visit 3	Effect of covariate <i>p</i> -value
Weight	70.4 $\pm$ 11.3 <sup>a</sup>	69.5 $\pm$ 11.7 <sup>b</sup>	70.1 $\pm$ 11.3 <sup>ab</sup>	0.310
Body mass index	27.7 $\pm$ 4.6 <sup>a</sup>	27.1 $\pm$ 5.0 <sup>b</sup>	27.5 $\pm$ 4.8 <sup>ab</sup>	0.084
Systolic blood pressure	124.3 $\pm$ 17.4 <sup>a</sup>	120.0 $\pm$ 12.5 <sup>b</sup>	124.1 $\pm$ 15.6 <sup>a</sup>	0.040
Diastolic blood pressure	82.2 $\pm$ 8.8 <sup>a</sup>	79.5 $\pm$ 9.3 <sup>b</sup>	81.1 $\pm$ 7.5 <sup>ab</sup>	0.123
Fasting blood sugar	158.1 $\pm$ 47.5 <sup>a</sup>	149.0 $\pm$ 52.6 <sup>a</sup>	153.7 $\pm$ 50.9 <sup>a</sup>	0.279
Total cholesterol	173.1 $\pm$ 36.2 <sup>a</sup>	172.3 $\pm$ 38.8 <sup>a</sup>	177.8 $\pm$ 37.5 <sup>a</sup>	0.075
Triglyceride	240.0 $\pm$ 113.9 <sup>a</sup>	207.1 $\pm$ 96.4 <sup>b</sup>	159.3 $\pm$ 72.8 <sup>c</sup>	0.060
High-density lipoprotein	40.9 $\pm$ 9.4 <sup>a</sup>	40.3 $\pm$ 9.6 <sup>a</sup>	43.3 $\pm$ 10.2 <sup>b</sup>	0.782
Low-density lipoprotein	105.2 $\pm$ 32.4 <sup>a</sup>	112.2 $\pm$ 34.2 <sup>b</sup>	119.0 $\pm$ 35.1 <sup>b</sup>	0.135
Ratio	4.4 $\pm$ 1.1 <sup>a</sup>	4.3 $\pm$ 1.0 <sup>ab</sup>	4.2 $\pm$ 1.2 <sup>b</sup>	0.258
Uric acid	5.8 $\pm$ 1.6 <sup>a</sup>	5.5 $\pm$ 1.6 <sup>b</sup>	5.6 $\pm$ 1.6 <sup>ab</sup>	0.031

Different alphabets in the superscript showed statistical significance ( $p < 0.05$ ) in each measurement

In this study, the mean weight and BMI of the patients reduced significantly during the month of Ramadan. Yarahmadi et al<sup>2</sup> also reported a significant reduction in BMI among type 2 diabetic patients, but for males only. Other studies<sup>4,5</sup> also showed insignificant decrease in weight and BMI among type 2 diabetic patients. It is generally observed that Muslims stop doing physical activities, especially exercises during the month of Ramadan. It is especially directed toward the diabetic patients who ceased exercises during the daytime to avoid hypoglycemia. Furthermore, foods that are prepared for the iftar (the time to break the fast) are mostly cooked in oil and ghee. These factors work against weight reduction among those that are fasting. There is a significant fall of systolic and diastolic BP during the month of Ramadan. However, these downward changes were reversed in the month of Shawwal. Other studies<sup>2-4</sup> did not show any significant change in the BP of diabetic patients. Mean FG level of this study decreased during the month of Ramadan, and then increased in the month of Shawwal. The differences were not statistically significant. The decrease due to fasting in Ramadan was quit noticeable. However, due to large standard deviations it did reach a significant level. Many other studies<sup>3,5</sup> also did not show any significant change in glucose level among fasting diabetic patients in Ramadan. However, another study<sup>4</sup> showed significant rise in FG level. These contradicting findings indicate that if there was change in FG level, it could be due to diet pattern and/or physical activity of the patients. There was slight decrease in the total cholesterol level during the month of Ramadan. In contrast, a study<sup>2</sup> showed significant increase in the total cholesterol level during this month for such patients. Contrary to a published data,<sup>5</sup> this study showed significant decrease in triglyceride level in the month of Ramadan.

The results should be considered with caution, as the time of patients' visits, diet pattern, and physical activities were not being controlled. These conflicting

reports clearly indicate that there is a need of a population-based study for the 3 essential elements for DM patients; drug regimens, diet control, and daily activity to come up with some concrete results in the changes of glucose level, lipid profile, uric acid, and other parameters. Furthermore, a multicentric international controlled clinical trial should be conducted to evaluate the effects of gender, color, physical activity, food habits, sleep pattern, and other physiological and pathological variables on the control and type 2 diabetic patients during Ramadan fasting.

This study showed that Ramadan fasting was safe for diabetes type 2 patients and associated with weight loss and improvement in the overall diabetic control. The significant changes in triglyceride and LDL may lead in reduction in coronary artery diseases.

Received 10th July 2010. Accepted 6th September 2010.

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