

The Effect of Ramadan Fasting on Metabolic Parameters of Type 2 Diabetic Patients Under Nutrition Education and Modified Diet Therapy

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Abstract

Objective: To evaluate the effects of Ramadan fasting biochemical parameters of Type 2 Diabetes Mellitus (T2DM) patients.

Method: The study was carried out with 50 Type 2 diabetic patients (13 males, 37 females) who are being followed by Sisli Hamidiye Etfal Education and Research Hospital. A questionnaire was administered to determine the demographic characteristics and the status of the disease of patients before Ramadan. Some blood biochemical findings were analyzed before and after Ramadan. During this period, the diets of the patients were re-arranged according to the Guidelines of Turkish Endocrinology and Metabolism Association (55-60% carbohydrate, 15-20% protein, 25-30% fat of total energy).

Results: The average age of the patients, 51.10 ± 8.95 years. The average fasting blood glucose levels of patients were 124.36 ± 42.57 mg/dl before, 115.6 ± 27.95 mg/dl after Ramadan, this difference was not statistically significant ($p > 0.05$). Serum HbA1c levels were determined as $7.30\% \pm 1.38$ before, $6.80 \pm 0.72\%$ after Ramadan, difference was statistically significant ($p < 0.05$). Serum total cholesterol levels of patients before and after Ramadan were 194.86 ± 36.972 mg/dl and 191.08 ± 39.611 mg/dl respectively ($p > 0.05$). Serum triglyceride levels were significantly reduced when compared before and after Ramadan (respectively, 184.16 ± 142.450 mg/dl and 159.86 ± 104.276 mg/dl, $p < 0.05$). The HDL-cholesterol and LDL-cholesterol levels were increased after Ramadan but the difference was not statistically significant ($p > 0.05$).

Conclusion: Biochemical parameters were not influenced negatively in patients with type 2 diabetes whose fasting organized by modified medical nutrition therapy.

Keywords: Ramadan Fasting; Diabetic Patients; Nutrition Therapy

Introduction

Ramadan is the ninth month on the Islamic calendar and Ramadan fasting is one of the five pillars of Islam observed by over one billion Muslim adults worldwide. Muslims must abstain daily of eat, drink and smoke from dawn to dusk. The month of Ramadan contains 29-30 days and varies by geographical location and season. Depending upon these factors its duration may vary approximately from 10 hour in winter at 18 hour in summer-time [1-6].

Ramadan fasting is not a complete fast. During the one-month of fasting, Muslims consume 2 meals in a day. The first meal called sahur is usually consumed prior to the start of the day's fasting,

and the other called iftar at the break of the day's fast. Moreover there is no restriction to the amount of food or fluid that can be consumed during the permissible period [1,4].

Many physiological and psychological changes are observed during Ramadan

The practices and the food behaviors of the populations are not similar during this month of fasting by comparison to the remainder of the year Ramadan fasting may probably influence sleep quality, leading to subjective feelings of lethargy, malaise and poor motivation that could impact exercise performance due to the changes in food and fluid intake patterns [1,4,6].

Even though diabetes is classed as a metabolism disorder and a chronic non-communicable disease having serious health, economic and social consequences which is characterized by high level of blood glucose resulting from defects in insulin production, insulin action or both, many people with diabetes insist on fasting during Ramadan. It is of the utmost importance that people with diabetes and their healthcare providers are aware of the potential risks associated with fasting [5,7].

Varying effects of fasting have been reported in people with diabetes: deteriorating, improving, and showing no change [5,7-9].

Fasting during Ramadan, is an obligatory duty for all healthy adult Muslims. Ramadan fasting could not induce any harmful effect in young healthy subjects. However, certain groups are exempted from fasting temporarily or permanently including individuals who have acute or chronic diseases such as diabetes mellitus. Ramadan has reported a reduction in food intake, a decrease or increase in body weight and fat percentage, a decrease in resting metabolism and an increase in creatine, plasma albumin, hematocrit and urea levels. Although the sacred religious text of Islam exempts chronically ill individuals from fasting. Many Muslims with diabetes still wish to fast where as it can induce several complications in patients with diabetes. During fasting period, decreased food intake is a well-known risk factor for hypoglycaemia as by the iftar, increased food intake is the most important factor for hyperglycemia [2,4,5,7,9]. Following the reduced food intake during Ramadan, diabetic ketoacidosis (DKA) development risk increases due to hypoinsulinemia and hyperglucagonemia. This hormonal disequilibrium favoring hyperglycemia, lipolysis and ketone body formation and eventually development of DKA [7,9].

All people with diabetes who wish to fast during Ramadan should make the necessary preparations in order to undertake the fast as safely as possible. These include medical assessment and educational counselling [7].

Materials and Methods

Ethics Committee: The study was approved by the decision of T.R. Ministry of Health Sisli Etfal Education and Research Hospital Clinical Research Ethics Committee. This study was conducted before and during Ramadan (July-August 2011 and August - September 2011) with 50 T2DM (13 males, 37 females) patient who were without any diabetic complications Oral Hypoglycemic Drug use/not use daily insulin injections once or twice a T2DM all the patients accepted to attend voluntarily.

Patients with Type 1 diabetes, intensive insulin therapy, pregnant women, and impaired renal function were excluded from the study.

Demographic features, anthropometric (height, body weight and BMI) and biochemical findings (plasma glucose, total cholesterol, triglyceride, LDL, HDL, HbA1c) of patients were recorded on a form which was developed by the researcher. The WHO classification was used for evaluating BMI (underweight <18.5; normal =19-24.9; over weight ≥25-29.9).

The duration of diabetes, smoking, using medicines, diabetic complications, co-morbid diseases and physical activity levels of patients were examined. Physical activity levels of patients were determined according to WHO's recommendations. Biochemical parameters were analysed twice 15/days before and after Ramadan.

Biochemical parameters

- Fasting Blood Glucose
- HbA1c
- Total Cholesterol (T. Chol), Low Density Lipoproteins (LDL), High Density Lipoproteins (HDL), triglycerides (TG) and Very Low Density Lipoproteins (VLDL).

Patients fasting during Ramadan adjusted underwent medical nutrition therapy.

A personal medical nutritional therapy which is adjusted for Ramadan fasting was applied to the patients.

Consumption of foods contain simple carbohydrates have been restricted and given in 2-3 steps because of hyperglycemia and hypoglycemia risk. In iftar and sahur, both liquid and complex carbohydrates intake was increased due to slow digestion and absorption. On the 10th and 20th days of Ramadan, the patients were checked by telephone call.

Patients who were included to the study were followed for medical treatment as well.

Data were analyzed with SPSS 17.0 packed program. Independent sample t test was used to compare of two groups.

The Pearson correlation method was used to evaluate the relationships between variables. Results were evaluated within 95%, $p < 0.05$ significance level.

Results

This study was carried out on the same patient group in two stages including before and after Ramadan. Of the patients, 13 were male (26%) and 37 were female (74%). The mean diabetes age of the patients were 4.58 ± 3.86 years (5.62 ± 4.15 years for male and 4.22 ± 3.74 years for female). Distribution of the patients according to gender, age, body weight and BMI is shown in table

1. The mean age of patients was 51.10 ± 8.95 years (51.31 ± 5.65 years in male, 51.03 ± 9.92 years in female). The mean body weight of patients was 85.57 ± 12.98 kg (81.85 ± 10.95 kg in male, 86.88 ± 13.51kg in female). According to findings the mean BMI of patients was 33.49 ± 5.64 kg/m² (28.61 ± 3.44 kg/m² in male, 35.20 ± 5.27 kg/m²).

HbA1c and blood glucose levels of the patients before Ramadan and after Ramadan are given in Table 2. While HbA1c level was 30.7% ± 13.8 before Ramadan, it was 6.80% ± 0.72 after Ramadan. This difference was found statistically significant (p<0.05).

While blood glucose level was 124.36 ± 42.57 mg/dL, before Ramadan, it was 115.6 ± 27.95 mg/dL after Ramadan. This difference was not found statistically significant (p>0.05).

As seen in Table 3, the differences of HbA1c levels before and after ramadan was found statistically significant in Type 2 Diabetic patients except the group whose BMI ≥35 kg/m² (p<0.05). The reduction in plasma glucose level of the morbid obese patients is also determined statistically significant (p<0.05).

According to BMI classification, the differences of blood glucose levels was not found statistically significant except BMI ≥35 kg/m² group. Total cholesterol levels of patients before and after ramadan was not found statistically significant (p>0.05), (Table 3). Except

the patients with BMI: 30.0-34,9 kg/m², the triglyceride, HDL and VLDL levels of all patients were not found statistically significant (p>0.05) (Table 2).

BMI kg/m ²	Gender					
	Male (n:13)		Female (n:37)		TOTAL(n:50)	
	N	%	N	%	N	%
18.5-24.9 normal	1	7.7	4	10.8	1	2.0
25.0-29.9 over-weight	8	61.5	17	45.9	12	24.0
30.0-34.9 1 st obese	4	30.8	9	24.3	21	42.0
35-39.9 2 nd obese	0	0.0	7	18.9	9	18.0
≥40 morbid obese	0	0.0	4	10.8	7	14.0
BMI (kg/m ² \bar{x} ± SS	28.61 ± 3.44		35.20 ± 5.27		33.49 ± 5.64	
Body weight(kg)	81.85 ± 10.95		86.88 ± 13.51		85.57 ± 12.98	
Yearsold (year) \bar{x} ± SS	51.31 ± 5.65		51.03 ± 9.92		51.10 ± 8.95	

Table 1: Anthropometric measurements of the patients according to gender, age, body weight and BMI.

Biochemical Parameter	Gender									
	Male (n:13)			Female (n: 37)			Total (n:50)			
	\bar{x}	SS	t/p	\bar{x}	SS	t/p	\bar{x}	SS	t/p	
HbA1c (%)	Before	7.27	0.82	2.234	7.31	1.54	2.942	7.30	1.38	3.574
	After	6.83	0.80	0.045*	6.79	0.70	0.006*	6.80	0.72	0.01*
Glucose (mg/dL)	Before	120.46	30.44	0.281	125.73	46.37	1.490	124.36	42.57	1.510
	After	118.69	35.39	0.784	114.51	25.32	0.145	115.60	27.95	0.138
T. Chol (mg/dL)	Before	180.38	31.79	-2.42	199.95	37.70	1.959	194.86	36.97	0.88
	After	194.15	40.31	0.032*	190.00	39.86	0.060	191.08	39.61	0.38
TG (mg/dL)	Before	217.08	213.71	-0.14	172.59	108.93	3.50	184.16	142.45	2.01
	After	222.15	153.75	0.89	137.97	70.89	0.001*	159.86	104.27	0.05*
HDL (mg/dL)	Before	42.23	9.54	0.53	45.95	10.62	-1.99	44.98	10.38	-1.54
	After	41.54	7.98	0.61	47.84	11.85	0.054	46.20	11.25	0.13
VLDL (mg/dL)	Before	43.41	42.74	-0.14	34.45	21.80	3.32	36.78	28.50	1.92
	After	44.431	30.75	0.89	27.80	14.39	0.002*	32.12	20.93	0.06
LDL (mg/dL)	Before	98.53	22.86	-2.04/	119.52	28.62	0.32	114.07	28.57	-0.70
	After	113.40	27.79	0.06	118.05	35.01	0.751	116.84	33.07	0.49

Table 2: Biochemical Parameters of the patients by gender Before and After Ramadan.

*p < 0,05

BMI, kg/m ²		25-29,9 overweight			30-34,9 obese			≥35 morbid obese		
		\bar{x}	SS	p	\bar{x}	SS	p	\bar{x}	SS	p
HbA1c (%)	Before	7.26	0.97	0.05*	7.61	1.87	0.03*	6.95	0.74	.051
	After	6.83	0.78		6.90	0.78		6.65	0.58	
Glucose (mg/dL)	Before	113.0	24.10	0.78	132.14	58.54	0.42	122.75	27.08	.040*
	After	114.3	18.51		121.48	37.27		110.63	17.83	
T.Chol (mg/dL)	Before	179.2	25,29	.140	212.05	40.37	.715	187.13	31.38	.066
	After	189.0	30,95		209.52	42.10		171.13	32.02	
TG (mg/dL)	Before	141.5	75.03	.126	223.71	183.39	.004*	171.75	111.94	.079
	After	181.8	120.72		163.81	116.74		143.00	74.53	
HDL (mg/dL)	Before	43.08	9.17	.927	45.86	10.58	.016*	45.44	11.69	.926
	After	43.25	9.96		48.90	10.84		45.31	12.75	
VLDL (mg/dL)	Before	28.31	15.00	.106	44.742	36.67	.006*	34.21	22.42	.070
	After	36.75	24.11		33.157	23.38		28.28	14.99	
LDL (mg/dL)	Before	107.8	20.78	.330	123.89	31.19	.247	107.36	28.30	.507
	After	114.0	22.72		131.18	33.21		101.70	33.80	

Table 3: Biochemical Parameters of the patients according to BMI classification.

When the HbA1c levels of the patients compared according to their diabetes age, it is found that the reduction of HbA1c level after Ramadan is found statistically significant (p<0.05) except the patients whose diabetes age is 11 years and above (p> 0.05). The patients whose diabetes age is 6-10 years, the HbA1c levels were 7.40 ± 0.93% before Ramadan and it is determined as 7.09 ± 0.77% after Ramadan (p<0.05). According to diabetes age, the differences of blood glucose levels of patients before and after Ramadan were not found statistically significant (p>0.05).

When the patients compared according to physical activity level, the HbA1c levels of the patients whose physical activity less than

150 minutes per week was found 7.45 ± 1.02% before and 6.86 ± 0.76% after Ramadan. This difference was found statistically significant (p<0.05).

The HbA1c levels of the patients' whose physical activity more than 150 minutes per week was reduced from 7.24 ± 1.65% to 6.73 ± 0.71% after Ramadan. This difference was found statistically significant (p<0.05).

The difference between the blood glucose levels of the patients whose physical activity level is less or more than 150 minutes per week is not statistically significant before and after Ramadan (p> 0.05).

Metabolik Parameter		Diabetes age (years)								
		5 or less			6-10			11 or more		
		\bar{x}	SS	t/p	\bar{x}	SS	t/p	\bar{x}	SS	t/p
HbA1c %	Before	7.30	1.56	3.186/	7.40	0.93	2.380/	6.73	0.20	-0.115/
	After	6.70	0.69	0.00*	7.09	0.76	0.04*	6.76	0.68	0.919
Glucose (mg/dL)	Before	122.26	47.20	1.568/	133.2	30.31	1.047/	112.6	26.27	-1.650/
	After	110.29	25.13	0.126	125.4	28.92	0.318	138.3	44.27	0.241

Table 4: The HbA1c and fasting blood glucose Levels of patients after and before Ramadan depending on Diabetes Age.

* p < 0,05

Physical Activity level		< 150 minutes / week			>150 minutes / week		
Biochemical parameter		\bar{x}	SS	p	\bar{x}	SS	P
HbA1c %	Before	7.45	1.02	0.006*	7.24	1.65	0.018*
	After	6.86	0.76		6.73	0.71	
Glucose (mg/dL)	Before	122.0	36.90	0.901	126.6	47.23	0.087
	After	121.3	36.42		111.1	22.92	

Table 5: According to the Physical Activity Levels of patients HbA1c and Glucose Levels.

* p < 0,05

Discussion

Fasting, in the ninth month of the Islamic calendar, Muslims are performed by a religious rule. Mean fasting time varies between 11-18 hours according to sunrise and sunset. Sahur and Iftar are the two main meals of the day. There is not any restriction on the amount of the food consumption. In this study, fasting time ranged between 17-18 hours.

Due to the fasting period, there is high risk for hyperglycemia and hypoglycemia. Hyperglycemia development is related two main reasons. First, decreasing the insulin dose in order to prevent the hypoglycemia; second, increased energy intake which are high in fat and simple sugars. On the other hand as a result of fasting, risk of hypoglycemia development frequency increases. During the fasting, inadequate consumption of drugs and foods can effect the individuals with diabetes mellitus and other severe health problems [10].

Diabetic patients with no contraindication who insist on fasting should be called for medical assessment 1 month before of Ramadan. The risk factor of fasting should be well explained and the patients' glycemc levels must be monitored. Patients should be trained about medical nutritional therapy, appropriate physical activity and diabetes mellitus [11].

Saada., *et al.* [12], found a statistical significant rise in fasting plasma glucose level during the Ramadan, despite Saada., *et al.* Yarahmadi., *et al.* [13], Sari., *et al.* [14] and Laajam., *et al.* [15] did not found a significant difference in plasma glucose level during Ramadan. Similarly, of the patients enrolled in this study after Ramadan fasting blood glucose levels decreased compared to before Ramadan, but this difference was not statistically significant (p>0.05) (Table 2).

When the fasting blood glucose levels of the patients compared according to gender who participated in the study, blood glucose levels were lower in men than in women before Ramadan and

lower in women than in men after Ramadan. However, these differences between the genders before and after Ramadan were not statistically significant (Table 2). This difference can be the result of energy expenditure due to active working of men during the day time and where the most of the women were housewives. In the present study, the HbA1c levels of the patients were similar with the glucose levels probably with the same reasons.

According to the study which was conducted by Khatib., *et al.* [16], it was determined that there was a significant decrease in HbA1c level Similarly, Saada., *et al.* [12] reported similar results (p < 0.05).

However, Sulimani., *et al.* [17] and Gustaviani., *et al.* [18] found an increase in HbA1c levels after Ramadan. Additionally, in some cases, it is reported that the differences of HbA1c levels were not statistically significant [14,15,18-21].

Although the fasting blood glucose level is spontaneous value, HbA1c is used as an indicator which shows the medium plasma glucose level before 8-12 weeks [22]. The HbA1c levels of the type 2 DM patients who were attended to the study were found 7,30 ± 1,38% and 6,80 ± 0,72% respectively before and after Ramadan (Table 2) This difference is statistically significant (p<0.05).

According to gender before and after Ramadan, the HbA1c levels of the type 2 DM patients who were attended to the study were found %7,27 ± 0,82 and %6,83 ± 0,80 in male and %7,31 ± 1,54 and %6,79 ± 0,70 in female patients (p<0.05). Despite to the decrease in glucose level, it was not found statistically significant. These results indicate that, the patients followed their nutrition program.

Faisal., *et al.* [16] determined a decrease in plasma levels of triglycerides, total cholesterol, and an increase in LDL and HDL levels in Type 2 patients during Ramadan. On the otherhand Saada., *et al.* [12] found a decrease in plasma levels of triglycerides, total cholesterol, LDL, VLDL and an increase in and HDL levels in Ra-

madan. Whereas in the study conducted by Yarahmadi, *et al.* [13] it is found that there was an increase in total cholesterol and LDL levels. Similarly, Uysal, *et al.* [21] established an increase in HDL, decrease in triglyceride but not statistically significant difference in reduction of total cholesterol and LDL levels. Despite of all these studies Sari, *et al.* [14] found no significant difference in total cholesterol levels of patients.

In the present study, including two-stages of lipid profiles before and after Ramadan were investigated. Of the 50 type 2 DM patients' total cholesterol and VLDL level decreased, whereas HDL and LDL levels increased. This difference was not found statistically significant.

Moreover, according to the present study, TG levels of patients decreased after Ramadan than before. The decrease was statistically significant ($p < 0.05$) (Table 2). These alterations in blood lipid profiles are similar to other studies. This situation can be explained by quality and amount of foods that consumed, variations in body weight, differences in nutritional habits which affect the daily diet.

Of all the patients' only HbA1c level after Ramadan was significantly reduced in the BMI: 25-29 groups ($p < 0.05$). Decrease in HbA1c, triglyceride, HDL and VLDL levels were found statistically significant in BMI: 30.0-34,9 ($p < 0.05$). Only fasting blood glucose decreased in BMI ≥ 35 group and it is found statistically significant ($p < 0.05$) (Table 3).

When the HbA1c levels of the patients compared according to their diabetes age, it is found that the reduction of HbA1c level after Ramadan is found statistically significant ($p < 0.05$) except the patients whose diabetes age is 11 years and above ($p > 0.05$). According to diabetes age, the differences of blood glucose levels of patients before and after Ramadan were not found statistically significant (Table 4), ($p > 0.05$). This can be the result of behavioral changes of the patients in nutrition parallel to their medical diet therapy through the years.

The beneficial role of exercise has been fully documented and exercise should be incorporated systematically in the treatment of patients with diabetes. Low-intensity and long-duration exercise programs are considered the most suitable for diabetic patients [23,24]. Result of meta-analyses show that in type 2 diabetes exercise have an reduce HbA1c, independent of body weight [25]. The HbA1c levels of the patients' whose physical activity more than 150 minutes per week was reduced from after Ramadan. This reduction is statistically significant ($p < 0.05$). The difference between the blood glucose levels of the patients whose physical activity level is less or more than 150 minutes per week is not statistically significant before and after Ramadan (Table 5), ($p > 0.05$).

Conclusion

- This study was carried out with 50 type 2 diabetic patients participated voluntarily in the study and fasting biochemical parameters of patients were examined.
- The HbA1c levels were found $7,30 \pm 1,38$ and $6,80 \pm 0,72$ before and after Ramadan respectively. This difference was considered statistically significant ($p < 0.05$).
- The fasting blood glucose level of patients was 124.36 ± 42.57 mg/dl before Ramadan, 115.6 ± 27.95 mg/dL the after Ramadan, no significant differences were observed ($p > 0.05$).
- When Lipid profile of patients with type 2 diabetes was analyzed, total cholesterol levels decreased and LDL levels increased. in HDL levels were not statistically significant. Nevertheless after Ramadan decline in triglyceride levels were found statistically significant ($p < 0.05$).
- Depending on the effect of Ramadan fasting on patients' daily physical activity, eating and sleeping habits, the glycemic control, lipid profile can be affected significantly.
- As a result, though fasting does not alter the dramatically biochemical parameters of diabetic patients, the effects of long period of fasting on healthy people has been proven by scientific studies. For this reason, Patients who decide to fast during Ramadan should be assessed medically and nutritionally, monitored and should be informed by effective diabetes education in order to raise awareness.

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