

The effect of self glucose monitoring on glycemetic control of patients with diabetes mellitus fasting during Ramadan

Ramazan Orucu Tutan Diabetes Mellitus Hastalarında Kendi Kendine Glikoz Takibinin Glisemik Kontrole Etkisi

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ABSTRACT

Background: It is known that a significant number of patients with diabetes insist on fasting in the month of Ramadan, despite the advice of their physicians and reliable authorities. In order to provide the best possible care and support to these patients, the International Diabetes Federation (IDF) and the Diabetes and Ramadan (DAR) International Alliance created practical guidelines. The aim of this study was to investigate the effect of consulting a physician and glucose self-monitoring on diabetes management during Ramadan in patients with fasting diabetes.

Methods: With this retrospective observational study, patients over 18 years of age who were diagnosed with diabetes, who came to the diabetes outpatient clinic for control after Ramadan and who made their follow-up from our outpatient clinic before Ramadan, were included. Participants intending to fast (previous or not) were asked about previous fasting experiences, questions about whether they consulted the doctor before Ramadan, and for those who fasted, how they spent this Ramadan. The biochemical data of fasting patients before and after Ramadan were analyzed.

Results: A total of 394 patients with diabetes participated in the questionnaire and 98 of them (24.9 %) who were fasted were included in the study. The mean age of the fasting patients with diabetes was 59.7 ± 12.3 years and 39.2 % were female. It was detected that 86.7% of the fasting people were fasting for more than 15 days. Fasting rates were higher in males than females (32.4% to 20.8%). It was found that 25.9% of patients with type 2 DM and 10.3% of patients with type 1 DM were fasting. It was determined that 62.8% of the patients intending to fast were consulted to the physician about this subject, 55.3% of them were determined risk by physician and 70% of them followed up with self monitoring blood glucose (SMBG). It was determined that 23.4% (23/98) of fasting patients had a reduction in the number or dose of diabetes medications used; 5.1% (5/98) experienced a complication that would disrupt fasting; 16.3% gained weight (2.8 ± 2.4 kg) and 23.5% lost weight (2.7 ± 1.9 kg). A significant increase in HbA1c and a significant decrease in UACR were detected. It has been determined that A1c control of those who follow with SMBG is better protected than those who do not.

Conclusion: In our study, it was seen that a quarter of patients with diabetes fasted. The most valuable result of this study is that the diabetic patients have achieved a more successful diabetes control by providing auto control mechanisms with SMBG, regardless of whether or not they have received medical advice by physician consultation during the Ramadan period.

Keywords: Ramadan fasting, diabetes mellitus, glycemetic control

ÖZ

Amaç: Diyabetli hastaların önemli bir bölümünün, doktorlarının ve güvenilir otoritelerin tavsiyelerine rağmen Ramazan ayında oruç tutmakta ısrar ettiği bilinmektedir. Bu hastalara mümkün olan en iyi bakım ve desteği sağlamak için, International Alliance tarafından Uluslararası Diyabet Federasyonu (IDF) ve Diyabet ve Ramazan (DAR) Uluslararası İttifakı pratik kılavuzları oluşturulmuştur. Bu çalışmanın amacı, Ramazan orucu tutan diyabetik hastalarda hekime danışma ve kendi kendine glukoz izleminin diyabet yönetimine etkisini araştırmaktır.

Metod: Bu retrospektif gözlemsel çalışmaya diyabet tanısı konan, diyabet polikliniğine Ramazandan sonra kontrole gelen ve Ramazan öncesi poliklinik takibini yapan 18 yaş üstü hastalar dahil edildi. Oruç tutmuş olan hastalara (öncesinde tutmuş olan ve olmayan) daha önceki oruç deneyimleri, Ramazandan önce doktora danışıp danışmadıkları, oruç tutanların bu Ramazanı nasıl geçirdikleri sorulup anket doldurulmuştur. Oruç tutan hastaların Ramazan öncesi ve sonrası biyokimyasal verileri analiz edildi.

Bulgular: Çalışmaya 98'i (%24.9) oruç tutan 394 diyabetli hasta katıldı. Oruç tutan diyabetli hastaların yaş ortalaması 59.7 ± 12.3 yıl olup, % 39.2'si kadındı. Oruç tutanların %86.7'sinin 15 günden fazla oruç tuttuğu tespit edildi. Erkeklerde açlık oranları kadınlara göre daha yüksekti (%32.4 - %20.8) Tip 2 DM'li hastaların %25.9'unun, tip 1 DM'li hastaların %10.3'ünün oruç tuttuğu saptandı. Oruç tutmak isteyen hastaların %62.8'inin bu konuda hekime başvurduğu, %55.3'ünün hekim tarafından risk tespit edildiği ve %70'inin kendi kendine kan glukoz izlemi(SMBG) ile takip edildiği belirlendi. Oruç tutan hastaların %23.4'ünün (23/98) kullanılan diyabet ilaçlarının sayısında veya dozunda azalma olduğu; %5.1 (5/98) orucu bozacak bir komplikasyon yaşadığı; %16.3'ünün kilo aldığı (2.8 ± 2.4 kg) ve %23.5'i kilo verdiği (2.7 ± 1.9 kg) gözlemlendi. HbA1c'de belirgin bir artış ve idrar albumin atılımında anlamlı bir düşüş saptandı. Kişisel kan şekerini takip edenlerin A1c kontrolünün takip etmeyenlere göre daha iyi korunduğu belirlendi.

Sonuç: Çalışmamızda diyabetli hastaların dörtte birinin oruç tuttuğu görüldü. Bu çalışmanın en değerli sonucu, diyabet hastalarının, Ramazan ayında doktor konsültasyonu alıp almadıklarına bakılmaksızın, SMBG ile kendi kendine oto kontrol mekanizması sağlayarak daha başarılı bir diyabet kontrolü elde etmiş olmasıdır.

Anahtar kelimeler: Ramazan orucu, diabetes mellitus, glisemik kontrol

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Introduction

Ramadan is the month in which fasting Muslims undergo a radical change in the type and frequency of their meals, their sleep and wake patterns, as well as their hunger and satiety period. It is a month that Muslims have avoided eating, drinking, smoking and using oral / subcutaneous medications from the time of dawn until sunset. It is important to mention that the Quran has made a clear exemption for the sick, elderly, travelers, children, expectant and breastfeeding mothers, not to fast during Ramadan [1]. However, a significant number of patients with diabetes insist on fasting in Ramadan despite the advice of their doctors and the permission of the trusted authorities. The Epidemiology of Diabetes and Ramadan (EPIDIAR) study from 2001, which included 13 countries, found that 42.8% and 78.7% of patients with Type 1 or Type 2 diabetes mellitus respectively, fasted for at least 15 days during Ramadan [2]. More recently, the CREED study reported that 94.2% of T2DM patients fasted for at least 15 days and 63.6% fasted every day [3]. Existing recommendations on the management of people with diabetes who fast during Ramadan are mostly based on expert opinion rather than evidence gained from clinical studies [4].

As a result of the complexity of diabetes management during Ramadan, understanding the fasting pathophysiology with diabetes is important for the treating physician. Fasting patients with diabetes have an increased risk of hypoglycemia, hyperglycemia, dehydration and ketoacidosis [5]. Therefore, training on physical activity, food consumption and drug adjustment is essential to protect against complications. The International Diabetes Federation (IDF) and the Diabetes and Ramadan (DAR) International Alliance joined resources to provide the best possible care and support to diabetes patients fasting in Ramadan, and created IDF-DAR practical guides for patients and healthcare professionals [4].

As it is timed in accordance with the lunar calendar of Ramadan and since the latter is 11 days shorter than the solar calendar, the onset of the fasting period falls back eleven days every year, corresponding to the same day approximately every 33 years. Thus, the Ramadan period

covers all seasons of the year, including long and hot summer. The fasting period starts before dawn and ends with twilight, therefore Turkey is experiencing the longest period in June when the maximum period of daytime fasting period occurs. With this study, we aimed to investigate the effect of consulting a physician prior to Ramadan and glucose self-monitoring during Ramadan on diabetes management in fasting patients in 2019, which in that particular year fell from May to June.

Material and Method

Our study observed the tenets of the Helsinki Declaration and it was planned to be performed at the Kartal Dr Lutfi Kırdar Training and Research Hospital. It has been reported that Muslims who have fasted during Ramadan avoid consulting doctors and therefore, prospective studies are difficult to carry out [6]. As a result, our research was designed before Ramadan and was planned to be done retrospectively, in order to avoid any intervention in the natural course of the patient participation process. The patients over the age of 18, diagnosed with diabetes and consenting to participate in the survey study, who came to the diabetes out-patient clinic after Ramadan and were also followed before Ramadan, were included in the study.

Socio-demographic data of all participating patients such as age, height, weight, body mass index (BMI), diabetes type and disease duration, were recorded. In the second stage, a questionnaire was filled including questions about how the patients spent Ramadan: previous fasting experiences, whether a doctor was consulted before Ramadan, whether the risk scale was determined, whether the diabetic medication doses were reduced, whether the medical condition caused a breakdown in the fasting, whether personal glucose monitoring was performed and the reasons of those who did not, and finally, whether they experienced weight change during Ramadan. In the third stage, fasting plasma glucose (FPG), glycolyzed hemoglobin A1c(A1c), creatinine, cholesterol, triglycerides, HDL cholesterol, VLDL cholesterol, LDL cholesterol levels, estimated glomerular filtration rate (eGFR) by CKD-EPI and urinary albumin creatinine ratio (UACR), were recorded from the hospital information system in patients

who were fasting during Ramadan.

Descriptive statistics of socio-demographic characteristics were made according to fasting status. Data is presented as means (standard deviations) for continuous variables and number (percentages) for categorical variables. Comparison of two continuous independent variables with normal distribution used the Student t test, while comparison of two independent variables without normal distribution used the Mann Whitney U test. Patient characteristics among each group were compared by the Chi-squared test or the Fisher exact test for categorical variables. Whether biochemical changes were significant before and after Ramadan was analyzed with Paired Sample T test. Whether these changes were affected by consultation with the physician prior to Ramadan or control by personal blood glucose measurement was analyzed by One-Way Analysis of Covariance (ANCOVA). $P < 0.05$ was considered significant. All statistical analyses were performed using SPSS version 22 software (SPSS Inc. Chicago, IL, USA).

Results

In the survey conducted after 2019 Ramadan, a total of 394 (64.7% women; mean age 60.5 ± 12.5 years) diabetes patients were included. 7.4% of the patients were type 1 DM (n: 29); 1 of them was MODY. The mean diabetes duration of all patients was 16.6 ± 7.3 years. It was observed that 24.9% (n: 98) of the patients had fasted. It was determined that 86.7% of the fasting people were fasting for more than 15 days. In patients with fasting diabetes, 77.6% of OAD was metformin, 54.1% Dipeptidyl peptidase-4 (DPP-4) inhibitors, 23.5% of sodium glucose cotransporter 2 (SGLT2) inhibitors, 12.2% of Sulfonylureas (SU), and 42.9% of basal insulin, 11.2% of short-acting, 8.2% were using mix insulin

The socio-demographic characteristics of the fasting and non-fasting patients are presented in Table 1. The means height of fasting people were determined longer. Fasting rate was higher in males than females (males were 32.4% to 20.8%). Excluding one fasting Mody patient, type 2 DM patients fasted more than patients with type 1 DM (25.9% and 10.3% respectively)

It was determined that 58.7% of patients (174/296) who did not fast this year, were fasting in previous years. It was found that 157 of these patients did not prefer to fast due to health reasons that particular year. It was determined that 62.8% of patients (142/226) who intended to fast consulted with a physician about this issue and 55.3% of them (125/226) were identified at risk by their physician.

Table 1: Socio-demographic characteristics of the study population by fasting status

		Non-fasting (n:296)		Fasting (n:98)		p sig
Age, years		61	(12.8)	59.9	(11.5)	0.142
Duration of DM, years		16.9	(7.0)	15.3	(8.1)	0.11
Height, cm		160.4	(8.3)	162.6	(9.1)	0.035
Weight, kg		79.4	(15.5)	81.7	(13.4)	0.189
Body mass index (kg/m ²)		30.9	(6.1)	31	(5.0)	0.867
Gender, n (%)	male	94	(67.6%)	45	(32.4%)	0.011
	female	202	(79.2%)	53	(20.8%)	
DM	type 1	26	(89.7%)	3	(10.3%)	0.03
	type 2	269	(74.1%)	94	(25.9%)	

Data was given as mean (SD) and number (%)

That year, 23.4% of fasting patients (23/98) were found to have reduced the number or dose of their diabetes medications. It was determined that 5.1% of the patients who fasted that year (2 of them from hypoglycemia, 2 of them from hyperglycemia and 1 of them from hypertension) had a condition that would require disruption of fasting, and only 1 of them required hospitalization. 70% of fasting patients followed up with personal blood glucose measurement: the rest did not feel it was necessary. It was determined that they did not follow up blood glucose measurements by reasoning that it would disrupt the fasting. It was determined that 40% of fasting patients experienced weight change during the month of Ramadan. Some of them (n: 16) gained weight (2.8 ± 2.4 kg); while some of them (n: 23) lost weight (2.7 ± 1.9 kg).

Laboratory changes of fasting patients before and after Ramadan are shown in the Table 2. Accordingly, although there is a statistically insignificant decrease in fasting plasma glucose (FPG) levels, a significant increase in HbA1c is noteworthy. A significant decrease in Urine Albumin-to-Creatinine Ratio (UACR) was

also noted.

Table 2: Change of laboratory findings of patients before and after Ramadan

	Before Ramadan	After Ramadan	p sig
Fasting Plasma Glucose, mg/dl	152,9 (44.0)	144.6 (51.4)	0,072
Hb A1c (%)	7.8 (1.2)	7.9 (1.3)	0.031
Creatinine, mg/dl	0.84 (0.25)	0.85 (0.27)	0.246
eGFR (mL/min/1.73m ²)	87.3 (21.2)	87.5 (21.1)	0.904
Total cholesterol (mg/dl)	192.9 (39.2)	196.1 (37.7)	0.382
Triglycerides (mg/dl)	154.8 (86.7)	170.7 (99.6)	0.064
HDL cholesterol (mg/dl)	48.7 (11.5)	48.8 (11.2)	0.957
VLDL cholesterol (mg/dl)	31.4 (17.1)	34.3 (20.1)	0.082
LDL cholesterol (mg/dl)	111.1 (35.1)	110.9 (26.5)	0.375
Urinary albuminin creatinine ratio, µg/mg	47.1 (129.5)	37.9 (87.7)	0.032

Data was given as mean (SD)

Prior to the start of Ramadan, 52% of fasting patients consulted their physician and 48% of them did not. The differences in FPG, A1c and LDL cholesterol levels before and after Ramadan were determined similarly. The changes of all laboratory findings before and after Ramadan was statistically insignificant.

Regarding self-monitoring blood glucose (SMBG), it was determined that 70% of the fasting patients (58/83) followed their fingertip blood sugar during Ramadan and 30% of them (25/83) did not. As seen in Table 3, Figure 1, and Figure 2, it was found that A1c control of those who followed personal blood glucose levels better than non-followers (p: 0.023). While FPG averages of those who did not monitor blood sugar increased after Ramadan, those who did on the other hand were observed to decrease, although not in a statistically significant way (p: 0.105). Similarly, although the UACR averages were not statistically significant, it was found that patients who followed blood glucose decreased more than those who did not.

Discussion

Our study did not show any effect of consulting a doctor prior to Ramadan on glucose regulation, but the positive effects of SMBG have been proven. The most valuable determination offered by this study is that the individual's instant status determination by glucose monitoring plays a role

in the control of diabetes, probably through the auto control mechanism, more so than the doctor's consultation.

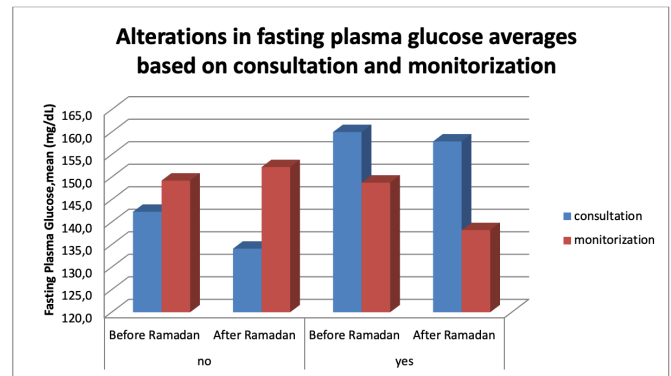


Figure 1. Alterations in fasting plasma glucose averages based on consultation and monitorization

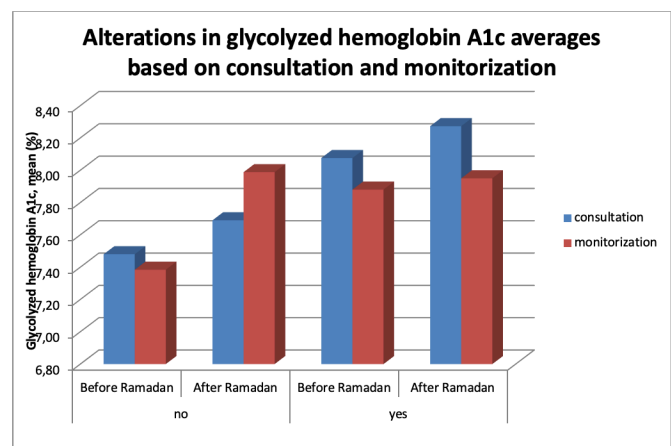


Figure 2. Alterations in glycolyzed hemoglobin A1c averages based on consultation and monitorization

In addition, our study showed that FPG in patients with fasting diabetes decreased after Ramadan compared to before Ramadan, but A1c levels increased significantly. This situation, explained by the high level of post prandial glucose levels, suggests that diabetic patients have also been influenced by the attractiveness of Turkish cuisine with a high content of carbohydrates reflected the iftar feast. This result was somewhat different from literature. There were studies so far showing that fasting in Ramadan has healing effects [7-12], has no negative effects [13-18], that the frequency of severe hypoglycemia was increasing [2], that glycemic control is impaired [19]. For example, in a study conducted by Bauguera et al. on a very limited number of diabetic patients (n: 38), it was found that those with impaired glycemic control before the Ramadan were further impaired during

Table 3: Changes in laboratory findings according to the status of blood glucose monitoring by the patient

	not-followed (n:25)				followed (n:58)				p sig
	Before Ramadan		After Ramadan		Before Ramadan		After Ramadan		
FPG (mg/dL)	149.2	(52.2)	152.2	(62.2)	148.8	(33.6)	138.2	(34.5)	0.105
HBA1C (%)	7.38	(1.2)	7.99	(1.8)	7.88	(1.1)	7.95	(1.1)	0.023
Creatinine (mg/dl)	0.83	(.3)	0.87	(.3)	0.80	(0.2)	0.80	(0.3)	0.310
eGFR (mL/min/1.73m ²)	87.1	(23.4)	84.6	(23.4)	94.2	(45.7)	87.8	(20.1)	0.765
Total cholesterol (mg/dl)	197.8	(32.0)	193.8	(35.4)	191.1	(36.9)	198.4	(38.5)	0.247
Triglycerides (mg/dl)	153.0	(99.1)	175.0	(81.7)	156.1	(87.0)	169.0	(112.9)	0.702
HDL cholesterol (mg/dl)	51.6	(12.9)	50.5	(12.2)	47.9	(10.2)	48.6	(10.2)	0.948
VLDL cholesterol (mg/dl)	32.0	(18.8)	35.0	(16.4)	31.2	(17.4)	34.1	(22.8)	0.874
LDL cholesterol (mg/dl)	113.3	(28.2)	105.0	(29.8)	109.7	(33.3)	111.9	(27.3)	0.51
UACR (µg/mg)	40.9	(64.0)	39.6	(81.0)	56.4	(162.3)	43.9	(101.0)	0.167

Data was given as mean (SD). 15 cases had missing values. FPG: Fasting Plasma Glucose, eGFR: Estimated glomerular filtration rate, UACR: Urinary albumin creatinine ratio,

Ramadan, but returned to their baseline levels afterwards. In the same study, it was found that patients who were good before their metabolic control were not adversely affected during Ramadan [20].

In addition, microalbuminuria levels were found to decrease after Ramadan (mean 47.1 mg/g before Ramadan and 37.9 mg/g after Ramadan). There are conflicting publications on this subject in the literature. For example, in a study by Şahin et al, similar to ours, microalbuminuria levels decreased significantly after the Ramadan compared to the levels before Ramadan [13], but in the study performed by Kamar et al., it was found that UACR increased after the Ramadan [21]. In a study by Esmaeilzadeh, it was shown that intermittent fasting improved endothelial and non-endothelial dependent vasodilations. In this study, microvascular endothelial functions of skin vessels were measured with laser doppler imager, and endothelial-dependent and independent dilatations were evaluated with acetylcholine and sodium nitroprusside iontophoresis [22]. Based on the fact that the endothelial tissue is a whole, it may be thought that the change in the skin vessels will parallel the change in the renal vessels and therefore the excretion of the microalbumin during the Ramadan, with the improvement of the endothelial functions.

In our study, it was observed that approximately 30% of diabetes patients fasted. Esen from Turkey reported that 41.6% of 190 diabetic patients fast and 65% of them did not consult during Ramadan in his study [23]. These results were not compatible

with the results of our study.

Since healthy individuals were not included in the study or there was no study to represent our society in the literature, it is impossible to make any evaluation about the rate of fasting in diabetics, compared to the non-diabetic population. In the EPIDIAR study, which included Algeria, Bangladesh, Egypt, India, Indonesia, Jordan, Lebanon, Malaysia, Morocco, Pakistan, Saudi Arabia, Tunisia and Turkey, it was determined that 42.8% of patients with type 1 diabetes and 78.7% of type 2 diabetes fasted, 78.7% of them fasted for at least 15 days [2]. In our study, fasting rates for at least 15 days were 10% in patients with type 1 DM and 25% in patients with type 2 DM.

Our study did not show any effect of consulting a doctor prior to Ramadan on glucose regulation, but the positive effects of personal blood sugar monitoring have been proven. Compared to before Ramadan, the mean of FPG of those who performed SMBG decreased afterwards, while those who did not increased. It was determined that means of hemoglobin A1c levels increased in both groups, but those who did not perform SMBG increased significantly more than those who did.

Microalbuminuria levels of the patients who consulted the physician before Ramadan decreased and the eGFR increased; in addition, it was observed that those who were not consulted had an increase in microalbuminuria and a decrease in eGFR. This may probably be attributed to the better preservation of renal hemodynamics with the arrangements made in oral antidiabetic

medicines with the advice of the physician. It was also shown in another study that education given to patients with diabetes before Ramadan minimizes the risk of hypoglycemic events, and potential weight gain can be prevented [24]. In our study, it is notable that five patients who had a negative experience throughout Ramadan were in the not-consulted group.

We observed that there was a minimal deterioration in lipid parameters after Ramadan compared to before Ramadan, but it was not statistically significant. Studies conducted so far show that there is some deterioration in lipid levels in Ramadan [9][10][22], included data on some improvement [11][19] or reported no change [20]. It was thought that the reason for the negative effect was the unhealthy diet and sedentary lifestyle, incompatible with the spirit of Ramadan.

Limitations

Our study had limitations. Instead of hemoglobin A1c, fructosamine, which shows glucose regulation in a shorter period of time, could be used as used in some of the studies related to Ramadan fasting. Since glycolyzed hemoglobin A1c was used in our routine practice, this could not be included. These results may not be compatible with the normal population. Patients followed in the diabetes center may be more attentive to their treatment.

Conclusion: As a result, we strongly recommend SMBG, which has been found to play very effective role in glucose control during Ramadan, to all fasting diabetic patients.

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