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Original Article

The effect of the Lenten fast on diabetes control in patients with type 2 diabetes mellitus

Dina Ali Ahmed*, Lobna Farag El-Toony, Omer Mohammed Herdan, Amal Mohammed Abd El-All

Assiut University Hospital, Internal Medicine Department, Assiut, Egypt

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ABSTRACT

Background: Egyptian Christians account for about 10%–15% of the population; the largest absolute number in the Middle East and North Africa. The Lent period is one of the three principal fasting periods which is less documented in the scientific literature.

Objectives: To evaluate the effect of Lenten fasting on anthropometric measures, biochemical and glycemic parameters in Christian patients with type 2 diabetes mellitus.

Methods: A prospective study, which was carried out in Assiut university hospital clinics of internal medicine during the period between February and May 2018 on 125 Christian patients with type 2 diabetes who fasted the Lent. The study was carried out in 3 phases.A semi-structured questionnaire was used to assess the risk category of fasting. Data were presented as mean ± standard deviation.

Results: Fasting blood glucose decreased significantly during, and after the fast.The number of patients with fasting blood glucose <8 mmol/L increased during fasting from 24.8% to 32.0%.Hypoglycemia during fasting occurred in 12.8% of patients. Hyperglycemia and dehydration were the main causes of breaking the fast.Low-density lipoprotein cholesterol increased during and after the fast. There was no significant change in high density lipoprotein cholesterol. Body weight of patients did not significantly change during fasting.

Conclusion: The Lenten fasting affected different biochemical parameters of fasting diabetic patients. The variations in the amount and type of diets of fasting patients caused variations in the results among patients of the study and between this study and the other studies.

1. Introduction

The Egyptian Christians, “nearly all of whom are Copts (adherents of the Coptic Orthodox Church or other Coptic churches)", most likely account for about 10%–15% of Egypt's population. The Copts (Christians of Egypt) who belong mostly to the Coptic Orthodox Church of Alexandria, observe fasting periods according to the Coptic calendar. These fasting periods are exceeded by no other Christian community except the Ethiopian Orthodox Church. Out of the 365 days of the year, the Copts fast over 210 days. The major fasting periods during the ecclesiastical calendar year are, the Nativity fast, the fast of Nineveh, the fast of Great Lent, the fast of the Apostles, the Assumption, Wednesday and Friday Weekly Fasts. The Great Lent consists of eight weeks (55 days), which correspond to the 40 days that Christ fasted on the mountain, a week of preparation before the Lent, the Holy Week which is the last week of fasting that precedes the Easter. During the Lent, fasters abstain from dairy products, eggs, and meat every day. Also, fasters abstain from fish in this period. The Orthodox Christian diet consists mainly of bread, fruits, legumes, nuts, seafood, snails, and vegetables during fasting periods. This diet can be considered as a variant of vegetarianism [1].

Diabetes is one of diseases with high prevalence in Egypt which is considered one of the top 10 countries in prevalence of diabetes [2]. As fasting is a spiritual habit aims to practicing patience and not risking patient's life, religions excused patients including diabetic patients from fasting. However, patients insist to fast regardless the risks that may associate with fasting.

The effects of Christian fasting are not well studied in scientific

* Corresponding author.
E-mail addresses: dinaalihamad@yahoo.com (D.A. Ahmed), leltoni@aun.edu.eg (L.F. El-Toony), herdan4@aun.edu.eg (O.M. Herdan), amalabdelaal@aun.edu.eg (A.M. Abd El-All).

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literature and few studies discuss its effect on some anthropometric measures and biochemical measures of the healthy fasters [3,4]so the aims of our study were to evaluate the impact of Lenten fasting on diabetic patients and to evaluate the associated risks with it.

2. Methods

The study was carried out in Assiut university hospital outpatient clinics of Internal medicine department (diabetes and endocrinology unit) during the period between February and May 2018. Patients were recruited from daily follow-up in the clinics using the convenience sampling technique. Patients were informed about the study during their regular care before the fasting.

2.1. Inclusion criteria

Christian patients with type 2 diabetes mellitus who intended to fast the Lent.

2.2. Exclusion criteria

Patients with serious comorbidities such as recent acute coronary syndrome or severe hepatic/renal disease, elderly patients with alertness problems, newly diagnosed type 2 diabetic (<3 months) patients, patients with recent hospitalization for diabetic ketoacidosis or severe hyperglycemia a month prior to start of the fast, hypoglycemia during the past month and patients who received short term corticosteroid therapy.

2.3. Design

A prospective study, which was carried out on 125 Christian diabetic patients. The study was done in three phases: the first phase (2–3 weeks before the preparation week of the fast), the second phase (the last week of the fast), and the third phase (4 weeks after the end of the Holy Week).

2.4. Data of the patients

Data of the patients were collected after their consent to participate in the study and through a semi-structured questionnaire, which included: Age, sex, nutritional habits and degree of physical activity of the patient. Duration of diabetes, current treatment and medical complication of diabetes, history of hyperglycemia, diabetic ketoacidosis or hypoglycemia in the 3 months before the start of the fast and history of fasting during the previous Lent.

In each phase of the 3 phases, Anthropometric measures including (Body weight, waist circumference and Body mass index), blood pressure and laboratory investigation including (Fasting blood glucose, Complete blood count, Serum creatinine and blood urea, Serum uric acid level and Lipid profile) were collected. HbA1c were measured in first phase of the study. At the end of fasting, number of fasting days and causes of breaking the fast were reported.

2.5. Statistical analysis

Data were analyzed using SPSS (Statistical Package for the Social Science, version 20, IBM, and Armonk, New York). Continuous data was expressed in the form of mean ± SD while nominal data was expressed in the form of frequency (percentage). Student t-test was used to compare mean of different two groups and ANOVA test for more than two groups. Multivariate regression analysis was used to determine the independent risk factors for HbA1C % of patients and fasting blood sugar. A p-value of less than 0.05 was considered statistically significant.

2.6. Ethical consideration

The study was approved by the Faculty's Ethics Committee and permission was obtained from the Ethics Committee who assured that confidentiality would be maintained and ethical principles would be followed.

3. Results

The study included a total of 125 Christian patients with T2D who fasted during the Great Lent period (after exclusion of patients who did not follow up within 1 month after the end of the fast). Baseline Demographic and Clinical characteristics of the study group were shown in Table 1.

According to risk stratification of patients with diabetes who fast, the studied patients were categorized into: 37 patients (29.6%) were in moderate/low risk category while 88 patients (70.4%) were

Table 1
Baseline Demographic and Clinical Characteristics of Christian diabetic patient group.

Variable	Measure	n = 125
Age in years	Mean ± SD	53.64 ± 10.6
	Median (Range)	57 (29–70)
Disease Duration in years	Mean ± SD	7.85 ± 5.0
	Median (Range)	8 (0.25–20)
Complications	No	21 (16.8%)
	Microvascular	89 (71.2%)
	Macrovascular	2 (1.6%)
	Both	13 (10.4%)
Co-morbidity	Yes	55 (44%)
Glycaemic status in the 3 months prior to start of the fasting	Normal	76 (60.8%)
	Hypoglycaemia	8 (6.4%)
	Hyperglycaemia	41 (32.8%)
Glycaemic status in the previous Lent fasting	Normal	43(34.4%)
	Hypoglycaemia	8(6.4%)
	Hyperglycaemia	74(59.2%)
BMI		
	Mean ± SD	34.54 ± 6.1
• Normal (<25)		11 (8.8%)
• Overweight (25–29)		21 (16.8%)
• Obese (>30)		93(94.4%)
BP(mmHg)	Mean ± SD	
Systolic BP		123.20 ± 15.6
Diastolic BP		76.24 ± 10.1
Treatment		
• Insulin		34 (27.2%)
• Oral anti-diabetic		96 (76.8%)
• Oral anti-diabetic and insulin		5(4.0%)
Glycaemic parameters		
FBG(mmol/L)	Mean ± SD	11.87 ± 6.2
HBA1c	Mean ± SD	8.54% ± 1.6
HBA1c < 7%		23 (18.4%)
HBA1c >7%		102 (81.6%)
CBC	Mean ± SD	
• HB(g/dL)		15.15 ± 2.6
• Platelet*10^9/dL		247.61 ± 63.2
Bl. Urea(mmol/L)		5.47 ± 2.3
S. Creatinine(umol/L)		5.02 ± 1.3
Uric Acid (mg/dL)		4.68 ± 1.0
Lipid Profile (mg/dL)	Mean ± SD	
• Cholesterol		230.79 ± 73.8
• Triglycerides		150.14 ± 63.4
• LDL		151.23 ± 65.9
• HDL		50.64 ± 13.7

Abbreviations: BMI, body mass index; BP, blood pressure; CBC, complete blood count; FBG, fasting blood glucose; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SD, standard deviation.

in high and very high risk categories.

Table 2 summarized the impact of Lenten fasting on anthropometric and biochemical parameters by comparing the three phases of the study (before, during and after the fast). Body weight, BMI and waist circumference showed no significant changes during and after the end of fasting.

Systolic blood pressure significantly decreased during fasting. However, it raised after the end of fasting. Diastolic blood pressure showed no change during and after fasting.

HB level decreased during fasting but with no statistically significant difference ($p = 0.325$). Platelet count showed statistical significant decrease during and after the end of fasting, but remained within normal values.

The results of the study showed a significant decrease in blood glucose during fasting and after the end of Lent with significant statistical difference between pre and post fasting.

Total cholesterol and LDL-C increased significantly between the beginning and the end of the study. The triglycerides level increased during fasting but it decreased again after the end of fasting. The HDL cholesterol did not significantly change during Lent.

Hypoglycemia occurred in 16 patients (12.8%) with a frequency of 1–4 attacks in most of them. However, 6 patients of them experienced many attacks of hypoglycemia and one of them was admitted to hospital because of hypoglycemic coma.

Hyperglycemia and dehydration were the main causes of breaking fast in diabetic patients; 52 patients broke their fast due to hyperglycemia (41.6%) and 47 patients due to dehydration (36.6%) as shown in Fig. 1.

Fig. 2 showed the percentage of patients according to the number of days they fasted with complet abstinence of food.

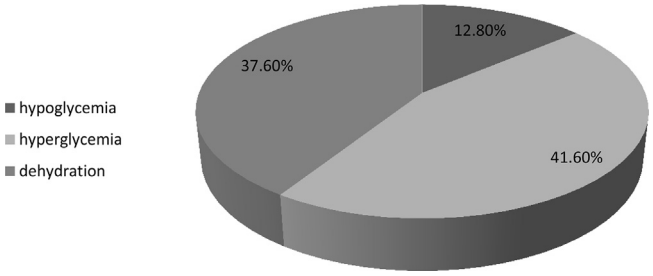

Fig. 1. The frequency of complications that broke patients fast.

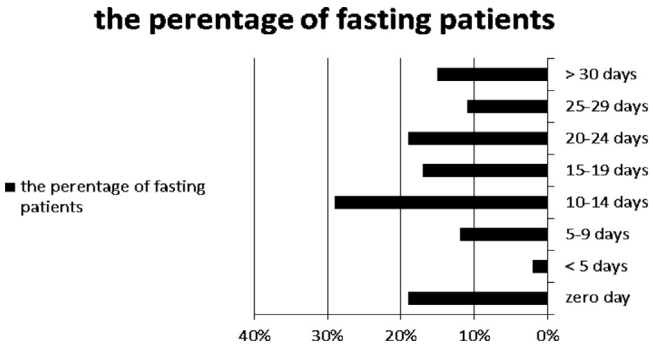

Fig. 2. The frequency of fasting days complet abstinence of food in patients of the study.

Table 3 showed the multivariate linear regression analysis of the significant factors predicting HbA1c and fasting blood glucose.

The intercept (HbA1c %) was 8.3 (95% CI: 7.7–9.6) after adjusting for all correlates ($p < 0.001$). With one-year increase in duration of diabetes, there was 0.062 significant decrease in the HbA1c% ($P = 0.028$). With the presence of co-morbidities, there was 1.112 significant decrease in the HbA1c% ($P < 0.001$). Also, with increasing cholesterol level, there was 0.054 significant increase in the HbA1c% ($p < 0.001$). Fasting blood glucose was 13.3 (95% CI: 11.1–15.5) after adjusting for all correlates ($p < 0.001$). With the presence of complications or co-morbidities there was decrease in blood glucose by 2.818 points and 1.212 points respectively.

4. Discussion

In our study, which included 125 Christian diabetic patients, 93.2% of patients had complications of diabetes either macro-vascular or micro-vascular complications. The mean fasting blood glucose was 11.87 ± 6.2 mmol/L and the mean HbA1c was 8.54 ± 1.6%. Only 18.4% of patients had HbA1c <7%. Three months

Table 2
Impact of Lenten fasting on anthropometric parameters, body composition and glycaemic parameters during the fasting (Christian group).

Variable	Pre	During	After	P-value[a]
	Mean ± SD			
Body Weight/Kg	84.35 ± 15.6	84.38 ± 15.6	84.52 ± 15.6	= 0.189
P-value[b]	$P_1 = 0.774$	$P_2 = 0.100$	$P_3 = 0.328$	
Waist/cm	106.15 ± 14.8	106.38 ± 14.5	106.54 ± 14.4	= 0.227
P-value[b]	$P_1 = 0.137$	$P_2 = 0.126$	$P_3 = 0.087$	
BMI	34.54 ± 6.1	34.67 ± 6.0	34.70 ± 5.9	= 0.109
P-value[b]	$P_1 = 0.149$	$P_2 = 0.330$	$P_3 = 0.120$	
Systolic BP	123.20 ± 15.6	121.44 ± 12.9	123.76 ± 13.5	= 0.009
P-value[b]	$P_1 = 0.030$	$P_2 = 0.024$	$P_3 = 0.663$	
Diastolic BP	73.65 ± 7.9	74.92 ± 6.5	74.85 ± 8.2	= 0.266
P-value[b]	$P_1 = 0.351$	$P_2 = 0.444$	$P_3 = 0.141$	
HB level(g/dL)	15.15 ± 2.6	12.78 ± 1.7	12.78 ± 1.6	= 0.325
P-value[b]	$P_1 = 0.323$	$P_2 = 0.934$	$P_3 = 0.323$	
Platelet count	247.61 ± 63.2	246.52 ± 62.1	246.52 ± 62.0	= 0.049
P-value[b]	$P_1 = 0.083$	$P_2 = 0.964$	$P_3 = 0.083$	
Cholesterol (mg/dL)	230.79 ± 73.8	251.76 ± 77.9	251.78 ± 75.5	<0.001
P-value[b]	<0.001	= 0.986	<0.001	
Triglyceride(mg/dL)	150.97 ± 60.8	156.14 ± 63.4	150.52 ± 57.5	= 0.004
P-value[b]	= 0.021	<0.001	= 0.812	
LDL(mg/dL)	151.23 ± 65.9	167.33 ± 70.2	168.11 ± 68.6	<0.001
P-value[b]	<0.001	= 0.544	<0.001	
HDL(mg/dL)	50.64 ± 13.7	50.21 ± 13.8	50.64 ± 13.4	= 0.492
P-value[b]	= 0.379	= 0.214	= 0.994	
FBG(mmol/L)	11.87 ± 6.2	10.33 ± 4.1	10.25 ± 3.7	= 0.003
P-value[b]	<0.001	= 0.505	<0.001	
FBG <8 mmol/L	31 (24.8%)	40 (32.0%)	26 (20.8%)	= 0.001
P-value[b]	<0.001	<0.001	<0.001	

–Significance level is considered when $p \leq 0.05$.

[a] Repeated measure ANOVA was used to compare the mean difference between groups.

[b] Paired T-test analysis was used (P1=Pre-vs. During, P2 = During vs. after, P3= Pre-vs. after).

Table 3
Multiple linear regression model to predict HbA1c and fasting blood glucose by the study group.

Variable	Co-efficient		*t*-test	p-value	95% CI	
	β	SE			Upper	Lower
HBA1c %						
• Constant	8.381	0.491	17.68	<0.001	7.708	9.652
• Disease Duration	−0.062	0.002	−2.22	= 0.028	−0.116	−0.007
• Co-morbidity	−1.112	0.268	−4.15	<0.001	−1.643	−0.581
• Cholesterol Level	0.054	0.001	2.45	= 0.016	0.01	0.083
fasting blood glucose						
• Constant	13.301	0.111	11.97	<0.001	11.101	15.500
• Complications	−2.818	0.261	−2.23	= 0.027	−5.316	−0.321
• Co-morbidity	−1.212	0.676	−1.79	= 0.041	−2.551	−0.128

before the start fasting, 32.8% of the patients experienced hyperglycemic attacks and 6.4% experienced hypoglycemic attacks. This refers to poor diabetes control and poor compliance of patients to follow up.

Because of all previous characters of the patients of the study, most of the patients were considered in high and very high risk categories for fasting. They should not fast, but they insisted to fast according to religious regulation by the abstinence of meat, seafood and dairy products every day and complete abstinence of food and drink from 12 a.m. to 5 p.m. on some days.

74.4% of the patients were obese confirming the problem of obesity and its strong relation to diabetes in Egypt [5]. This reflects lack of physical activity and bad nutritional habits of our patients. As most of Christian patients in Egypt depend on fried food (potato, falafel and eggplants) and carbohydrate for long duration in the year, there is higher risk for gaining weight. Although fresh fruits and vegetables and dairy product alternatives are allowed during fasting periods, low socioeconomic states, poor dietary knowledge and social habits of patients decrease their consumption as main foods. In the current study, the body weight of patients showed no significant changes during and after fasting. This is probably due to that effect of fasting on body weight may need more time to be evaluated.

Few studies were done to evaluate the impact of orthodox Christian fasting on healthy and diabetic fasters. The previous studies showed decreased caloric intake and decreased body weight during fasting in Greek Orthodox Christians [6]. There was an increase in carbohydrate intake while both protein and fat intake decreased [7]. In our study, there was decrease in total amount of food intake due to long duration of fasting especially in patient with complete abstinence. Most of fasting patients of the study depended mainly on carbohydrates (whole-grain brown bread), fried foods (potato, falafel), Egyptians beans and fresh green salad in different amounts and ratios.

In our study, blood glucose level decreased during fasting. In a previous study that was done in Egypt showed the same result (8) while other studies conveyed that fasting may or may not decrease blood glucose levels [9,10]. 12.8% of patients demonstrated symptomatic hypoglycemia. The majority of them occurred during complete abstinence and was self-managed by breaking the fast. One attack led to hospital admission. While hyperglycemia was the main cause that led to fast break (52%). The risk of hyperglycemia was higher than hypoglycemia as patients ate high caloric foods rich in carbohydrate and fat.

In our study total cholesterol and LDL-C increased significantly during fasting. Also, triglycerides increased during fasting and decreased again after the end of fasting. The HDL cholesterol did not significantly change during Lent. These changes were related to the ditery habits of the patients of the study which included fried foods as a main part of daily diets in variable amounts between patients.A previous study in Egypt showed increase in total cholesterol in 54.5% diabetics while LDL showed a slight non-significant increase in diabetic patients. HDL, on the other hand was worse in 55.6% of the diabetic patients parallel to improvement in 33%. TG levels were significantly lowered in the 30% of diabetic patients [8]. The studies done on Greek Orthodox Christian showed that both Total Cholesterol and LDL cholesterol levels decrease during fasting periods while there was no change in TG level [9]. Studies reported decrease in HDL-cholesterol [9] while others found no change [10]. The differences in the amount and ratio between carbohydrates and fats in the fasting diets could explain the variations in results of th lipid profile of patients in different studies. While the Greek orthodox Christians' diet, which is an example of the Mediterranean diet, is rich in olive oil and nuts and was ranked as the most likely dietary model to provide protection against coronary heart disease [11] the Egyptian diet is rich in fried foods. However, the Egyptian food is rich in brown whole-grain (Baladi) bread, beans (fava beans) and sesame seeds. Fava beans block carbohydrate absorption and have lipid-lowering effects [12] while Sesame reduce Total Cholesterol, LDL-C and triglyceride levels as shown in previous studies [13]. These nutritive effects and synergism of these dietary constituents could explain some of the health benefits observed in the Egyptian Christian fasters and again could explain the variations between patients in different studies included this one. Also the effect of abstinence of food completely with irregular pattern in most of patients should be taken into considerations.

5. Limitation of the study

Our study has some limitations; there were significant variations between patients of the study in their dietary habits regarding the amount and type of food. Also, there were no healthy non-diabetic groups as control groups.

6. Conclusion

Lenten fasting had an impact on biochemical and glycemic parameters of diabetic patients. Patients should be categorized according to the risk of fasting before the start of fasting and their blood glucose and HbA1c should be controlled. Patients with high risk should encouraged against fasting. Encouraging fasters to consume fresh fruits, vegetables and dairy product alternatives such as coconut and soya milk and learning them different methods of cooking other than frying such as steaming, grilling and boiling. More research is needed to be performed on Christian fasting to examine each of the principal fasting periods.

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Conflicts of interest

The authors declare they have no conflicts of interest and all the authors have read and approved the final submitted version.

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