

RESEARCH ARTICLE

THE EFFECT OF RAMADAN FASTING AND LIFESTYLE ON DIABETIC PATIENTS IN YEMEN ENVIRONMENT

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Abstract

During Ramadan, Muslims who are ill or have health conditions that may deteriorate upon fasting, including patients with diabetes, are exempt. During the Ramadan fast, it is essentially a radical change in lifestyle for the period of 1 lunar month that may affect diabetic and cardiac patients. So, this study, was carried out during the period of April 2021 to May 2021 (Ramadan month) in Taiz city on 64 already diagnosed diabetic patients. During fasting (stage 1), at fasting breaking (stage 2), and after 2 hours (stage 3), blood glucose level was measured by an automated analyzer. The body mass index (BMI) was calculated as $BMI: \text{weight (Kg)} / \text{height (m)}^2 = (w/h^2)$.

Results showed statistical significant effects of test times on blood glucose level. No statistically significant effect of sex on blood glucose level with test time was recorded. The effects of age and treatment type on blood glucose level in Ramadan were observed ($P=0.003, 0.042$ respectively). Blood glucose levels of individuals with diabetes duration larger than 15 years have higher blood glucose levels at stages 1 and 2 (Odds ratio= 2 and 1.4 respectively). The major of the participants were healthy weight and overweight (37.5 % and 31.3 % respectively). A higher proportion of male participants was overweight (37.5%) with BMI-mean 28.08 Kg/m^2 and healthy weight (35%) with BMI-mean 23.23 Kg/m^2 . The correlation between BMI and residual blood glucose level was statistically significant ($p<0.001$) in stages 1, 2, and 3.

There were no statistically significant relationships between BMI and blood glucose level, these findings agree with other authors. On the other hand, RMA-regression analysis and Pearson correlation emphasized the correlation between BMI and residual blood glucose level in stages 1, 2, and 3. From current study, perhaps concludes that the variations in blood glucose levels may be mainly due to lifestyle modification (diet, physical activity, and sleeping hours) during Ramadan month. So, the results of our study and the other kinds of literature indicate that fasting in Ramadan is safe for the majority of patients with diabetes management.

Keywords: Ramadan, Lifestyle, Diabetic Patients, Yemen.

Introduction

Diabetes mellitus (DM) is a global public health problem that encompasses heterogeneous group of disorders characterized by hyperglycemia associated with metabolic, cellular, and blood disturbances leading to long-term macrovascular and microvascular complications.

Diabetes mellitus and cardiovascular diseases are approaching epidemic proportions worldwide and is associated with substantial public and personal burden [1-7]. DM is one of the major causes of mortality and morbidity in most developed and developing countries [5-8].

Fasting during Ramadan is one of the five pillars of Islam. Muslims neither eat nor drink anything from dawn

until sunset [1, 2]. The time of observance differs each year because it is a lunar calendar. Fasting period varies with the geographical site and the season. In summer months and northern latitudes, the fast can last up to 18 h or more. Muslims observing the fast must not only abstain from eating and drinking, but also from taking oral medications, smoking as well as intravenous feeding fluids and nutrients [1-4, 9-10].

During Ramadan, Muslims who are ill or have health conditions that may deteriorate upon fasting, including patients with diabetes, are exempt [11]. It has been estimated that 40-50 million individuals with diabetes fast during the month of Ramadan [12].

During the Ramadan fast, it is essentially a radical change in lifestyle for the period of 1 lunar month that may affect diabetic and cardiac patients [2, 3, 7, 9, 13]. In Ramadan, the Muslims eat two meals, one before dawn and the other shortly after sunset. This change of meal schedule is accompanied with changes in sleep habit (shortening of time to sleep) and lifestyle habits [13-16]. The drug schedule during the daytime is changed because of fasting, which may have an affect DM patients.

Ramadan fasting entails major changes in dietary patterns and frequency. These changes could potentially induce metabolic alterations in both healthy and diseased Muslims [17,18]. Despite taking fewer meals, this practice is usually compensated by ingesting large amounts of sugary food and drinks that are high in carbohydrates and fats, especially when breaking the fast [19]. The overall calorie consumption of individuals with type 2 diabetes has been reported to increase during Ramadan [20, 21]. Moreover, the doses of antidiabetic agents are often adjusted at this time to reflect the change in lifestyle during Ramadan. One study showed that, among diabetic patients whose doses of oral hypoglycemic agents (OHA) were modified during Ramadan, 58% had changed the timings of the administration of their medications [22].

During Ramadan, it has also been reported that physical activities, especially exercising, tend to decrease from a fear of feeling too weak [23]. Patients with diabetes have been advised by healthcare providers to avoid excessive physical activity during Ramadan, because the practice of fasting may increase the risk of hypoglycemia, especially a few hours before the sunset meal. However, one study reported that appropriate levels of physical activity during fasting did not interfere with tolerance to physical exercise [24].

Furthermore, it has also been postulated that the act of fasting may increase the risk of poor glycemic control, which raises questions about the safety of Ramadan fasting in patients with diabetes. During fasting, the decrease in blood glucose levels triggers compensatory mechanisms in the body of healthy individuals which

cause a reduction in insulin secretion or the breakdown of stored glycogen to prevent hypoglycemia [25]. However, in patients with diabetes, this regulation is compromised due to either dysfunction of insulin secretion or sensitivity or occasionally both [26].

One epidemiological study reported that the risk of severe hypoglycemia increased sevenfold during the month of Ramadan in patients with diabetes [12]. However, another study reported that Ramadan fasting was safe and did not significantly increase the incidence of hypoglycemic events [27]. So, the objective of this study was to investigate the effect of Ramadan fasting on the levels of blood glucose and assess the fasting condition and the effects of fasting on metabolic control among diabetic patients observing fast during Ramadan in Yemen.

Materials and methods

This study was carried out during the period of April, 2021 to May,2021(Ramadan month) in Taiz city.

Participants and design

The study was done on 64 already diagnosed diabetic patients (Age limit 16- 85 years; 42 males and 22 females). This study was carried out by trainers who planned the research and by three university students from biology department. The questionnaires were filled out during face-to-face interviews with the individuals with diabetes after the questions were explained. Patients who were willing to participate were included in the study. The fasting period during Ramadan is usually 29–30 days; it was 30 days in the year of this study. The questionnaire was structured by the researcher (age, sex, the weight, length, having diseases other than diabetes, the duration of the incidence of diabetes, and education).

Measures and data collection

According to Olgun 2006 [28], the data were collected via a questionnaire. Height was measured in centimeters using a height scale (Meter), while the patient was standing bare feet and with normal straight posture, and weight was measured in kilograms using a weight balance (Cammry-Personal Scale). During fasting (stage 1), at fasting breaking (stage 2), and after 2 hours (stage 3), blood glucose level was measured by an automated analyzer (SD, Codefree, Blood glucose monitoring system-MT Promedt Consulting GmbH-Germany).

According to WHO diagnostic criteria for DM, a Fasting plasma sugar ≥ 126 mg/dl, Random plasma glucose ≥ 200 mg/dl (in patients with classic hyperglycemic signs), 2hour plasma glucose ≥ 200 mg/dl [29].

Body mass index (BMI) was calculated as BMI: weight (Kg) / height (m)²= (w/h²) based on Bener and Yousafzai [30]. A person was considered moderate thinness if the BMI value was between 16 and 17 kg/m², healthy weigh

if the BMI value was from 18.5 to 25 kg/m², overweight if BMI was from 25 - 30 kg/m² and obese if the BMI value was ≥ 30 kg/m² according to Murguía-Romero *et al.* [31]. For elucidating the relationship between BMI and blood glucose level, the data were described by reduced major axis (RMA) and Pearson correlation coefficient.

Statistical analysis

Software PAST package release 3.25 (2001). *p-value* less than 0.05 were considered as statistically significant.

Results

Results for donors at stages 1, 2, and 3 in Ramadan were summarized in Table (1) and Figure (1). General linear model (GLM) analysis for repeated measures showed statistical significant effects of test times on blood glucose level.

According to one-way ANOVA analysis, no statistically significant effect of sex on blood glucose level with test time was recorded. But Tukey analysis emphasized on the difference between mean blood glucose level at stage 1 and stage 3. On the other hand, the difference between mean blood glucose levels at stages 2 and 3 was recorded (Table 2 and Figure 1).

As shown in Table (3) and Figures (2 & 3), the effects of age and treatment type on blood glucose level in Ramadan were observed (*P*=0.003, 0.042 respectively). Mean age of the patients with diabetes participating in the study was 52±1.71 years, most of whom was higher blood glucose level (70.3%) at stage 3. A total of 51 (79.7%) had diabetes used Tablets as antidiabetes. All donors with insulin treatment were associated with a risk factor (Odds ratio= 6.5).

Body composition (i.e. gender), education level and diabetes duration significantly affect the risk association. The males have higher blood glucose level at stage 1 than that of females at stage 3. The correlation between education and blood glucose level in Ramadan was unobserved. Blood glucose level of individuals with diabetes duration larger than 15 years have higher blood glucose level at stages 1 and 2 (Odds ratio= 2 and 1.4 respectively).

The mean body mass index (BMI) was 25.9 Kg/m² (SD ±5.5), the major of the participants were healthy weight and overweight (37.5 % and 31.3 % respectively), whereas the proportion of obese was 20.3%.

A higher proportion of male participants was overweight (37.5%) with BMI-mean 28.08 Kg/m² and healthy weight (35%) with BMI-mean 23.23 Kg/m², whereas the proportion of healthy weight and obese participants was equal (33.3) with BMI-mean 22.66 and 34.07 Kg/m² respectively in females. Non-significant decrease in the BMI (Moderate thinness) in males (BMI 17.22 Kg/m²)

was observed. Using RMA-regression analysis and Pearson correlation, the correlate between BMI and residual blood glucose level was statistically significant (*p*<0.001) in stages 1, 2, and 3 (Fig. 6).

Table 1: Results from GLM and LSD analyses on blood glucose measurements during fasting, fasting breaking and after 2 hours in Ramadan to diabetic patients (n=64).

Test times	blood glucose g/dl
Fasting	176.19±8.88 ^a
	(86-352)
Fasting breaking	160.23±8.31 ^{ab}
	(78-324)
After 2 h.	281.64±14.10 ^{ab}
	(110-544)
F	93.108
p-values	0.000

All values are reported as mean ± SE, range, The Means with the same letters indicate significant difference (*p*<0.05) The significant *p*-values are in bold.

Table 2: Results from the one-way ANOVA and Tukey analyses on blood glucose during fasting, fasting breaking and after 2 hours in Ramadan to diabetic patients (n=64).

Gender	Test time	Blood glucose (g/dl)
Male	fasting	172.48±10.59 ^a
		88.00-335.00
	fasting breaking	159.86±10.97 ^b
		85.00-324.00
	after 2 h.	269.19±18.33 ^{ab}
		110.00-544.00
<i>F</i>	18.885	
<i>P- value</i>	7.039	
Female	fasting	183.27±16.30 ^a
		86.00-352.00
	fasting breaking	160.95±12.42 ^b
		78.00-275.00
	after 2 h.	305.41±21.05 ^{ab}
		160.00-508.00
<i>F</i>	21.012	
<i>P- value</i>	1.011	

All values are reported as mean ± SE, range, *F*-values and significant levels. The Means with the same letters indicate a significant difference (*p*< 0.05).

Table 3: Patient demographics and odds ratio (n=64).

Patient characteristics	Odds ratio				
	All	Fasting	Fasting breaking	After 2 hours	λ (P-value)
Age (years)	*52±1.71 (16-85)				0.058 (0.003)
≥45 (%)	46 (71.9)	1	0.9	1.3	
Gender (n)					0.951 (0.385)
Males (%)	42 (65.6)	0.7	1	2.5	
Education (n)					0.978 (0.716)
Literate (%)	48 (75)	1.5	1.1	0.5	
Duration of diabetes (years)	*10±0.90 (1-37)				0.316 (0.185)
≤15 (n)	54 (84.4)	2	1.4	1	
Treatment (Type)					0.873 (0.042)
Tablets %	51 (79.7)	n.a	6.5	6.5	

All values are reported as Wilks' lambda (λ) of multivariate regression.

The significant p-values are in bold ($p < 0.05$).

*Mean, SE, minimum and maximum

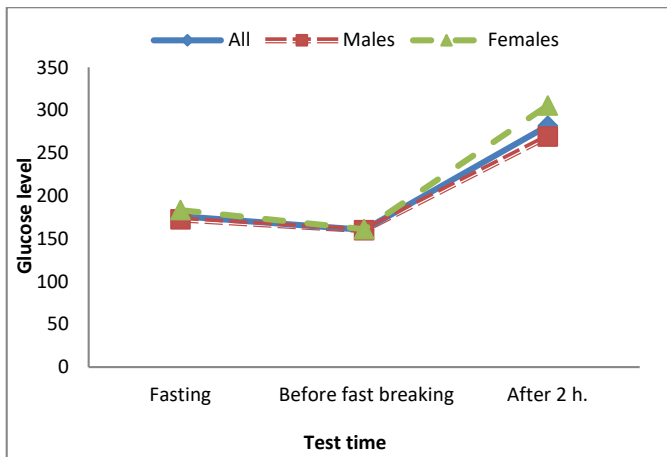


Fig. 1: The effect of fasting on blood glucose level

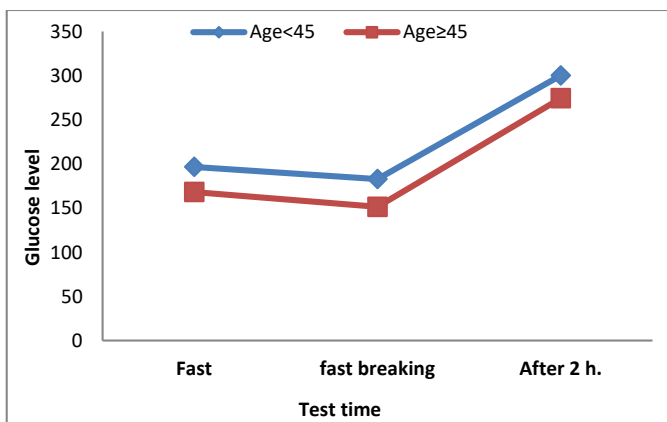


Fig. 2: The effect of fasting on blood glucose level according to age.

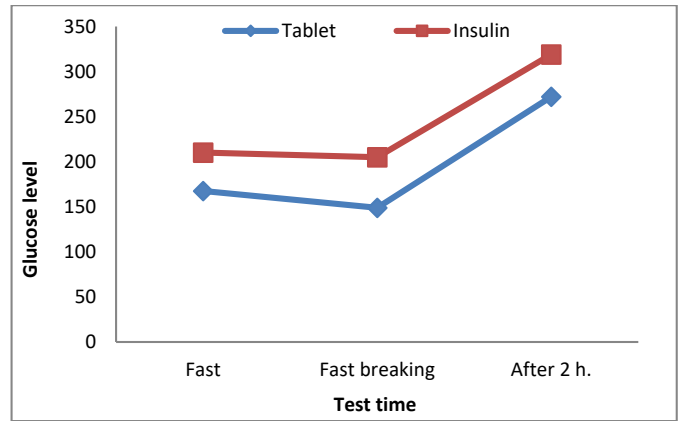


Fig. 3: The effect of fasting on blood glucose according to treatment.

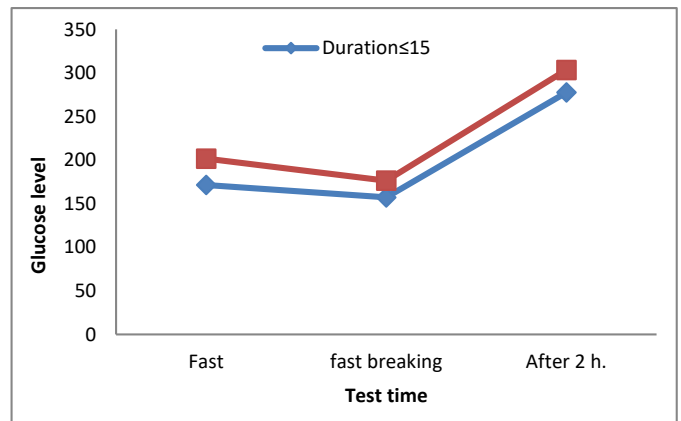


Fig. 4: The effect of fasting on blood glucose according to the duration of diabetes.

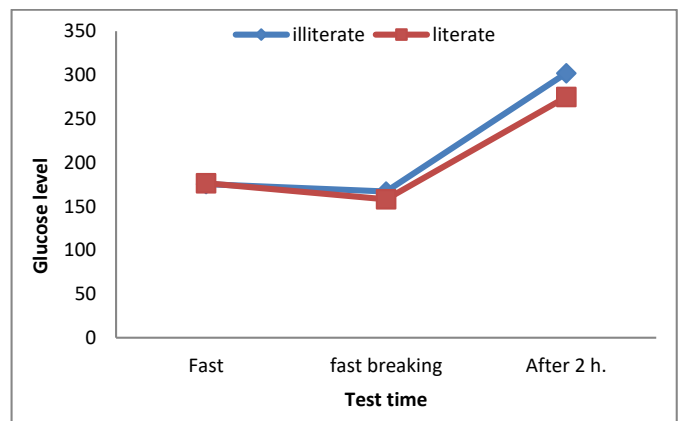


Fig. 5: The effect of fasting on blood glucose according to education.

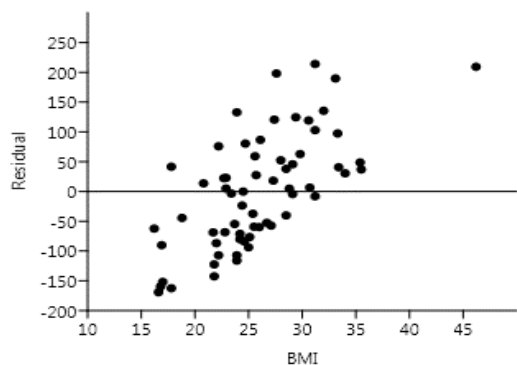


Fig. 6: The correlation between RMA-regression residual and blood glucose level in stage 1

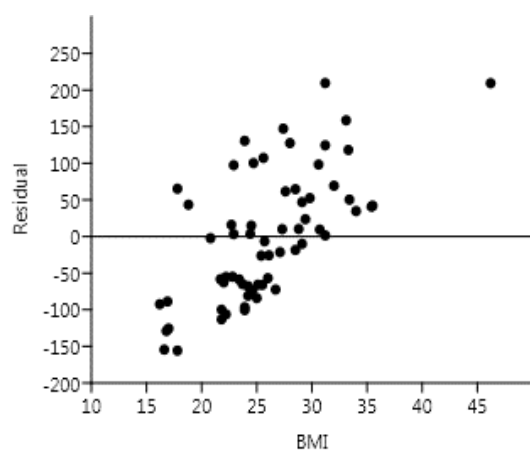


Fig. 6: Continue (in stage 2)

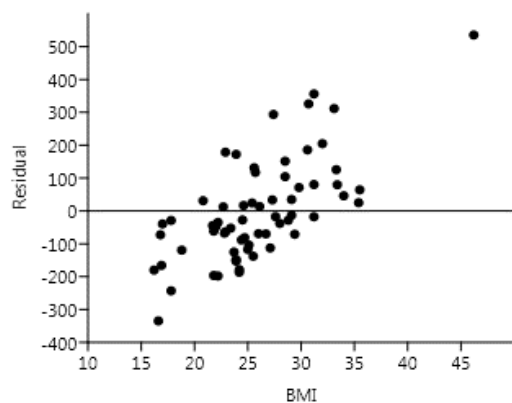


Fig. 6: Continue (in stage 3)

Discussion

The present study included a representative Muslim diabetic population in the State of Yemen (Taiz-city). The current study found a positive impact of Ramadan fasting on blood glucose level, it revealed a rise little in blood glucose level during fasting and elevation significant after 2 hours than that blood glucose level in fasting breaking ($p=0.000$).

In fact, although blood sugar levels in diabetes can be achieved through manipulation of diet, exercise, and medication, a change in any one of these three things can skew blood sugar levels and create complications associated with hyperglycemia or hypoglycemia [1, 14].

Fasting during the month of Ramadan is a religious activity that devout Muslims practice whether they are diabetic or not. As such fasting involves abstinence from food and water for 12 h or more during the day from dawn to dusk, it is evident that advice regarding exercise and medication will have to be modified appropriately during this period [1–3, 9]. There is ample evidence that it is safe for well-controlled diabetics to fast during the month of Ramadan [1, 2, 32–35].

During the month of Ramadan, the majority of people have a meal after sunset, referred to as Iftar (breaking of the fast), and a smaller meal before dawn referred to as *Sahor* (pre-dawn). A decrease in daily calorie intake has been seen as one of the advantages of Ramadan fasting [36–43]. Some authors observed a decrease in energy intake (103Kcal/d), though not statistically significant, which is correlated with meal frequency [37, 39]. However, in another study [44], the total daily energy intake remained unchanged.

Diet during non-fasting hours should not differ from the usual recommended healthy and balanced diet for people with diabetes [45, 46]. Meals should not be skipped and the “*Sahor*” meal should be taken as late as possible and not at midnight [45, 47]. Ideally, three meals a day spaced four to six hours apart would still be consumed. Culturally important foods do not have to be forbidden, but very sweet desserts and high-fat and fried foods should be limited to small portions [46]. Gorging and overconsumption should be avoided. Concerning dehydration during Ramadan, it represents the greatest health risk for a full-day fast. To reduce the risk, two liters of water or sugar- and caffeine-free liquid should be consumed [48].

Carbohydrate and lipid metabolism are influenced by fasting, resulting in changes in blood chemistry. There is no caloric intake during fasting, and the continual use of glucose in the body for various vital functions leads to lowering of blood glucose level. The depletion of glycogen stores after prolonged fasting further decreases its level [49].

Our study participants demonstrated lower levels of blood glucose during the month of Ramadan, which was consistent with the observations reported by earlier workers [10, 15, 49–51].

The Body mass index (BMI) dropped significantly among females but to a lesser extent among males. This could be related to stress or food insecurity [52]. Sahin *et al.* [10] have done observations on the effects of Ramadan fasting on type 2 diabetes before and after Ramadan, they found the frequencies of both severe hyperglycemia and hypoglycemia were higher in the fasting group, but the difference was not significant.

More recent studies did not find any negative effects of extended fasting on glucose regulation of patients with

diabetes who are using certain medications. No serious adverse event was observed, and they have failed to demonstrate the benefits of increasing the number of meals in patients with diabetes [4, 14, 15]. This is confirmative with the current reported study.

The war in Yemen, which started on March 25th, 2015 and has lasted until now, has had many socioeconomic effects on the people, including patients with diabetes mellitus. Over the following year, millions of people, including women and children, are suffering from malnutrition, and other people have been forced to flee their homes. Treatment of non-communicable diseases (NCDs) are responsible for 39% of mortality in Yemen) can be difficult during humanitarian crises, where insecurity and damaged health systems reduce access to treatment for patients [53-56]. Our analysis shows that the odds of the fasting in Ramadan and higher blood glucose level values is related to characteristics of people including age, sex and diabetes duration.

The control of glycemic in many of the patients become worst after the war. The lack of electricity caused some of them to stop using insulin, and many wanted to stop using insulin because of the difficulties they had keeping the insulin vials cold in the absence of electricity [52, 57, 58]. In the current study, all patients with insulin treatment was associated with risk factor (Odds ratio= 6.5).

Ensuring good control of plasma glucose during the fasting month of Ramadan is a challenge for both physicians and patients [1]. Along with these changes in medication, it is important that doctors educate their patients about how their plasma glucose depends on the relationship between food intake and glucose-lowering medication. Patients should also be told of the need to monitor their plasma glucose on a regular basis throughout the fasting month [14].

The major of the participants were healthy weight and overweight (37.5 % and 31.3 % respectively), whereas the proportion of obese was 20.3%. Male participants were overweight (37.5%) and healthy weight (35%), whereas the proportion of healthy weight and obese participants was equal (33.3) in females. There were no statistically significant relationships between BMI and blood glucose level, these findings agree with Olgun [28] and Bener and Yousafzai [30]. On the other hand, RMA-regression analysis and Pearson correlation emphasized the correlate between BMI and residual blood glucose level in stages 1, 2, and 3

Conclusion

The variations in blood glucose levels may be mainly due to lifestyle modifications (diet, physical activity, and sleeping hours) during Ramadan month. So, the results of our study and the other literatures indicate that fasting

in Ramadan is safe for the majority of patients with diabetes management.

Recommendations

We noticed that controlling blood sugar levels during Ramadan was very difficult. Therefore, we believe that educating patients on healthy fasting and giving them more information around fasting Ramadan by care team members, is very important.

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مقالة بحثية

تأثير صيام رمضان وأسلوب الحياة على مرضى السكري في بيئة اليمن

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المُلخَص

خلال رمضان، المرضى المسلمون مثل مرضى السكري يمكن المرض يفسد صيامهم لذلك هم معفيين من الصيام، وتغير أسلوب الحياة في رمضان ربما يؤثر على مرضى السكري والقلب، لذلك تم إجراء هذه الدراسة خلال شهر رمضان من ابريل 2021 الى مايو 2021م على 64 مريض سكري، حيث تم قياس مستوى جلوكوز الدم خلال فترة الصيام، قبل الإفطار مباشرة، وبعد الإفطار بساعتين، وكذلك حساب دليل كتلة الجسم باستخدام المعادلة التالية:

الوزن (بالكيلوجرام) ÷ الطول (بالمتر)²

وقد وجد أنه هناك تأثير للصيام على مستوى جلوكوز الدم، وليس هناك تأثير ذو أهمية لنوع الجنس، كذلك وجد تأثير للعمر ونوع العلاج المستخدم. وقد وجد أن مستوى جلوكوز الدم خلال فترة الصيام وقبل الإفطار للأفراد الذين لهم فترة طويلة مرضى بالسكري أنه اعلى مقارنة مع الأفراد الذين لهم فترة أقل مرضى بالسكري. ليس هناك علاقة ذو أهمية إحصائية بين كتلة وزن الجسم ومستوى جلوكوز الدم وهذا أتفق مع نتائج لباحثين آخرين، فقد وجد أن أغلبية المشاركين في التجربة كانوا يملكون وزن صحي أو وزن زائد وأغلبهم من الذكور. بينما التحليل الإحصائي RMA-regression ومعامل الارتباط لبيرسون أكد على وجود ارتباط ذو أهمية إحصائية بين كتلة وزن الجسم المقدر للفرد ومستوى جلوكوز الدم. هذه الاختلافات في مستوى جلوكوز الدم في رمضان ربما يكون ناشئ عن تغير أسلوب الحياة خلال شهر رمضان في اليمن. فقد أشارت نتائج الدراسة الحالية ودراسات سابقة لباحثين آخرين أن الصيام في رمضان سوف يكون آمن للأغلبية من مرضى السكري في حالة الاهتمام الصحي الجيد والتوعية الصحية من خلال فرق التوعية الصحية.

الكلمات المفتاحية: رمضان، أسلوب الحياة، مرضى السكري، اليمن.

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