



Alexandria University Faculty of Medicine
Alexandria Journal of Medicine

<http://www.elsevier.com/locate/ajme>



Interest of the therapeutic education in patients with type 2 diabetes observing the fast of Ramadan



Henda Jamoussi, Rym Ben Othman*, Salma Chaabouni, Amel Gamoudi, Olfa Berriche, Feten Mahjoub, Imen Sebai, Chiraz Amrouche

National Institute of Nutrition, Department A, Tunis, Tunisia

Received 15 October 2015; revised 21 December 2015; accepted 11 January 2016
Available online 28 January 2016

KEYWORDS

Therapeutic education;
Type 2 diabetes;
Ramadan;
Hypoglycemia

Abstract The fast of Ramadan is a dilemma for diabetic patients due to the complexity of the management of diabetes during this holy month and the multiple risks they face (hypoglycemia, etc.).

Objectives: Evaluate the impact of a structured protocol of therapeutic education in a sample of type 2 diabetes, who were authorized by their doctors to fast, on metabolic and anthropometric profiles.

Methods: This prospective study was conducted among 54 type 2 diabetic patients (28 men and 26 women) aged 36–65 years, recruited from National Nutrition Institute. Patients were divided into two groups: the first group ($n = 26$) received an education session one to two weeks before the month of Ramadan; the second group ($n = 28$) did not have appropriate therapeutic education except therapeutic adjustments. All our diabetic patients benefited from anthropometric measurements, determination of body composition and metabolic assessment (HbA1c, cholesterol, triglycerides, etc.) before and after the month of Ramadan.

Results: The fast was completed without complications in 25 diabetic patients educated group and 22 control patients.

We found that weight loss was greater among educated diabetic patients (-1.05 kg) than in controls (-0.58 kg), but without statistical significance. Body composition has not undergone significant changes in both diabetic groups.

Therapeutic education has led to a decline of 0.27% in HbA1c in the educated group while glycemic control in diabetic patients uneducated remained stable. Furthermore, we observed a better lipid profile in diabetic patients educated than those who did not have education.

Conclusion: Our results justify the interest of patient education centered on the month of Ramadan in all type 2 diabetic patients observing the fast of the holy month. This education should be continued during Ramadan in order to fulfill this religious rite safely.

© 2016 Alexandria University Faculty of Medicine. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

* Corresponding author at: 15 rue jbel lakkhdher, Tunis, Tunisia. Tel.: +216 52262806.
E-mail address: benothman@gmail.com (R. Ben Othman).

Peer review under responsibility of Alexandria University Faculty of Medicine.

<http://dx.doi.org/10.1016/j.ajme.2016.01.002>

2090-5068 © 2016 Alexandria University Faculty of Medicine. Production and hosting by Elsevier B.V.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Fasting during Ramadan is one of the five pillars of Islam. It is mandatory for all adult Muslims in good health. Diabetic patients who fast are exposed to several risks related on the one hand to the period of fasting and on the other to changes of rhythm and eating habits that characterize the month of Ramadan i.e. the consumption of meals rich in saturated fats and carbohydrates with high glycemic index.¹ Despite the ban on the practice of fasting by their doctors, some diabetic patients insist to fast. According to the study “EPIDIAR”², conducted in 2003 in 13 Islamic countries, 79% of type 2 diabetic patients observe the fast of Ramadan. So in order to prevent or reduce the risk of complications in diabetic patients who fast, recommendations have been drawn^{1,3,4} and it shows that therapeutic education focused on the month of Ramadan, including dietary adjustments and while insisting on glycemic self-monitoring is crucial. These observations led to carry out this study, whose main objective is to assess the effectiveness of a structured therapeutic education protocol before the month of Ramadan with a sample of type 2 diabetic patients, identified as low or medium risk of complications, which were allowed to fast.

2. Methods

This is a prospective study which involved 54 type 2 diabetic patients, recruited two weeks before Ramadan at the service “A” of the Tunis National Institute of Nutrition, which have been authorized by their doctors to fast the month of Ramadan. In 2013, this month took place from July 9 to August 7. All patients were treated with ADO (oral antidiabetics) and had an HbA1c \leq 9% (glycosylated hemoglobin). Patients who have experienced severe hypoglycemia in the three months preceding the month of Ramadan or with macrovascular complications including ischemic heart disease, renal impairment and pregnant and lactating women were excluded from the

study. The recruited patients were divided into two groups (Fig. 1).

The objective of this education was to enable patients to acquire knowledge and self-care skills to better manage their disease during the month of Ramadan, namely:

- Ensure a balanced food intake in both qualitative and quantitative terms (limiting fatty and fried foods and products with high glycemic index).
- Prevent dehydration by ensuring adequate fluid intake during periods of non-fasting.
- Recognize the clinical manifestations of hypoglycemia, hyperglycemia and learn what to do when they occurred.
- Ensure proper therapeutic compliance by following adaptations of treatment established by the physician.

Emphasize the importance of SMBG, particularly during the period of fasting, for screening hypoglycemia (< 0.7 g/l) and hyperglycemia (> 3 g/l) which are indications to interrupt fasting.

All patients underwent a search of degenerative complications and anthropometric measures including the calculation of body mass index (BMI) and the measure of fat mass by impedance and a complete lipid and glycemic assessment. These measurements were performed fifteen days to a month before Ramadan (t1) and were done one or two weeks after the end of the holy month (t2). Statistical analyzes were performed using EPI INFO software using the chi-square test (χ^2) for the comparison of qualitative variables. As for the comparison of means, it is based on the Student’s *t*-test or Kruskal–Wallis if the conditions are required. A difference is considered statistically significant if the *p* value is less than 0.05.

3. Results

The general characteristics of the population are summarized in Table 1, and both groups were fair for the different parameters with a *p* value that was not significant.

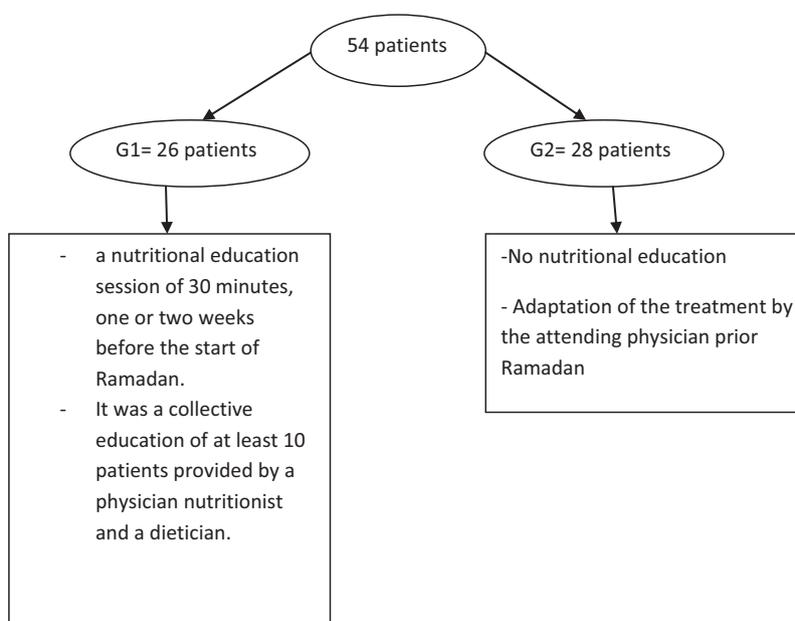


Figure 1 Design of the study.

Table 1 Sociodemographic, clinical and biological characteristics of the patients.

| Characteristics | | Educated group G1 (n = 26) | Non educated group G2 (n = 28) |
|--------------------------------------------|----------------------------|----------------------------|--------------------------------|
| Age (years) | | 53 ± 5.3 | 55 ± 8.6 |
| Sex (n/%) | Men | 11 (42.3%) | 17 (60.71%) |
| | Women | 15 (57.7%) | 11 (39.29%) |
| Physical activity (n/%) | Sedentary | 15 (57.69%) | 16 (57.14%) |
| | Moderate | 8 (30.76%) | 10 (35.71%) |
| | Intensive | 3 (11.55%) | 2 (7.15%) |
| IMC (n(%)) | IMC < 25 kg/m ² | 2 (7.7%) | 2 (7.14%) |
| | IMC ≥ 25 kg/m ² | 24 (92.3%) | 26 (92.86%) |
| Diabetes duration (years) | | 4.27 ± 4 | 6 ± 3.7 |
| HbA1c (Nbre(%)) | (< 7%) | 8 (31%) | 7 (25%) |
| | (≥ 7%) | 18 (69%) | 21 (75%) |
| Metformin | | 12 (46%) | 13 (46%) |
| Sulfonylureas | | 3 (12%) | 2 (7%) |
| Metformin + sulfonylureas | | 6 (23%) | 10 (36%) |
| Metformin + DPP IV inhibitors ^a | | 3 (12%) | 0 (0%) |
| Metformin + alpha-glucosidase inhibitor | | 2 (7%) | 3 (11%) |

^a DPP IV: Dipeptidyl peptidase-4.

Table 2 Evolution of clinical and biological parameters before and after Ramadan.

| | | Educated group G1 (n = 26) | | | Non educated group G2 (n = 28) | | | p |
|----------------------------|----------|----------------------------|---------------|--------|--------------------------------|---------------|--------|-------|
| | | Before Ramadan | After Ramadan | Δ | Before Ramadan | After Ramadan | Δ | |
| Weight (kg) | | 83.5 ± 12 | 82.4 ± 13 | -1.05 | 82 ± 14 | 81.1 ± 14 | -0.58 | NS |
| BMI (kg/m ²) | < 25 | 67.7 ± 5.4 | 68.3 ± 8.4 | +0.55 | 54 | 53.4 | -0.6 | NS |
| | 25–29.99 | 77.5 ± 9.5 | 76 ± 10 | -1.24 | 73.99 ± 6.4 | 73.8 ± 6.6 | -0.2 | 0.004 |
| | > 30 | 85.88 ± 9.9 | 84.82 ± 10.2 | -1.05 | 90.39 ± 13.4 | 89.25 ± 13.3 | -0.95 | NS |
| Fatty mass (%) | | 32.5 ± 11 | 32.2 ± 11 | -0.386 | 29 ± 8 | 28.6 ± 8 | -0.5 | NS |
| HbA1c (%) | | 7.47 ± 0.92 | 7.23 ± 1.0 | -0.27 | 7.66 ± 1.15 | 7.66 ± 1.0 | -0.004 | NS |
| Triglycerides (mmol/l) | | 1.38 ± 0.8 | 1.32 ± 0.54 | -0.05 | 1.42 ± 0.58 | 1.43 ± 0.6 | +0.01 | NS |
| Cholesterol total (mmol/l) | | 4.56 ± 1.09 | 4.43 ± 0.9 | -0.13 | 4.4 ± 1.07 | 4.28 ± 0.23 | -0.12 | NS |
| LDL-C (g/l) | | 1.14 ± 0.32 | 1.02 ± 0.35 | -0.144 | 1.16 ± 0.4 | 1.07 ± 0.43 | -0.05 | NS |
| HDL-C (mmol/l) | M | 1.01 ± 0.18 | 1.02 ± 0.18 | +0.07 | 0.98 ± 0.17 | 1. ± 0.2 | +0.02 | NS |
| | F | 1.12 ± 0.17 | 1.24 ± 0.25 | +0.11 | 1.03 ± 0.24 | 1.08 ± 0.22 | +0.04 | NS |

M: men

F: females

Δ = After Ramadan – before Ramadan

The impact of patient education on different parameters before and after Ramadan is summarized in [Table 2](#).

During the month of Ramadan, the average blood glucose levels measured at 11 am were 1.33 ± 0.2 g/l in the educated group and 1.41 ± 0.4 g/l in the control group. The difference was not statistically significant and the mean capillary blood glucose measured two hours after breaking the fast (iftar) in educated diabetics (1.9 ± 0.5 g/l) was comparable to that of non-educated group (2 ± 0.6 g/l).

Among our patients, 47 subjects had fasted the whole month of Ramadan (29 days). Almost all educated diabetics (96%) fasted all the holy month, while 22% of non educated diabetics had interrupted their fast. Educated diabetics fasted for a longer period (28.5 days) than non-educated patients

(25.5 days). One patient from each group presented hypoglycemia requiring breaking the fast, but no severe hypoglycemia was reported. One diabetic enjoyed a therapeutic education and two uneducated patients had to break their fast for other reasons such as fatigue and heat. The fasting-related complications occurring are summarized in [Table 3](#). The frequency of minor hypoglycemia decreased before and during Ramadan in both groups from 15% to 4% for G1 and 18 to 11% for G2.

4. Discussion

We have not noted an efficiency of our education program on weight, BMI and fat mass which could be explained by the lack

Table 3 Different complications made during Ramadan.

| | Educated group G1 (n = 26) | Non educated group G2 (n = 28) | Total |
|----------------------------------|-------------------------------|-----------------------------------|-------|
| Minor hypoglycemia (≥ 1 episode) | 2 | 4 | 6 |
| Severe hypoglycemia | 0 | 0 | 0 |
| Hyperglycemia | 0 | 1 | 1 |
| Dehydration | 0 | 0 | 0 |
| Ischemic event | 0 | 0 | 0 |
| Keto-acidosis | 0 | 0 | 0 |
| Total | 2 | 5 | 7 |

of monitoring during the month of Ramadan, changing both quantity and quality of food as well as low level of physical activity. The study READ (Ramadan Education and Awareness in Diabetes)⁵ which was conducted in England in 2010 with 111 type 2 diabetics treated with ADO showed an average weight loss of 0.7 kg in patients group that received educational support vs 0.6 kg in the control group. The study of Smaoui⁶ and Mustafa⁷ showed a weight gain. The overweight type 2 diabetic patients often tend, as in the general population, to loose a little weight during Ramadan. Indeed, the study of northern Algeria⁸ showed a statistically significant weight loss in diabetic obese patients during Ramadan. The authors of this study noted a resumption of weight a month after Ramadan. A Jordanian study⁹ showed an average weight loss of 1.57 kg between the beginning and the end of Ramadan. This weight loss was only significant in overweight patients. In a recent study conducted during Ramadan 2014, the authors found a greater improvement of weight after educational program.¹⁰

The decrease in HbA1C may be secondary to the decrease in the number of daily meals, which is accompanied by a reduction in hyperglycemic peaks. In the literature, the results are controversial as to the change in HbA1c. Indeed, a significant decrease was noted by some authors^{6-8,10,11} ranging from 0.11% to 1.94%, a stability of HbA1c has been noted by others¹²⁻¹⁴ and some have even noted a deterioration in glycaemic control.^{15,16} In diabetic patients, blood glucose variations depend on the quantity and quality of diet, possible excessive consumption during Iftar, the drug compliance and changes in physical activity.

It appears that the therapeutic education centered on Ramadan has a beneficial effect on reducing the risk of hypoglycemia. Our consistent results with the results of the study READ⁵ showed a significant decrease in the number of hypoglycemic episodes from 9 to 5 in the group that received education. The epidemiological study, "Epidemiology of Diabetes and Ramadan" (EPIDIAR), gathering the data from nearly 12,000 patients with diabetes during Ramadan in 13 different countries², found an increase in the relative risk of severe hypoglycemia of 7.5 in type 2 diabetics. It should be noted that this study did not take into account the severe hypoglycemia requiring hospitalization and excluded those that required the intervention of a third party without hospitalization as well as nonsevere hypoglycemia. The incidence of these is probably underestimated. In type 2 diabetic patients, increasing the frequency of hypoglycemia during that month

is not systematically recovered. The hypoglycemia could be favored by a bad adaptation of hypoglycemic therapy and the jump of meal sehour (the last meal before the beginning of fast and which often occurs early in the morning). The observational study of Uysal et al.¹⁶ found an increase in symptomatic hypoglycemia, while other studies^{17,18} did not find an increase of hypoglycemia in patients treated with oral antidiabetic agents or insulin. This divergence of results in the risk of hypoglycemia, can be explained by the unfolding of Ramadan in different seasons with a variable duration of the period of daytime fasting. Thus, the risk of hypoglycemia can vary from year to year. In addition, hypoglycemia is more common in diabetics treated with drugs with high hypoglycemic power. Finally, the small number of studies diminishes the power of statistical tests.

As regards the risk of hyperglycemia, EPIDIAR study² showed a 5-fold increase in the incidence of episodes of severe hyperglycemia (requiring hospitalization) in patients with type 2 diabetes and a factor of 3 incidence of hyperglycemia episodes with or without ketoacidosis in type 1 diabetes requiring hospitalization. The risk of hyperglycemia is attributed to the reduction of excessive doses of antihyperglycemic drugs (in order to prevent hypoglycemia) and excessive consumption of foods with high glycaemic index. As for hypoglycemia, the incidence of non-severe hyperglycemia was not assessed in the study EPIDIAR. McEwen¹⁰ found severe hypoglycemic events in the control group who did not receive an individualized education.

It appears from all these results that the practice of fasting of Ramadan by many diabetic patients is not without risk of complications (hypoglycemia, hyperglycemia, etc.). This finding justifies the imperative of therapeutic management of diabetes in Ramadan adapted to allow diabetic patients to fast with the lowest risk of complications.

Changes in lipid parameters were marked by a stability of triglyceride levels in both groups of patients. In the literature, study results are somewhat discordant not to conclude formally the effect of fasting on lipid parameters. Some authors showed improvement to an antiatherogenic profile.^{7,16} By contrast, some authors found an altered lipid profile in people with type 2 diabetes. Indeed, the study of Khatib and Shafagoj⁹, performed in 44 Jordanians, reported a decrease in triglycerides during Ramadan with a slight increase in LDL cholesterol and total cholesterol. The study of Khaled et al.⁸ in 80 Algerian women with type 2 diabetes and obesity showed a significant increase of approximately 14% of total cholesterol, 17% of triglycerides and 22% of LDL and a decrease in HDL-cholesterol. A Tunisian study¹⁵ showed no significant differences between total cholesterol and triglycerides before and at the end of Ramadan, while the rate of LDL increased and the rate of HDL declined. These changes disappeared 20 days after the end of fasting. These alterations were attributed to changes in eating habits during the period of Ramadan, and more specifically, to the consumption of meals high in saturated fats.

5. Conclusion

The month of Ramadan is a dilemma for diabetics, who value fast, while avoiding the risk of complications (severe hypoglycemia, hyperglycemia, ketoacidosis, etc.) they may face.

These findings justify the interest of a structured therapeutic education program adapted to the month of Ramadan which is characterized by profound changes in lifestyle and eating habits.

The observation of this holy month of fasting is a real challenge for the diabetic himself and his doctor. Therapeutic education should therefore have an important place in the management of recommendations of diabetes during Ramadan in order to complete fasting safely. It should be strengthened among diabetic who choose to fast despite the medical and religious exemptions. Ramadan is a good time to acquire knowledge on diabetes management as well as during this month throughout the year.

Conflict of interest

The authors declare that there are no conflict of interests.

References

- Al-Arouj M, Assaad-Khalil S, Buse J, Fahdil I, Fahmy M, Hafez S, et al. Recommendations for management of diabetes during Ramadan: update 2010. *Diabetes Care* 2010;**33**(8):1895–902 Aug.
- Salti I, Bénard E, Detournay B, Bianchi-Biscay M, Le Brigand C, Voinet C, et al. A population-based study of diabetes and its characteristics during the fasting month of Ramadan in 13 countries: results of the epidemiology of diabetes and Ramadan 1422/2001 (EPIDIAR) study. *Diabetes Care* 2004;**27**(10):2306–11 Oct.
- Hui E, Bravis V, Hassanein M, Hanif W, Malik R, Chowdhury TA, et al. Management of people with diabetes wanting to fast during Ramadan. *BMJ* 2010;**340**:c3053.
- International meeting on diabetes and Ramadan recommendations: edition of the Hassan II Foundation for Scientific and Medical Research on Ramadan 1995.
- Bravis V, Hui E, Salih S, Mehar S, Hassanein M, Devendra D. Ramadan education and awareness in diabetes (READ) programme for Muslims with type 2 diabetes who fast during Ramadan. *Diabet Med J Br Diabet Assoc* 2010;**27**(3):327–31 Mar.
- Smaoui N, Böhme P, Collin JF, et al. Diabète et Ramadan: représentations et pratiques de santé des patients et des soignants et intérêts de l'éducation thérapeutique du patient. *Diab Metab* 2012;**38**(2):A47–8.
- Mustafa H, Hashim T, Beshyah Salem A, et al. Targeted diabetes education and glycemic control during Ramadan fasting: an exploratory study. *Ibnosina J Med Biomed Sci* 2012;**4**(6):242–8.
- Khaled BM, Belbraouet S. Effect of Ramadan fasting on anthropometric parameters and food consumption in 276 type 2 diabetic obese women. *Int J Diab Dev Countries* 2009;**29**(2):62–8.
- Khatib FA, Shafagoj YA. Metabolic alterations as a result of Ramadan fasting in non-insulin-dependent diabetes mellitus patients in relation to food intake. *Saudi Med J* 2004;**25**(12):1858–63.
- McEwen LN, Ibrahim M, Ali NM, Assaad-Khalil SH, Tantawi G, Nasr G, et al. Impact of an individualized type 2 diabetes education program on clinical outcomes during Ramadan. *BMJ Open Diab Res Care* 2015;**3**(1):e000111.
- Maislos M, Abou-Rabiah Y, Zuili I. Improved diabetes control after prolonged fasting the Ramadan model. *Pract Diab Int* 2001;**18**(5):149–51.
- Belkhadir J, el Ghomari H, Klöcker N, Mikou A, Nasciri M, Sabri M. Muslims with non-insulin dependent diabetes fasting during Ramadan: treatment with glibenclamide. *BMJ* 1993;**307**(6899):292–5.
- Bouguerra R, Belkadh A, Jabrane J, Hamzaoui J, Maâtki C, Ben Rayana MC, et al. Metabolic effects of the month of Ramadan fasting on type 2 diabetes. *East Mediterr Health J Rev Santé Méditerranée Orient Al-Majallah Al-Şiḥḥiyah Li-Sharq Al-Mutawassit* 2003;**9**(5–6):1099–108.
- Laajam MA. Ramadan fasting and non-insulin-dependent diabetes: effect on metabolic control. *East Afr Med J* 1990;**67**(10):732–6.
- Bouguerra R, Jabrane J, Maâtki C, Ben Salem L, Hamzaoui J, El Kadhi A, et al. Ramadan fasting in type 2 diabetes mellitus. *Ann Endocrinol* 2006;**67**(1):54–9.
- Uysal AR, Erdoğan MF, Sahin G, Kamel N, Erdoğan G. Clinical and metabolic effects of fasting in 41 type 2 diabetic patients during Ramadan. *Diab Care* 1998;**21**(11):2033–4.
- Bakiner O, Ertorer ME, Bozkirli E, Tutuncu NB, Demirag NG. Repaglinide plus single-dose insulin glargine: a safe regimen for low-risk type 2 diabetic patients who insist on fasting in Ramadan. *Acta Diabetol* 2009;**46**(1):63–5.
- Cesur M, Corapcioglu D, Gursoy A, Gonen S, Ozduman M, Emral R, et al. A comparison of glycemic effects of glimepiride, repaglinide, and insulin glargine in type 2 diabetes mellitus during Ramadan fasting. *Diab Res Clin Pract* 2007;**75**(2):141–7.