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Impact of Ramadan Fasting on Energy Intake and Anthropometry of Type 2 Diabetics-Study in Two Regions of the Central Highlands and Southeastern Algeria

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ABSTRACT

Introduction: During the month of Ramadan, muslims change their lifestyle. The objective of this study is to evaluate the effect of Ramadan fasting on the energy intake and anthropometry of type 2 diabetics.

Methods: Epidemiological study by questionnaire were collected before (T0), during (T1) and after (T3) Ramadan 2013. The data were collected during medical consultations in sanitary establishments in two regions of the central highlands (Boussaâda) and the south-east of Algeria (Djamaâ). The survey card concerned a food recording and anthropometry repeated during the 3 time periods mentioned before.

Results: The study concerned 476 diabetics (255 women, 221 men) with the mean age of 54.9±4.7 years old. 66.4% of diabetics of Boussaâda and 61.8% of Djamaâ followed nutritional education sessions preparing for fasting ($p>0.05$). The number of fasting days during the month of Ramadan is 24.0±1.7days. By comparing both of the regions, no significant difference was observed in the energy intake distribution and in macronutriments of the diabetics ($p>0.05$). By comparing the 3 periods, the diabetics of Boussaâda had an energy intake significantly increased at T1 ($p=0.000$). In Djamaâ, the energy intake decreased from T0 to T2 ($p=0.000$). The energy distribution of macronutrients remained stable ($p>0.05$) between the three periods. Body mass index, waist circumference and the waist-to-hip ratio were significantly decreased from T0 to T2 ($p<0.05$).

Conclusion: Ramadan had an influence on the energy intake and anthropometry of diabetics. Food consumed during the fast-breaking meal is characterized by its richness in carbohydrates and lipids. Nutritional education sessions provide the diabetic patients deciding to fast with a chance for properly managing their condition.

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Introduction

Ramadan fasting is one of the five pillars of Islam. It is a holy month for Muslims, during which they have to fast every day from sunrise to sunset. This religious practice, however, exempts diabetics from this obligation, because fasting is not without consequence on their health. In order to show solidarity with their families, or out of habit or fear of being excluded from society; many diabetic people prefer to fast at all costs, as has been demonstrated in numerous studies (1).

During the month of Ramadan, food intake is exclusively nocturnal and characterized by a copious fast-breaking meal and a light meal at dawn based on slow sugars (2). The fast of Ramadan could even allow to control food

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intake (3).

These modifications are also accompanied with changes in the style of life and with disturbances in the sleep cycle. The diabetic subject wishing to fast must be followed and educated in advance in an adequate way in order to fast safely (2). Several studies were conducted on food aspect of diabetics fasting in the month of Ramadan, but few studies have been investigated the anthropometry element. In Algeria, the few studies carried out relate particularly to biochemical parameters. The objective of this study is to evaluate the impact of fasting Ramadan on the energy intake and anthropometry of type 2 diabetics Muslim population from two regions of the central highlands and southeastern Algeria and to make a comparison between the two.

Material and methods

1. Place of the survey

An analytical and explanatory epidemiological questionnaire survey was carried out in a public health institution located in Boussaâda (city of M'sila) in the central highlands and in a public hospital in Djamaâ (city of El Oued) in the southeastern Algeria.

The protocol of the study was proposed to the physicians and the administrative direction of both establishments and it was consequently approved.

2. Recruitment of subjects

The recruitment of the subjects depended on their consent to participate in the study. The recruitment points were the waiting rooms. The criteria of inclusion in this study were: all diabetics type 2 patients, aged between 18 to 74 years old, treated with diet and / or oral antidiabetic, expressing the desire to fast the month of Ramadan. The exclusion criteria consisted of patients with diabetes of less than 5 years and treated by insulin.

3. Period of the survey

The subjects of both regions were followed during three periods:

Before Ramadan (T0): between 1st and 29th June, 2013;

During the month of Ramadan (T1): between 10th July and 7th August, 2013;

After Ramadan (T2): between 2nd and 30th September, 2013 (one month after Ramadan).

4. Survey questionnaire

The questionnaire composed of three topics: general information, a weekly food and anthropometric measurements.

General information

Questions related to gender, date of birth, duration of diabetes, family history and complications associated with diabetes.

Food record

Food and drink recordings over three consecutive days were carried out. The quantities of food were converted into nutrient quantities through food composition tables (4, 5).

Anthropometric measurements

They concerned the weight and the waist for the calculation of the body mass index (BMI) to estimate the weight state. Waist circumference (WC) and hip circumference were also taken. The waist-hip ratio (WHR) and WC alone are a reflection of the anatomical distribution of fat mass and allow evaluating the metabolic and cardiovascular risk (even in the absence of obesity). Anthropometric measurements were carried out according to the international recommendations (6).

-Food recording and anthropometry were repeated during T1, T2 and T3.

-The number of fasting days was also noted

5. Statistical analysis

The R software for Windows (version 3.2.4) was used for data analyses. Quantitative variables were presented as mean and standard deviation. Qualitative variables were presented as numbers and percentage.

The Student test was used for the comparison between two means, the Chi2 test for the comparison between two percentages and the analysis of variance for the comparison between several means. A p-Value less than 0.05 was considered statistically significant.

Results

1. Characteristics of the subjects

The general characteristics of the diabetics of both regions in the period T0 are presented in Table 1. The study concerned 235 diabetics in

Table 1. General characteristics of diabetic patients in both regions

Variables	Region of Boussaâda (N=235)	Region of Djamaâ (N=241)
	Mean ± SD [Min-Max]	Mean ± SD [Min-Max]
Age (years)	55.1 ± 4.8 [52.0-59.0]	54.7 ± 4.7 [50.0-61.0]
Duration of diabetes (years)	15.3 ± 3.5 [11.0-20.0]	15.1 ± 2.5 [10.0-18.0]
Family history of diabetes (%)	189 (80.4%)	192 (79.7%)
Nutritional education sessions	156 (66.4%)	149 (61.8%)
Number of day fasting (d)	24.3 ± 1.9* [20.0-29.0]	23.8 ± 1.6* [17.0-25.0]

N: effective; m: Mean; SD: Standard Deviation; Min: Minimum; Max: Maximum; *significant difference (*P<0.05*)

Boussaâda (121 women, 114 men) and 241 diabetics in Djamaâ (134 women, 107 men).

There was no significant difference between the two diabetes groups in terms of age, duration of diabetes, and family history. More than half of the diabetics in Boussaâda (66.4%) and Djamaâ (61.8%) attended nutritional education sessions to prepare for Ramadan fasting. No significant difference was observed in the follow-up between the two groups of subjects. During the month of Ramadan the diabetics from Boussaâda fasted more days than those of Djamaâ (p=0.002).

2. Energy intake during the three periods

When comparing both regions and during the three periods of the survey (T0, T1, T2), there was no significant difference related to the energy intake and macronutrient distribution (p>0.05). Only one significant difference was noted at T0, concerning energy intake for diabetics in Djamaâ (Table 2).

Comparing the three survey periods, Boussaâda' diabetics energy intake during Ramadan is the highest comparing to the other periods outside Ramadan (p=0.000), during which it increased by 137.1 Kcal/day then it decreased by 140.8 Kcal/day, while the distribution of major nutrients remained the same (p>0.05).

For Djamâa, the highest energy intake of diabetics is in T0 (p=0.000), after which it decreased by 140.6 Kcal/day in T1 and 177.3 Kcal/day in T2. The distribution of major nutrients also remained stable (p>0.05).

3. Anthropometry of diabetics during the three periods

Whatever the survey period is, Djamaâ' diabetics BMI is higher than that of Boussaâda diabetics (p<0.05). During and after Ramadan, diabetics of Boussaâda had the most important WC (p<0.05). For the WHR, a small but significant difference was observed during the month of Ramadan (p=0.042) between the two diabetic groups (Table 3).

Comparing the three survey periods in both

Table 2. Dietary energy intake and macronutrient in both regions before, during and after Ramadan

	Dietary energy intake and macronutrients	Region of Boussaâda (N=235)	Region of Djamaâ (N=241)	P-value
		Mean ± SD [Min-Max]	Mean ± SD [Min-Max]	
Before Ramadan	Energy intake (kcal/d)	1652.0 ± 389.2 [709.7-1987.0]	1896.3 ± 456.7 [913.4-1981.9]	0.000*
	Carbohydrates (%)	61.2	60.1	0.804
	Fat (%)	29.2	30.7	0.749
	Protein (%)	9.6	9.2	0.806
During Ramadan	Energy intake (kcal/d)	1789.1 ± 145.3 [989.4-2417.3]	1755.7 ± 475.6 [1415.3-2145.6]	0.303
	Carbohydrates (%)	56.4	59.0	0.608
	Fat (%)	30.2	29.0	0.780
	Protein (%)	13.4	12.0	0.703
After Ramadan	Energy intake (kcal/d)	1511.2 ± 532.1 [789.2-1995.3]	1578.4 ± 566.7 [948.6-2015.4]	0.183
	Carbohydrates (%)	54.8	56.3	0.735
	Fat (%)	31.7	31.8	0.914
	Protein (%)	13.5	11.9	0.605
P1-value		0.000*	0.000*	
P2-value		0.349	0.698	
P3-value		0.880	0.785	
P4-value		0.380	0.502	

N: effective; m: Mean; SD : Standard Deviation ; Min : Minimum ; Max : Maximum ; P1-value : comparison between energy intake in the three periods ; P2-value : comparison between carbohydrates in the three periods ; P3-value : comparison between fat in the three periods ; P4-value : comparison between protein in the three periods ; * significant difference (P<0.05).

Table 3. Anthropometry of diabetic patients in both regions before, during and after Ramadan

	Parameters	Region of Boussaâda (N=235)	Region of Djamaâ (N=241)	P-value
		Mean ± SD [Min-Max]	Mean ± SD [Min-Max]	
Before Ramadan	BMI (kg/m²)	28.7 ± 2.7 [23.1-32.2]	29.5 ± 1.9 [23.7-34.1]	0.000*
	WC (cm)	100.7 ± 1.5 [89.3-101.8]	100.5 ± 1.4 [95.7-105.0]	0.133
	WHR	1.1 ± 0.4 [0.4-1.4]	1.1 ± 0.5 [0.5-1.2]	0.994
During Ramadan	BMI (kg/m²)	26.4 ± 2.5 [22.3-31.6]	28.0 ± 1.7 [23.2-33.9]	0.000*
	WC (cm)	99.5 ± 1.3 [88.1-102.4]	98.7 ± 1.9 [93.4-102.1]	0.000*
	WHR	1.0 ± 0.7 [0.7-1.3]	1.1 ± 0.3 [0.5-1.2]	0.042*
After Ramadan	BMI (kg/m²)	26.7 ± 1.9 [23.8-30.2]	27.3 ± 1.2 [24.0-31.7]	0.000*
	WC (cm)	98.6 ± 1.5 [89.3-101.1]	98.2 ± 1.4 [94.5-101.0]	0.003*
	WHR	1.0 ± 0.5 [0.8-1.4]	1.0 ± 0.6 [0.8-1.5]	0.778
P1-value		0.000*	0.000*	
P2-value		0.000*	0.000*	
P3-value		0.074	0.032*	

N: effective; m: Mean; SD : Standard Deviation ; Min : Minimum ; Max : Maximum ; BMI: Body Mass Index ; WC, waist circumference ; WHR, waist-to-hip ratio ; P1-value : comparison between BMI in the three periods ; P2-value : comparison between WC in the three periods ; P3-value : comparison between WHR in the three periods ;* significant difference (P<0.05).

regions, we noticed that at T0, BMI and perimeters (WC and WHR) were higher than the two other periods (p<0.05), except in the case of WHR in Boussaâda (p=0.074).

Discussion

The contribution of studies on the effect of fasting Ramadan on food consumption and anthropometry of Muslims' diabetics remains insufficient. The style of life changes from one country to another and even from a region to another in the same country. The period of fasting of Ramadan is accompanied by changes in food and lifestyle to which the diabetic patients wishing to fast must also adapt themselves. The choice of survey in these two regions of Algeria was a contribution to a multicentric study, in order to compare the different cultures and traditions and their impact on the effect of fasting.

The type 2 diabetes mellitus (T2DM) affects both sexes with a discreet male majority and concerns especially individuals of more than 40 years old. It is, however, in progress to the subjects from 30 to 40 years old and even emerging as a frequent complication of obesity (7).

The diabetics who choose to fast during Ramadan must follow nutritional education sessions before this holy month to reduce the risk of complications. More than half of the diabetic subjects of the two regions followed these sessions, without difference (p=0.370). The education of the patients and their family on the contraindications of fasting, the risk of acute complications, the preventional means and treatment are essential (8). The diabetics who fast and participate in an educational program and there by raise their awareness to the diabetes centered on the Ramadan were more likely to make healthy lifestyle choices and minimize the risk of hypoglycemic events and a weight gain (9). In a study carried out on 125 subjects with T2DM aged of 51.0±7.0 years old which were followed during the Ramadan of 2011 in the region of Sidi Bel Abbes (West of Algeria), the researchers found that 70 subjects benefited from nutritional educational sessions and glycemic self-monitoring sessions were organized before the Ramadan and among them 96 % of diabetics were able to fast more than 21 days with a hypoglycemia frequency of 9 times which is considered as low compared to the remaining diabetics (10). The participants in this study were able to fast more than 15 days during the month of Ramadan (minimum 17 days, maximum 29 days). The exact date of Ramadan rotates each year for about 10 days. During summer, the days are longer (fasting more than 15 hours) and the temperature is scorching which can sometime reach to 50°C, specially in the interior regions such M'sila and El Oued.

Generally, regardless of the survey period, the energy intake of diabetics in the two regions is lower than the nutritional recommendation intake of Martin (11), which is 2400kcal/day for men and 1900kcal/day for women (healthy subjects). Considering the fact that that patients with T2DM might have an overweight (BMI≥25,00 kg/m2), the energy intake can be adjusted on average to 15% of the recommended contribution and therefore can cover their energy

intakes.

The distribution of carbohydrates, lipids and proteins against the recommended values is respectively 50-55%, 25-30% and of 11-15% (11).

The diabetic diet of the two regions was hyper-carbohydrated, providing an important caloric excess especially during T0. Moreover, the distribution of the carbohydrates depended on proteins during T0 for the diabetics of both regions. The attendance rate in the nutritional educational sessions (over 60%) and following the proposed program can encourage the diabetics who fast to reduce their consumption of carbohydrates. The carbohydrate intake should be reduced to ensure the best food balance and especially the best sensitivity to the insulin in the body (12).

An excess of lipid contribution is largely stored in the adipose tissue resulting, in long term, in an increased fat mass (13). It is important to be wary of hidden fats. Indeed, lipid intake is not just fats of seasoning, but includes those contained in other foods.

Regarding protein intake, it can increase up to 20% during caloric restrictions, it is essential for the maintenance of a good integrity of the organism. Proteins associated with carbohydrate foods would reduce their hyperglycemic effect, and it is recommended to maintain a satisfactory protein intake to prevent muscle wasting and to preserve normal physical activity (14).

By comparing the three periods of survey, only the energy intake showed a significant increase during T1 for the diabetics of Boussaâda. On the other hand, for the diabetics of Djamaâ, energy intake decreased from T0 to T2 ($p = 0.000$). The macronutrient distribution remained unchanged. However, the part of carbohydrates was high during T0 and T1. According to the results of a tunisian study (15), the energy intake during the month of Ramadan declined substantially from 2084 ± 515 kcal/day at T0 to 1981 ± 464 kcal/day at T1 but this modification is not statistically significant. Other studies found an increase in daily energy intake (16). These contradictory results can be explained by a different duration of diurnal fasting from one year to the next and by different dietary habits from one country to another.

During the breaking of the fast (*F'tour*), the traditional dishes proposed are very energetic. The presence of meat (and thus of protein intake) is almost systematic during the whole month of Ramadan. According to a study carried out in Morocco, the consumption of lipids and proteins did not change in the majority of patients during the month of Ramadan (17). A study in Oman has investigated the dietary changes of 334 patients with T2DM during the month of Ramadan. The authors found that 67.4% of the patients had not changed their dietary intake, in 16.2% of the study group it had increased it, and in 16.5% of them the dietary intake had decreased. However the majority of them (50.9%) said that they consumed less carbohydrate during fasting (18). According to a Tunisian study concerning a healthy population, the carbohydrate intake during Ramadan is decreased by 8% (19). These contradictions in the results showed a decrease or an increase according to the geographical zones and therefore according to the local culinary habits (20).

Concerning the anthropometry, the diabetics of the two regions presented a BMI of ≥25.00kg/m^2 characterizing this population as overweight (BMI≥25.00 kg/m^2). The overweight and the weight gain are predictive of T2DM (26). In addition, the diabetics have a WC mean greater than 100 cm which highlights a the risk for cardiovascular diseases. Individuals were considered as obese if their WC≥94 cm and a WC≥80 cm for man and woman, respectively. The risk is increased when the fat mass accumulates at the upper part of the body and in particular at the abdominal level (21).

The WHR allows to determine the morphotype of android and gynoid obesity, if it exceeds 0,95 in man and 0,80 in woman (21). The results of the present study showed a WHR around 1.0.

By comparing the anthropometric measurements during the three survey periods, we noticed a slight decrease of values at T0 to T2. In a study carried out on 240 healthy subjects aged 18-70 years old in Mashhad, they noted a significant reduction in the BMI and the WC between T0 and T2 (22). The results of the study on the effect of Ramadan fasting on the anthropometry of diabetics are contradictory. In a study in Tunisia, the fasting had no significant influence on weight and BMI. These constants remained stable during fasting and three weeks after the end of the month of Ramadan (15). This decrease of the in both BMI and weight could be explained, on the one hand, by the increase in the participants' physical activity,

and by the specific evening prayers during the month of Ramadan (Tarawih) or by the preparation of the meal of *F'tour* and the meal before dawn (*S'hour*), and by the change of the lifestyle with a modification of the diet and sleep cycle (since residents of the study area spend more hours indoors during summer due to high temperature).

Conclusion

Ramadan fasting had an effect on diet and anthropometry of diabetics population. The consumption of sugary and fatty products must be reduced for diabetic patients during the month of Ramadan. A better distribution of the nocturnal energy ratio will maintain an energy balance between intakes (food) and expenditure (physical activity).

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Conflict of interest

The authors declare that they have no conflicts of interest in relation to this article.

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