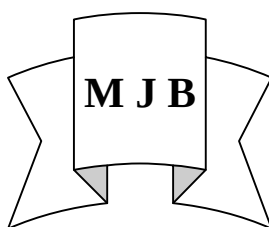


Blood glucose and lipid profile levels in Ramadan

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Abstract

The sequence of alterations in the concentrations of blood glucose and the compositions of different serum lipids following fasting in Ramadan is not known

We therefore monitored the concentrations of total cholesterol (TC), triglyceride (TG), very low density lipoprotein cholesterol (VLDL-C), low density lipoprotein-cholesterol (LDL-C) and high density lipoprotein-cholesterol (HDL-C) as well as blood glucose.

Fasting blood samples were taken from 50 healthy volunteers at the beginning, during Ramadan and then 30 days following Ramadan. Blood analysis was determined for glucose and lipid profile.

Results showed non significant increase in the levels of TC, TG, and LDL-C during the first 9 days of fasting in Ramadan. This was followed by a decrease in their concentration after 18 days of fast, which tend to rise progressively by the end of Ramadan reaching their initial values 30 days later. No changes were found in VLDL-C through out the study. HDL-C concentration showed a gradual and highly significant decrease ($P < 0.001$) in its value from start to the end of Ramadan reaching near initial values 30 days following Ramadan.

Blood glucose level remains unchanged during the 18 days of fasting in Ramadan, but later showed a progressive decrease towards the end of Ramadan that remains even after 30 days.

These changes although unlikely would affect normal people, may be significant in hyperlipidemic patients. Physicians working in Muslim countries should be aware that fasting in Ramadan might influence some laboratory findings.

الخلاصة

التعاقب بتغير تراكيز سكر الدم والمكونات المختلفة لدهون الدم للأشخاص الصائمين في رمضان ليس واضحاً الى حد ما. ولهذا قمنا بدراسة (LDL-C)، قليلة الكثافة (VLDL)، البروتينات الدهنية واطنة الكثافة (Tg)، الكليسيريدات الثلاثية TC تراكيز مستويات الكوليسترول الكلي) وكذلك سكر الدم عند الصائمين خلال شهر رمضان (HDL-C) وعالية الكثافة. سحبت 50 عينة من دم الأشخاص الصائمين في بداية وخلال شهر رمضان وبعد شهر من انتهاء رمضان لدراسة التغير بتراكيز السكر ونمط الدهون. بمستويات الكوليسترول الكلي والكليسيريدات الثلاثية والبروتينات الدهنية واطنة الكثافة خلال 9 $p < 0.05$ أظهرت نتائج الدراسة ارتفاعاً معنوياً (في اليوم الثامن عشر، في اليوم السابع والعشرين) $p > 0.05$ أيام من بداية شهر رمضان ثم أعقب نقصان غير معنوي لبعض القيم المذكورة اعلاه (في مستويات السكر والبروتينات الدهنية عالية الكثافة بالتعاقب وانخفاض غير معنوي $p < 0.01$) وعالي المعنوية $p < 0.05$ حصل انخفاض معنوي (لبقية مكونات الدهون مقارنة باليوم الأول. في اليوم الثلاثين الذي أعقب شهر رمضان أظهرت تراكيز الكليسيريدات الثلاثية، البروتينات $p > 0.05$) بمستوى البروتينات الدهنية عالية الكثافة مقارنة $p > 0.05$ الدهنية واطنة الكثافة جداً واطنة الكثافة انخفاضاً غير معنوي وارتفاعاً غير معنوي (بمستوى السكر والبروتينات الدهنية عالية الكثافة مقارنة $p < 0.01$) وعالي المعنوية $p < 0.05$ باليوم السابع والعشرين، وحصول انخفاض معنوي باليوم الأول من الدراسة. ان التغيرات بهذه المستويات تؤثر بشكل أو بآخر على الأشخاص الطبيعيين لكن هذا التغير يكون ذا اثر على الأشخاص الذين يعانون من فرط الدهون ولهذا فان الاخصائين في الاقطار المسلمة يأخذون جلياً بنظر الاعتبار التغير بهذه القيم خلال شهر رمضان.

Introduction

Ramadan is one of the five pillars of Islam. During this month fasting is obligatory for all adult and healthy Muslim during the day- light hours of the whole month every years. Children are excused, but the elderly who are well are not allowed to postpone the fast. Pregnant, lactating and menstruating woman, traveling and sick people are permitting to postpone their fasting to another time¹.

The quality of food eaten daily is similar before and during Ramadan, however in Ramadan there is a change in eating pattern from several spaced meals in the day to one large meal at sunset, and one light meal before dawn. There is also a tendency to consume more sugary juices and sweet food during this month².

Physiological changes during Ramadan are not known and reports in the literature concerning the effects of fasting in Ramadan are very few. Two previous studies carried out in this country at 1985 and 1987 revealed a contradictory results about total serum cholesterol, and neither of these studies concerned with the changes that may happened in the distribution of cholesterol fraction within lipoproteins during Ramadan^{3,4}.

Therefore, the present study was conducted to evaluate the effect of Ramadan fasting on lipid profiles and blood sugar after 10 years of economic sanction that may have led to major changes in food quality.

Materials and Methods

A total of 50 volunteers (45 males, 5 females) with a mean age 30years (ranging from 20-50 years) were participated in this study. All subjects undertook ordinary activities during Ramadan. At the time of the study, the period of Ramadan was November 27th to December 27th, 2000. All volunteers were found healthy on general medical examination. None was receiving any medication known to affect the lipid and glucose metabolism, and none of them were smokers.

Venous blood was collected into clean tubes after an average fast of 14 hours on the first day and again on day 9, 18 and 27 during Ramadan and then at 30 days following Ramadan. The first day samples were used as the baseline values, and each subject served as his own control. Specimens were allowed to clot at room temperature for 2 hours; serum then was separated and stored at -18°C until subsequent analysis, which was performed within 1- 4 days.

The serum concentrations of TC, TG and HDL-C (after precipitation with sodium phosphotungstate-MgCl₂) and blood glucose were determined enzymatically using kits from Bio-Merieux, France. All procedures were followed according to instructions of manufacture. Quality control sera from Bio-Merieux were included in each assay batch for all above analytes. The inter-assay coefficient of variation was 4% for TC, TG and glucose, 6% for HDL-C.

Data were expressed as mean±SD. Comparison between the means was made using the student's paired t-test. $P < 0.05$ was considered as significant.

Results

The clinical characteristics for all subjects participated in this prospective study with their data, which were recorded at the beginning of Ramadan, are summarized in Table 1.

Table 2 shows the mean levels of blood glucose, serum TC, TG, VLDL-C, LDL-C, HDL-C and body mass index of subjects at the 1st, 9th, 18th and 27th days during Ramadan.

Results on 9th day fasting showed, non significantly elevated ($P > 0.05$) concentrations of blood glucose, serum TC, TG, VLDL-C and LDL-C, however the concentration of HDL-C was highly significantly lowered ($P < 0.001$) as compared with their values on the 1st day.

Eighteen days following fasting, the concentrations of TC and HDL-C were highly significantly lowered ($P < 0.001$). Whereas the concentrations of blood glucose, serum TG, VLDL-C and LDL-C were non significantly decreased ($P > 0.05$).

On day 27th, the concentrations of all parameters except blood glucose and HDL-C were insignificantly decreased ($P > 0.05$). The concentrations of blood glucose and HDL-C were highly

significantly lowered ($P < 0.001$) as compared to their values on the 1st day.

The comparison between the changes in the values of blood glucose, TC, TG, VLDL-C, LDL-C, HDL-C and body mass index at 1st, 27th and 30 days following Ramadan were summarized in Table 3. Results showed that, at 30 days following Ramadan, the concentrations of TG, VLDL-C, and LDL-C, were non significantly elevated ($P > 0.05$) as compared with their values on day 27th and 1st of Ramadan. Where as HDL-C showed a significant increase ($P < 0.01$), while the concentrations of blood glucose and total serum cholesterol were non significantly decreased ($P > 0.05$) in comparison to their values on day 27th. However the level of blood glucose and HDL-C were highly significantly lowered ($P < 0.001$) than that on the 1st day. On the other hand non significantly decrease was observed in serum total cholesterol level ($P > 0.05$) in comparison to its initial values on the 1st day.

Although body mass index has been decreased during and at the end of Ramadan as compared with their initial values at 1st day, however the differences remains statistically non significant ($P > 0.05$). The value of body mass index tends to increase following 30 days of Ramadan.

Discussion

Doctors working in Muslim countries are often faced with problem of advising people on whether or not to fast when they are unwell. Since the metabolic consequences of fasting in Ramadan are not clearly known, doctors usually faced a dilemma. This study attempts to answer some of these questions by investigating the changes in blood glucose and serum lipid levels during fasting in Ramadan and then after 30 days following Ramadan.

In the present study there was an non significant decrease in the body mass index during fasting in Ramadan and non significant increase after Ramadan. A

possible cause for such finding could be attributed to the low energy intake due to the reduction in food intake, which could be the reason for the reduction observed in body weight during Ramadan. These results are in agreement with those of many other investigators⁵⁻⁸. Analysis of 70 research papers showed that the loss of body weight is associated with reduced concentrations of lipid in the population study⁹.

Our data showed a reduction in the concentrations of lipids during Ramadan. A significant decrease in the concentrations of TC and HDL-C were observed on day 18th, while on day 27th the reduction were non significant for all parameters except for blood glucose and HDL-C in which the decrease was significant. It has been found that the body weight reduction is accompanied by a decrease in TC, TG, VLDL-C and LDL-C^{9,10}. The decrease in serum TG has been attributed to its use as a source of energy during Ramadan fasting¹¹.

Some reports had demonstrated an increase in lipid parameters during Ramadan fasting. This may be due in part to the various dietary habits in different Islamic countries. For instance, a decrease of daily energy intake during Ramadan has been reported in Indian Muslim¹². However, in Saudi Arabian¹³ and Moroccan⁹ populations there was an increase in daily energy intake during Ramadan fasting. In Tunisian subjects, no change in total energy intake has been reported¹⁴.

In the present study, a marked decreased was found in serum HDL-C concentration which is in contrast with the data reported by other investigator⁹⁻¹⁴. On the other hand, it is in partial agreement with result reported by Writh *et al*¹⁵, who observed a gradual decrease in the level of HDL-C during the long-term fast of 22 days. Opposite result was reported by Maislos *et al*¹⁶, who found a marked increase in HDL-C level during Ramadan fasting with no significant change in the levels of TC, TG,

VLDL-C and LDL-C. These results have been attributed to inductive effect of eating one large evening meal a day on lipid profiles. This fact was documented by other workers; Gwinup *et al*¹⁷ found an increased in serum lipids in hospital patients during 2 to 3 week period when their daily food intake was consumed in one large evening meal as compared to a period when the food was divided into 10 small rations. Similarly, Irwin and Feeley¹⁸ noted that in the 15 healthy women, the mean serum cholesterol level was significantly lower when diet was served in three equal meals per day than when it was served in one large and two small meals. There is also some evidence indicating that body weight loss is associated with an increase in lipoprotein lipase activity, which may increase the hydrolysis of VLDL and transfer of its lipid to HDL-C⁹.

Ramadan provides a unique model to study the effect of fasting refeeding pattern. Our finding of increased serum cholesterol and HDL-C levels on day 27th in relation to their values on day 18th was similar to the finding of Gwinup *et al*¹⁷ and Irwin and Feeley¹⁸. These authors found that total cholesterol was significantly higher when the food intake was served as one large meal.

On day 27th, the level of blood glucose was significantly lowered as compared its concentration on the 1st day. A possible cause for such decreased probably due to either the effect of fasting (27 days) on glycogen storage inside the liver or due to the dietary habits of some people to eat only after sunset, and neglected the light meal before dawn.

Thirty days following Ramadan, results showed that, the concentrations of all parameters except for HDL-C were non significantly changed as compared to their values on day 27th of Ramadan. HDL-C level was significantly increased, however it was lower than its initial value at the first

day. Such increases or changes in those parameters could be attributed to returning to the same dietary habit as before Ramadan, in addition to the tendency of some person to consume more foods after long period of fasting.

In conclusion, the results of this study indicated an alteration the levels of blood glucose and serum lipid profiles during and after Ramadan fasting. However, these changes that we have shown here are slight, and none of them reached pathological proportions. These would be unlikely to have any adverse effects in normal subjects. Physicians working in Muslim countries must realize that Ramadan causes changes in blood constituents.

References

1. Sulieman S. Fedail., Denis Murphy., Salih *et al* .. Changes in certain blood constituents during Ramadan. *Am J Clin Nutr.* 1982; 36: 350-353.
2. Malak. Slonky.. Effect of fasting in Ramadan on plasma lipoproteins and apoproteins. *Saudi Medical Journal.* 1989; 7: 561-565.
3. Allawi N.S., Khabil H.M., Al-Dabbagh E.H., Al-Sulaiveni B.K... Some of the effects of fasting Ramadan on the blood and urine chemistry. *Iraqi Medical Journal.* 1985; 33: 14-21.
4. Al-Naama L.M., Al-Naama M.M., Naama A.A.R., Barri J.A.. The effect on some blood constituents during fasting in Ramadan. *Medical Journal Basrah University.* 1987; 6: 37- 42.
5. Hallak MH., Nomani MZA.. Body weight loss and changes in blood lipid levels in normal men on hypocaloric diets during Ramadan fasting. *Am. J. Clin. Nutr.* 1988; 48: 1197-1210.
6. Hassaini MM. A dietary study of NDSU Muslim students during fasting, in month of Ramadan [abstract]. In: Hussaini MM. Sakr A. Islamic dietary laws and practices. 2nd ed. Chicago: *Islamic food and Nutrition council of America.* 1984. 38-40.
7. Angel JF., Schwarz N.E.. Metabolic changes resulting from decreased meal frequency in adult male Muslims during the Ramadan. *Fas. Nutr. Rept. Int.* 1975; 11: 29-38.
8. Husain R., Duncan M T., Cheah SH. Ch'ng SL, Effects of fasting in Ramadan on tropical Asiatic Muslims. *Br. J. Nutr.* 1987; 58: 41-48.
9. Dattilo AM., Kris-Etherton PM.. Effects of weight reduction on blood lipids and lipoproteins. A meta-analysis. *Am J Clin Nutr.* 1992; 26: 320-328.
10. Dennis KE; Goldberg AP. Differential effects of body fatness and body distribution on risk factors for cardiovascular disease in women impact or weight loss. *Arterioscler Thromb.* 1993; 13: 1487-1494.
11. Chandalia HB., Bharqau A., Kataria V.. Dietary pattern during Ramadan fasting and its effects on the metabolic control of diabetes. *Pract. Diabetes.* 1987; 4: 287-289.
12. Frost G., Pirani S.. Meal frequency and nutritional intake during Ramadan. A pilot study. *Hum. Nutr. Appl. Nutr.* 1987; 41: 47-50.
13. El-Ati J., BejiC., Danguir J.. Increased fat oxidation during Ramadan fasting in healthy women. An adaptive, mechanism for body-weight maintenance. *Am. J .Clin. Nutr.* 1995; 62: 302-307.

14. Writh A., Rithaler F., Roth A., Schlierf G.. Reduced uptake and esterification of free fatty acids during prolonged fasting. *Int J Obs.* 1983; 7: 353-359.
15. Gwinup G., Byron RC., Roush WH., Krueger H., Hamwi GJ.. Effect of nibbling versus gorging on serum lipids in man. *Am. J. Clin. Nutr.* 1963 ; 13: 209-12.
16. Irwin MI., Feeley RM. Frequency of meals effect on serum lipids and fat digestibility in young women. *Am. J. Clin. Nutr.* 1967; 20: 816-24.
17. Maislos M., Abou-Rabiah Y., Zuili I., *et al* . Gorging and plasma HDL-C. The Ramadan model. *Europ J. Clin. Nutr.* 1998 ; 52: 127-130.

Table1: The Clinical Characteristics for all subjects participated in the study.

Number	50
Sex	
Male	45
Female	5
Age (years)	30 ± 20
Weight (kg)	68.4 ± 13.96
Height (cm)	174.16 ± 6.69
Body mass index	22.46 ± 3.82
FBS (mg/dl)	98 ± 14.6
TC (mg/dl)	195.8 ± 49
TG (mg/dl)	80.4 ± 32
VLDL-C (mg/dl)	15.9 ± 6.4
LDL-C (mg/dl)	113.4 ± 46.6
HDL-C (mg/dl)	73.3 ± 18.9

Data are presented as mean±standard deviation.

Table 2: Mean levels of blood glucose, lipids and BMI during Random.

Parameters	1 st	9 th	18 th	27 th
-Glucose (mg/dl)	98±14.6	98±15.5	94.7±15.2	86±21*
-TC (mg/dl)	195.8±49	208±39.7	165.8±37**	188±14.6
-TG (mg/dl)	80.4±32	97.4±41.6	76.2±43.9	70.6±41
-VLDL-C (mg/dl)	15.9±6.4	19.2±8.7	14.9±7	14.2±8.1
-LDL-C (mg/dl)	113.4±46.6	131±42	97.6±31.5	110.4±41.6
HDL-C (mg/dl)	73.3±18.9	60.5±17.6**	55.4±13**	58.5±11.9**
BMI	22.47±3.82	21.88±3.39	21.44±4.22	21.83±3.38

Data are presented as mean±standard deviation.

* P<0.01 , ** P<0.001

Table3: Comparison between changes in the value of blood glucose, Lipid profile and BMI during and after Ramadan.

Parameters	1 st	27 th	30 days after Ramadan
-Glucose (mg/dl)	98±14.6	86±21	82±13.6***a
-TC (mg/dl)	195.8±49	188±41.6	185.7±39.6
-TG (mg/dl)	80.4±32	70.6±41	86.2±46
-VLDL-C (mg/dl)	15.9±6.4	14.2±8.1	16.5±9.2
-LDL-C (mg/dl)	113.4±46.6	110.4±41.6	114.6±42.8
HDL-C (mg/dl)	73.±18.9	55.5±11.9***	65.7±16.8*a **b
BMI	22.47±3.82	21.83±3.38	26.22±4.02

Data are presented as mean±standard deviation.

* P<0.05 , ** P<0.01 , *** P<0.001

a : 30 days after Ramadan versus 1st day. b: 30 days after Ramadan versus 27th day.