

Islamic Fasting and Diabetes

Fereidoun Azizi¹

¹ Endocrine Research Center, Research Institute for Endocrine Sciences, ShahidBeheshti University of Medical Sciences, Tehran, Iran.

ARTICLE INFO

Article type:

Original Article

Article history:

Receive: 06-Jan-2013

Revise: 02-March-2013

Accept: 24-Feb-2013

Publish: 01-July-2013

Keywords:

Fasting

Glucose homeostasis

Glycogen

Diabetes mellitus

ABSTRACT

The aim of this article is to review health-related aspects of Ramadan fasting in normal individuals and diabetics. During fasting days of Ramadan, glucose homeostasis is maintained by meal taken before dawn and by liver glycogen stores. Changes in serum lipids are variable and depend on the quality and quantity of food consumption and changes in weight. Compliant, well controlled type 2 diabetics may observe Ramadan fasting; but fasting is not recommended for type 1, non-complaint, poorly controlled and pregnant diabetics. Although Ramadan fasting is safe for all healthy individuals and well controlled diabetics, those with uncontrolled diabetics and diabetics with complications should consult physicians and follow scientific recommendations.

► Please cite this paper as:

Azizi F. Islamic Fasting and Diabetes. *J Fasting Health*. 2013;1(1):1-5.

Introduction

Fasting during Ramadan is the religious duty of all healthy adult Muslims. The Islamic fast during the month of Ramadan is strictly observed worldwide by millions of Muslims. A whole month of intermittent fasting, from dawn to dusk, every year is particular only to Islam and considering that Islam has over one billion followers worldwide, it can be assumed that few hundreds of million people observe Ramadan fasting each year. The experience of fasting teaches Muslims self-discipline and self-restraint and enables them to empathize with those less well off, the suffering and the impoverished. Fasting is not obligatory for children, menstruating women, or the sick and travelers; pregnant and lactating women are also exempt and permitted to postpone their fasting to an appropriate time when it can be observed without it affecting their maternal obligations. (1)

During Ramadan, the majority of Muslims have two good-sized meals, one immediately after sunset and the other just before dawn. They are

allowed to eat and drink only between sunset and dawn, when they begin their day of fasting until sunset. Since the Islamic calendar is based on a lunar cycle, the Islamic year contains 354 days, because of which Ramadan moves back eleven days every year and may fall during any of the four seasons, making the duration of daily fasting vary between 11 and 18 hours in the north in tropical countries. The month of Ramadan is either 29 or 30 days.

Islamic fasting provides a unique model of intermittent fasting daily for one month. It is also distinct from regular voluntary or experimental fasting in that the faster does not drink during fasting hours. Not only does Ramadan fasting discipline the body to restrain from eating food and drinking water, it also requires restraining every part of one's physical body, the mouth and ears from gossip and profanity; all sexual thoughts and activities during fasting hours are also forbidden. Thereby, a Muslim engages his or her entire body in the physical observance of the Ramadan fast. The eyes, the ears, the tongue, and even the private parts are

* Corresponding author: Fereidoun Azizi, Professor of Internal Medicine & Endocrinology, Endocrine Research Centre, Research Institute for Endocrine, Shahid Beheshti University of Medical Sciences, Tehran, Iran. P.O. Box: 19395-4763 Tel: +98 21 22409309; Fax: +98 21 22402463; Email: azizi@endocrine.ac.ir

© 2013 mums.ac.ir All rights reserved.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

equally obligated to be restrained. Therefore, one may assume that physiological changes occurring during Islamic fasting would differ from those observed during an experimental fast. (2)

This review discusses various health-related aspects of Ramadan fasting in health and its impact on some disease processes.

Metabolic Effects of Ramadan fasting

The effects of fasting during Ramadan on various organs are summarized, in Table 1, may be affected by genetic and environmental factors, such as nutrition habits and the length of fasting day, therefore, difference in the effects of Ramadan fasting may occur between seasons and countries.

Carbohydrate Metabolism

Carbohydrate metabolism during experimental short-term fasting have been reviewed extensively. (3) The post absorptive period is defined as 8 to 16 hours after eating, a period of early adaption to starvation. The primary metabolic priority is the provision of adequate glucose for brain and other vital tissues, such as red blood, peripheral nerves and renal medulla.

The rate of glucose turnover is 2 mg/kg/minute in the post absorptive state. In normal adults, a slight decrease in serum glucose of between 3.3 to 3.9 mmol/L (60-70 mg/dl) occurs within a few hours after fasting; the fall in serum glucose however ceases due to breakdown of glycogen, and a decrease in both glycogen synthesis and glycolysis in the liver. These changes are a result of a fall in insulin and rises in glucagon and sympathetic activity. (3) In the early stage of the post absorptive period, the fall in glucose is associated with depletion of already modest liver glycogen stores, approximately 5% of the net weight of the liver. Only 1200 calories are stored as carbohydrate in liver, providing the basal requirement for glucose for only 5-6 hours. Muscle glycogen and skeletal muscle cells lack glucose-6 phosphatase and do not release glucose from stored glycogen directly into the circulation. Eventually, following about 16-24 hours of starvation (8-16 hours of absorptive period plus 5-6 hours of carbohydrate release from the liver), glycogen stores become depleted and gluconeogenesis is the only remaining source of glucose. Gluconeogenesis refers to the formation of glucose from three carbon precursors including lactate, pyruvate, amino acids and glycerol. Cortisol is the principal stimulus for the catabolism of muscle protein. These mechanisms provide the daily glucose needs of the brain (100-125 g) and red blood cells (45-50 g). Simultaneously the decrease in insulin and rise in catecholamine production results in lipolysis in

the adipose tissue and a rise in the level of free fatty acids, which replaces glucose as the essential fuel for use by other tissues of the body. (4)

In the first few days of Ramadan fasting serum glucose may decrease slightly, normalizing by the 20th day and showing a slight rise by the 29th day. (5) The lowest serum glucose level in this study was 63 mg/dl. Other studies have shown a mild increase (6) or variation in serum glucose concentration. (7)

During longer fasting days, of >16 hours, which follow a rather heavy meal taken before dawn (Sahur), the stores of glycogen, along with some degree of gluconeogenesis, maintain serum glucose levels within normal limits. Since gluconeogenesis becomes the only source of glucose after 16-24 hours of fasting, it is recommended that observer of fasts do not skip Sahur, their pre-dawn meal, because of the possibility of extended gluconeogenesis.

Metabolism of Lipids

Studies have shown that serum cholesterol may decrease in the earlier days of fasting and subsequently rise to pre-fasting values during the following days of Ramadan. (8) Raised concentrations of cholesterol and LDL, reported by some investigators, (9) may be related to weight loss during Ramadan fasting; others, however, have found either no change (10) or decreased levels of cholesterol during Ramadan fasting. (2, 6, 10, 11) Marked increase in plasma HDL cholesterol occurring after fasting of Ramadan has been observed and might be a promising finding. (11, 12) In trained athletes, sub maximal exercise during Ramadan fasting increases the lipid oxidation. (13) Apo A-1 concentration increases and Apo B levels fall in both normal and diabetic individuals. (14) Alterations in serum lipid may be related to consuming a large meal, as has been shown in individuals taking one large meal every day. (15) In fasting subjects, who did not show any weight change during the month of Ramadan, it has been seen that serum leptin and insulin concentrations increased and neuropeptide Y levels decreased; (16) another study however, did not find any significant change in amplitude or 24 hr mean concentration of leptin during Ramadan fasting. (17) The significant reduction in energy intake during Ramadan is accompanied by decrease in plasma total cholesterol, LDL-C, and triglyceride concentrations (18) and cardiovascular risk profiles. (19) Changes in blood lipids seem to be variable and depend probably on the quality and quantity of food consumption and the degree of weight changes.

Table 1. The effect of Ramadan fasting on metabolism and different organs in healthy individuals.

Metabolism/organ	Effects
Body weight	Variable, mostly decreased or unchanged
Carbohydrate	Glycogenolysis of the liver, some degree of gluconeogenesis in longer fasting days
Endocrine glands	Slight changes in protein binding of T4 and T3 and in serum calcium concentration. Small reversible shifts in cortisol, testosterone and prolactin secretions
Hematological profile	Small decrease in both iron and total iron-binding capacity
Lipids	Variable, depending on the quality and quantity of diet and weight change
Liver	Slight increase in indirect bilirubine in the first half of Ramadan fasting
Kidney	Small, insignificant changes in serum urea, creatinine and uric acid
Neuro-psychiatric	Change in chronotype and sleep patterns; increase in the prevalence of headaches; decrease in parasulcide
Gastrointestinal tract heart, lungs and eyes	None

Changes in blood lipids seem to be variable and depend probably on the quality and quantity of food consumption and the degree of weight changes. Avoiding weight gain and reducing the consumption of total calorie and saturated fatty acids are the main recommendations for those fasting during Ramadan.

Diabetes Mellitus

Study of diabetes and fasting in a few Islamic counties have shown that approximately half of the patients with type 1 and two third of patients with type 2 diabetes observe Islamic fasting in Muslim countries. (20) The majority of studies on Islamic fasting indicate that no major problems are encountered by patients with type 2 and even well controlled type 1 diabetes during Ramadan fasting. (21) The amount of energy intake is unchanged or decreased in most patients during fasting and weight loss may be observed. (22) There are no significant change in FBG, HbA1c, (23-25) fructosamine, insulin and C-peptide (23, 24) levels during fasting, although some studies do show a trend towards better glycemic control (26) while others indicate increase FPG and poor control of diabetes during this month of fasting. Changes in FPG may occur due to the changes in body weight and exercise habits, amount and type of foods consumed, gorging after breaking of the fast, or irregularity of medication compliance. (2) Although increases in total cholesterol levels have been reported, (22, 26) most patients with either type 1 or type 2 diabetes do not show significant changes in lipid profiles during Islamic fasting. (21, 25, 28)

In diabetic patients, serum concentrations of blood urea nitrogen creation, uric acid, alanine amino-transferase, aspartate amino-transferase, protein and albumin values show no significant changes during Ramadan fasting. (23, 29)

Although some reports do not show any increase in the rate of hypoglycemia, a study of 13 Muslim countries reported increased frequency in the occurrence of severe hypoglycemic episodes in both type 1 and 2

diabetes patients during this month of fasting, in particular in those who had changed their dose of oral hypoglycemic agents or insulin or had modified their levels of physical activity. (20)

recommendations: Diabetic patients that should not fast are those known to be non-compliant, poorly controlled, and all brittle type 1 diabetics; pregnant diabetics, those with a history of diabetic ketoacidosis or hyperosmolar coma, and patients with serious complications such as coronary artery disease, cirrhosis and chronic renal failure; elderly patients with any degree of alertness problem, and diabetics with frequent episodes of hyper- or hypoglycemia before and/or during Ramadan fasting. (30, 31)

Diabetics who are motivated to observe fasting in Ramadan must visit a physician and a dietician before Ramadan. Dietary and glycemic control should be achieved and advice relating diet adherence, appropriate exercise, self monitoring of blood glucose and compliance with medical therapy should be emphasized. (32- 34)

During Ramadan fasting, patients are advised against excessive gorging. If taking single dose short acting sulphonylurea or metformin, or both, the patient should take this with the sunset meal. If two or three doses of oral hypoglycemic drugs are taken each day, the morning and midday doses should be taken after sunset and half the normal evening dose before dawn, with Sahur. If a patient with controlled diabetes insists in fasting, he/she should take the normal morning dose after sunset and half of the evening dose before dawn. If basal insulin is taken, the long acting insulin should be reduced to two thirds. (34) Glycemic control may improve and the rate of hypoglycemia reduced by using short-acting insulin analogs, (35) or continuous subcutaneous insulin infusion. (36)

In conclusion, since over 50 million people with diabetes fast each year during the month of Ramadan, further scientific research on the medical and health-related aspects of the Ramadan fasting is needed. Health personnel practicing in Muslim countries, as well as those

caring Muslims in various parts of the world need to be fully aware of the physiological alterations occurring during Ramadan, the effects of Islamic fasting on diabetes and the pharmacodynamics of different medications during the month of Ramadan.

References

1. Azizi F. Medical aspects of Islamic fasting. *MJIRI* 1996; 10:241-6.
2. Azizi F. Research in Islamic fasting and health. *Annals of Saudi Medicine* 2002; 122: 186-91.
3. Heber D. Starvation and Nutrition therapy. In: DeGroot LJ, Jameson JL (eds) *Endocrinology*. Fourth edition, vol 1, Philadelphia, Saunders, 2001; pp 642-5.
4. Hasselbalch SG, Knudsen GM, Jakobsen J, Hageman LP, Holm S, Paulson OB. Blood-brain barrier permeability of glucose and ketone bodies during short-term starvation in humans. *Am J Physiol* 1995; 268: E1161-6.
5. Azizi F, Rasouli HA. Serum Glucose, Bilirubin, calcium, phosphorus, protein and albumin concentrations during Ramadan. *Med J IRI* 1987; 1: 38-41.
6. Temizhan A, Tandogan I, Donderici O, Demirbas B. The effects of Ramadan fasting on blood lipid levels. *Am J Med* 2000; 109:341-2.
7. Davidson JC. Muslims, Ramadan and diabetes melitus. *Br Med J* 1979; 2:1511-2.
8. El-Hazmi MAF, Al-Faleh FZ, Al-Mofleh IB. Effect of Ramadan fasting on the values of hematological and biochemical parameters. *Saudi Med J* 1987; 8: 171-6.
9. 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: 1197-210.
10. Ziaee V, Razaee M, Ahmadinejad Z, Shaikh H, Yousefi R, Yarmohammadi L, Bozorgi F, Behjati MJ. The changes of metabolic profile and weight during Ramadan fasting. *Singapore Med J* 2006; 47: 409-14.
11. Salehi M, Neghab M. Effects of fasting and a medium calorie balanced diet during the holy month Ramadan on weight, BMI and some blood parameters of overweight males. *Pak J Biol Sci* 2007; 10: 968-71.
12. Rahman M, Rashid M, Basher S, Sultana S, Nomani MZ. Improved serum HDL cholesterol profile among Bangladeshi male students during Ramadan fasting. *East Mediterr Health J* 2004; 10: 131-7.
13. Bouhlef E, Salhi Z, Bouhlef H, Mdella S, Amamou A, Zaouali M, Mercier J, Bigard X, Tabka Z, Zbidi A, Shephard RJ. Effect of Ramadan fasting on fuel oxidation during exercise in trained male rugby players. *Diabetes Metab* 2006; 32: 617-24.
14. Akanji AO, Mojiminiyi OA, Abdella N. Beneficial changes in serum Apo A-1 and its ratio Apo B and HDL in stable hyperlipidemia subjects after Ramadan fasting in Kuwait. *Europ J Clin Nutr* 2000; 54:508-13.
15. Gwinup G, Byron RC, Roush WH, et al. Effect of nibbling versus gorging on serum lipids in man. *Am J Clin Nutr* 1963; 13: 209-13.
16. Kassab S, Abdul-Ghaffar T, Nagalla DS, Sachdeva U, Nayar U. Interactions between leptin, neuropeptide-Y and insulin with chronic diurnal fasting during Ramadan. *Ann Saudi Med* 2004; 24: 345-9.
17. Bogdan A, Bouchareb B, Touitou Y. Response of circulating leptin to Ramadan daytime fasting: a circadian study. *Br J Nutr* 2005; 93: 515-8.
18. Afrasiabi A, Hassanzadeh S, Sattarivand R, Nouri M, Mahbood S. Effects of low fat and low calorie diet on plasma lipid levels in the fasting month of Ramadan. *Saudi Med J* 2003; 24: 184-8.
19. Fakhrzadeh H, Larijani B, Sanjari M, Baradar-Jalili R, Amini MR. Effect of Ramadan fasting on clinical and biochemical parameters in healthy adults. *Ann Saudi Med* 2003; 23: 223-6.
20. Salti I, Bénard E, Detournay B, Bianchi-Biscay M, Le Brigand C, Voinet C, Jabbar A; EPIDIAR study group. 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: 2306-11.
21. Sulimani RA, Laajam M, Al-Attas O, Famuyiwa FO, Bashi S, Mekki MO, et al. The effect of Ramadan fasting on diabetes control in type II diabetic patients. *Nutrition Research* 1991; 11: 261-4.
22. 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: 1858-63.
23. Laajam MA. Ramadan fasting and non-insulin-dependent diabetes: Effect on metabolic control. *East Afr Med J* 1990; 67:732-6.
24. Salman H, Abdallah MA, AlHowasi M. Ramadan fasting in diabetic children in Riyadh. *Diabetes Med* 1992; 9:583-4.
25. Dehghan MR, Nafarabadi MT, Navai L, Azizi F. The effect of Ramadan fasting on blood glucose and lipids in type 2 diabetics. *J Facult Med SBUMS* 1994; 18:42-7.

26. Khaled BM, Bendahmane M, Belbraouet S. Ramadan fasting induces modifications of certain serum components in obese women with type 2 diabetes. *Saudi Med J* 2006; 27: 23-6.
27. Ahmadani MY, Riaz M, Gul A, Waheed MI, Hydrie MZ, Hakeem R, Basit A. Clinical profile of fasting diabetic subjects during Ramadan. *J Coll Physicians Surg Pak* 2007; 17: 446-7.
28. Cesur M, Corapcioglu D, Gursoy A, Gonen S, Ozduman M, Emral R, Uysal AR, Tonyukuk V, Yilmaz AE, Bayram F, Kamel N. A comparison of glycemic effects of glimepiride, repaglinide, and insulin glargine in type 2 diabetes mellitus during Ramadan fasting. *Diabetes Res Clin Pract* 2007; 75: 141-7.
29. Mafauzy M, Mohammad WB, Anum MY, Zulkifli A, Ruhani AH. A study of fasting diabetic patients during the month of Ramadan. *Med J Malaya* 1990; 45:14-7.
30. Azizi F, Siahkolah B. Ramadan fasting and diabetes mellitus. *Int J Ramadan Fast Res* <http://www.labs. Net/ains, J 98 Ar 2. htm>, 1998; 2:6-10.
31. Sulimani RA, Famuyiwa FO, Laajam M. Diabetes mellitus and Ramadan fasting: the need for a critical appraisal. *Diabetes Med* 1988; 5: 589-91.
32. Al-Arouj M, Bouguerra R, Buse J, Hafez S, Hassanein M, Ibrahim MA, Ismail-Beigi F, El-Kebbi I, Khatib O, Kishawi S, Al-Madani A, Mishal AA, Al-Maskari M, Nakhi AB, Al-Rubean K. Recommendations for management of diabetes during Ramadan. *Diabetes Care* 2005; 28: 2305-11.
33. Mojaddid M, Hassanein M, Malik R. Prescribing in ethnic groups: Ramadan and diabetes-evidence based guidelines. *Pract Diabet Int* 2006; 17: 38-43.
34. Bakiner O, Ertorer ME, Bozkirli E. Repaglinide plus single-dose insulin glargine: a safe regimen for low-risk type 2 diabetic patients who insist on fasting in Ramadan. *Acta Diabetol* 2008.
35. Kadiri A, Al-Nakhi A, El-Ghazali S, et al. Treatment of type 1 diabetes with insulin lispro during Ramadan. *Diabetes Med* 2001; 27:482-6.
36. Bin-Abbas BS: Insulin pump therapy during Ramadan fasting in type 1 diabetic adolescents. *Ann Saudi Med* 2008; 28: 305-306.