Body composition, nutrient intake and physical activity patterns in young women during Ramadan

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ABSTRACT

Introduction: Muslims abstain from food and fluid between the hours of sunrise to sunset, and usually eat a large meal after sunset and a lighter meal before sunrise. The purpose of this study was to assess body composition, nutrient intake and physical activity patterns during Ramadan fasting.

Methods: This study was carried out during Ramadan in October 2004. A total of 57 female subjects were recruited from The Hashemite University in Jordan. Body weight, fat percentage, muscle mass, and percentage body water content were measured, and body mass index (BMI) was calculated. Estimated food records over a duration of three days were used to assess the intake of energy, carbohydrates, protein, fat, and sugars before and during Ramadan fasting. Physical activity patterns were determined from a three-day activity diary before and during Ramadan fasting; the amount of physical activity was expressed as the physical activity level.

Results: Body weight and BMI decreased significantly during Ramadan fasting. The mean energy and nutrients intake before Ramadan (energy; percent carbohydrates: protein: fat was 1,252; 56:12:33) and during Ramadan (1,171; 56:13:34) were not significantly different. The mean physical activity level was 1.54 before Ramadan and 1.51 during Ramadan, and this was also not significantly different.

Conclusion: This study revealed that there was a significant weight loss during Ramadan. Estimates of energy, carbohydrates, protein, fat and sugar did not change, despite the reduction in the number of meals taken. The overall activity patterns remained similar.

Keywords: body composition, fasting, nutrient intake, physical activity, Ramadan, weight loss

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INTRODUCTION

During Ramadan, able-bodied Muslims abstain from food and fluids between the hours of sunrise and sunset, and usually eat a large meal after sunset and a lighter meal before sunrise. The length of fasting time varies with the geographical position of the country and the season in which the month of Ramadan falls. Therefore, the length of the fast may vary from ten to 19 hours a day. Modification of meal frequency and eating patterns during Ramadan may affect different aspects of human health. Studies related to Ramadan fasting monitor for body weight changes during and after Ramadan in healthy subjects.[1-13] There have been many studies on metabolic changes during and after Ramadan, which manifested as changes in serum and urinary parameters.[5,6,8-12,14-19] The reduction in body weight has been reported quite frequently, but the connection of this weight loss to a loss of body fat was not often studied.[4,11] Studies in physical activity patterns, energy levels and nutrient intake during fasting are few.[2-3,11,20] Most studies had been conducted on men. This study was carried out in the month of Ramadan in October–November 2004 (Hijra 1425), and the average duration of fasting was 12 hours a day. In Jordan, working hours are reduced during Ramadan. The practice is to eat two meals, one before dawn (Sahour) and one just after sunset (Iftar). The aim of this study was to determine the effect of Ramadan fasting on body fat and water composition, nutrient intake and physical activity patterns in young women.

METHODS

The subjects consisted of 57 female college students at The Hashemite University. All of them volunteered for this study, none of them had chronic disease, nor was on a therapeutic diet. All the measurements were made on four different weeks: one week before Ramadan (T1), the first week of Ramadan (T2), the end of the second week of Ramadan (T3), and the end of the last week

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(T4). Nutrient intake and physical activity patterns were measured at T1 and T3. Measurements for women exempted from fasting during their menstrual period were not taken during these days. Body weight, body fat percentage, body water percentage, and muscle mass were measured at the same time (between 09:00 and 11:00), using Tanita BC-532 total inner scan (Tanita Company, UK). Body mass index (BMI) was calculated using the standard formula: weight (kg)/height^2 (m^2). Each subject was requested to keep two three-day records of food intake and activity patterns; once during the pre-fasting week and the second time during the second week of Ramadan, or on other fasting days for female subjects who were menstruating during the second week. Subjects recorded the approximate quantities of all food and beverages consumed, expressed in household measures, for three consecutive days; two weekdays and one weekend day. Nutrient intakes were estimated by using WinDiets software with values based mainly on the food-composition tables for use in the Middle East, published by the American University of Beirut in 1970.[21]

Activity diary records were kept for three consecutive days, two weekdays and one weekend day. The activity diary was a modification of the method originally described by Bouchard et al.[22] Subjects chose the number that best described the type of exercise they did every 15 minutes on a record sheet, which was divided into 96 periods for each day (1,440 minutes). Subjects were given a detailed explanation and demonstration of the activity diary before the commencement of the study. The physical activity diaries were analysed using WinDiets for Windows computer programme (Robert Gordon University, Aberdeen, UK). In this programme, age, weight, and gender of the subject were specified. The physical activity level (PAL) was calculated. Statistical analysis was performed using the Statistical Package for Social Sciences version 10.0 (SPSS Inc, Chicago, IL, USA). Results were expressed as mean and standard deviation (SD). ANOVA and Student's paired t-test were used for data analysis. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

The mean age of subjects was 21.6 (range 18–29, SD 4.14) years. Both the body weight and BMI were decreased significantly during Ramadan fasting, compared with values observed before the beginning of fasting (Table I). Body fat percentage and total body water content were altered significantly during the first week of fasting as compared with values observed before the beginning of fasting. Muscle mass was unaffected. Data showed that the total daily energy intake remained comparable before and during Ramadan, despite the decrease in meal frequency (Table II). Qualitative analysis of food consumed showed that the percentage of energy as carbohydrates, protein, and fat remained unaffected by Ramadan fasting; the amount of carbohydrates, protein and fat consumed also remained similar (Table II). Sugar consumption showed an insignificant increase during Ramadan fasting when compared to pre-Ramadan levels (Table II).

The activity patterns of the subjects before and during Ramadan fasting are shown in Table III. There was no significant effect of Ramadan fasting on PAL; analysis of time spent on each activity categories showed that standing and praying (category 3) were increased significantly ($p = 0.033$) during Ramadan fasting, compared with values observed before the beginning of fasting. The time spent on lying, sitting and watching TV (category 2) was longer during Ramadan, while the time spent on household chores (dusting and cleaning; category 4) was low during Ramadan, compared to before Ramadan fasting. However, these differences were also not significant.

DISCUSSION

Our study findings indicated Ramadan fasting affected body weight, BMI, body water percentage and body fat percentage. Interestingly, these changes were effected despite insignificant changes in energy and macronutrient intake. This study showed a significant weight reduction with Ramadan fasting, which was consistent with findings of other studies.[1,2,8,10,11,13,14] It has been suggested that this decrease in body weight could be attributed to a decrease in fluid intake.[11,14] It can also be attributed to a decrease in glycogen-bound water stores, extracellular volume contraction secondary to a lower sodium intake, and a moderate degree of hypohydration with little loss of body tissue.[23] Ramadan fasting is characterised by changes in meal schedule and frequency. Meals are exclusively nocturnal and less frequent, and consequently, this may affect energy and nutrient intake. In this study, total energy intake was not significantly different between the pre-Ramadan and Ramadan periods; this observation was consistent with many studies.[2,3] These findings are contrary to the common belief that Muslims tend to overcompensate in terms of food intake during Ramadan fasting. However, our results did run contrary to previous findings, which showed an increase in total energy intake in Saudi,[13] Moroccan,[9] and Turkish subjects.[24] On the other hand, some studies have reported a significant decrease in energy intake instead.[10,11,20,25]

There was no significant differences in carbohydrate, protein and fat consumption during

Table I. Body composition of the subjects.

Body composition	T1 (n = 47)	T2 (n = 47)	T3 (n = 47)	T4 (n = 47)
Weight (kg)	57.5 ± 8.2	57.2 ± 7.9*	57.0 ± 7.7*	56.9 ± 7.4*
Body fat (%)	24.9 ± 6.6	23.6 ± 6.8*	24.4 ± 6.3	24.5 ± 6.8
Muscle mass (kg)	40.5 ± 3.4	41.0 ± 2.6	40.5 ± 2.6	40.4 ± 2.2
Body water (%)	52.7 ± 4.3	53.6 ± 4.4*	52.9 ± 4.2	52.8 ± 4.3
Body mass index (BMI)	22.2 ± 3.1	22.1 ± 3.0*	22.0 ± 2.9*	22.0 ± 2.8*

Data expressed as mean value ± SD.

* significantly different from before Ramadan, $p < 0.05$.

Table II. Energy and nutrient consumption.

Consumption	Before Ramadan (n = 22)	During Ramadan (n = 22)	p-value
Energy (kcal)	1252 ± 271	1171 ± 268	0.680
Carbohydrates			
Consumption (g/day)	174.2 ± 40.8	164.3 ± 42.5	0.574
% of energy	55.8 ± 6.4	56.2 ± 6.8	0.801
Protein			
Consumption (g/day)	39.3 ± 10.9	37.7 ± 11.5	0.943
% of energy	12.2 ± 2.2	12.9 ± 3.1	0.959
Fat			
Consumption (g/day)	45.7 ± 13.9	44.8 ± 13.9	0.440
% of energy	32.8 ± 6.7	34.2 ± 5.3	0.468
Simple sugars			
Consumption (g/day)	47.7 ± 14.8	59.4 ± 22.6	0.070

Data expressed as mean value ± SD.

and before Ramadan fasting. Nevertheless, previous studies had found an increased intake of fat during Ramadan fasting.[2,3,11,13] These differences can probably be attributed to the unique food habits peculiar to different Islamic countries. Analysis of dietary intake data showed that subjects expressed an average energy intake below the recommended daily energy intake for adult females, which is 2,000 kcal.[26] The mean energy intake of the subjects during Ramadan was 58% of the recommended dietary allowances (RDA) and 62% before Ramadan fasting. Interestingly, the mean intake composition of carbohydrates, protein and fat were within normal values when compared to the RDA,[26] which are 45%–65%, 10%–35% and 20%–35%, respectively. However, under-reporting may be expected among the subjects of this study. Other food intake studies carried out on non-fasting subjects showed that underestimation of food intake has been noticed more in females than in males.[27-29]

PAL is calculated by summing the various activities during the day, and multiplying by the time spent in each activity as a proportion of the day. The average

Table III. Activity pattern of females before and during Ramadan fasting.

	Before Ramadan (n = 21)	During Ramadan (n = 21)	p-value
Physical activity level	1.54	1.51	0.387
Activity categories (minutes/day)			
1	550 ± 76	569 ± 67	0.203
2	415 ± 154	469 ± 148	0.299
3	107 ± 80	145 ± 91	0.033
4	210 ± 130	160 ± 88	0.095
5	71 ± 63	77 ± 57	0.703
6	48 ± 63	47 ± 40	0.965
7	36 ± 88	26 ± 45	0.433
8	2 ± 7	2 ± 4	1.000

PAL of healthy, well-nourished adults is a major determinant of their total energy requirement, especially when growth does not contribute to energy needs in adulthood. The PAL values that can be sustained for a

Table IV. Classification of lifestyles in relation to the intensity of habitual physical activity or PAL.[30]

Category	PAL value
Sedentary or light activity lifestyle	1.40–1.69
Active or moderately active lifestyle	1.70–1.99
Vigorous or vigorously active lifestyle	2.00–2.40*

* PAL values > 2.40 are difficult to maintain over a long period of time

long period of time by free-living adult populations range from about 1.40 to 2.40.[30] The average PAL for both before and during Ramadan was 1.54 and 1.51, respectively. These values were not significantly different from The Food and Agriculture Organisation/ World Health Organisation/United Nations University recommendations for light activity (i.e. 1.56) for women.[31] Consequently, subjects of this study are classified as having a sedentary or light activity lifestyle either during or before Ramadan, as shown in Table IV.

This study explores an important issue on physical activity and lifestyle. The subjects who volunteered in this study were young females (i.e. mean age is 21.6 years), and their being classified as having a light activity lifestyle underlines an important health concern. The practice of maintaining regular physical activity is associated with the maintenance of adequate body weight, cardiovascular and respiratory health, fitness, and a lower risk of developing chronic diseases associated with diet and lifestyle.[32-35] Dietary energy recommendations should be accompanied by recommendations to perform adequate amounts of physical activity regularly. Time spent on activities did not differ between pre-Ramadan and during Ramadan fasting for all activities except for the time spent on category 3, which includes praying. Muslims spend more time praying during Ramadan, thus the mean time spent on this type of activity was significantly higher compared to pre-Ramadan periods. Results from other studies corroborate with our findings as well.[10,20]

It is reasonable to expect that the obligation to eat only during the night will lead to a definite change in normal lifestyle activities, such as sleeping. However, in this study, no significant variation in total sleeping time before and during Ramadan was found (category 1). These findings were also consistent with other studies, which reported no differences in total sleeping time.[36,37] In conclusion, our results demonstrate that although no reduction in calorie intake was applied to the subjects, Ramadan fasting contributed to weight loss in healthy subjects. These findings may find an application in weight loss programmes among subjects complaining of obesity.

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REFERENCES

1. Ziaee V, Razaei M, Ahmadinejad Z, et al. The changes of metabolic profile and weight during Ramadan fasting. Singapore Med J 2006; 47:409-14.
2. 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.
3. el Ati J, Beji C, Danguir J. Increased fat oxidation during Ramadan fasting in healthy women: an adaptive mechanism for body-weight maintenance. Am J Clin Nutr 1995; 62:302-7.
4. Ramadan J, Telahoun G, Al-Zaid NS, Barac-Nieto M. Responses to exercise, fluid, and energy balance during Ramadan in sedentary and active males. Nutrition 1999; 15:735-9.
5. Akanji AO, Mojiminiyi OA , Abdella N. Beneficial changes in serum apo A-1 and its ratio to apo B and HDL in stable hyperlipidaemic subjects after Ramadan fasting in Kuwait. Eur J Clin Nutr 2000; 54:508-13.
6. Maislos M, Abou-Rabiah Y, Zuili I, Iordash S, Shany S. Gorging and plasma HDL-cholesterol – the Ramadan model. Eur J Clin Nutr 1998; 52:127-30.
7. Afifi ZE. Daily practices, study performance and health during the Ramadan fast. J R Soc Health 1997; 117:231-5.
8. Fedail SS, Murphy D, Salih SY, Bolton CH, Harvey RF. Changes in certain blood constituents during Ramadan. Am J Clin Nutr 1982; 36:350-3.
9. Adlouni A, Ghalim N, Benslimane A, Lecerf JM, Saile R. Fasting during Ramadan induces a marked increase in high-density lipoprotein cholesterol and decrease in low-density lipoprotein cholesterol. Ann Nutr Metab 1997; 41:242-9.
10. Husain R, Duncan MT, Cheah SH, Ch'ng SL. Effects of fasting in Ramadan on tropical Asiatic Moslems. Br J Nutr 1987; 58:41-8.
11. Sweileh N, Schnitzler A, Hunter GR, Davis B. Body composition and energy metabolism in resting and exercising muslims during Ramadan fast. J Sports Med Phys Fitness 1992; 32:156-63.
12. Maislos M, Khamaysi N, Assali A, et al. Marked increase in plasma high-density-lipoprotein cholesterol after prolonged fasting during Ramadan. Am J Clin Nutr 1993; 57:640-2.
13. Frost G, Pirani S. Meal frequency and nutritional intake during Ramadan: a pilot study. Hum Nutr Appl Nutr 1987; 41:47-50.
14. Gumaa KA, Mustafa KY, Mahmoud NA, Gader AM. The effects of fasting in Ramadan. 1. Serum uric acid and lipid concentrations. Br J Nutr 1978; 40:573-81.
15. Larijani B, Zahedi F, Sanjari M, et al. The effect of Ramadan fasting on fasting serum glucose in healthy adults. Med J Malaysia 2003; 58:678-80.
16. Cheah SH, Ch'ng SL, Husain R, Duncan MT. Effects of fasting during Ramadan on urinary excretion in Malaysian Muslims. Br J Nutr 1990; 63:329-37.
17. Adlouni A, Ghalim N, Saïle R, et al. Beneficial effect on serum aop AI, apo B and Lp AI levels of Ramadan fasting. Clin Chim Acta 1998; 271:179-89.
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. Nomani MZ, Hallak MH, Nomani S, Siddiqui IP. Changes in blood urea and glucose and their association with energy-containing nutrients in men on hypocaloric diets during Ramadan fasting. Am J Clin Nutr 1989; 49:1141-5.
20. Poh BK, Zawiah H, Ismail MN, Henry CJK. Changes in body weight, dietary intake and activity pattern of adolescents during Ramadan. Malay J Nutr 1996; 2:1-10.
21. Pellet PL, Shadarevian S. Food Composition Tables for Use in the Middle East. 2nd ed. Beirut: American University of Beirut, 1970.

22. Bouchard C, Tremblay A, Leblanc C, et al. A method to assess energy expenditure in children and adults. Am J Clin Nutr 1983; 37:461-7.
23. Leiper JB, Molla AM, Molla AM. Effects on health of fluid restriction during fasting in Ramadan. Eur J Clin Nutr 2003; 57 suppl 2:S30-38.
24. Aksungar FB, Eren A, Ure S, Teskin O, Ates G. Effects of intermittent fasting on serum lipid levels, coagulation status and plasma homocysteine levels. Ann Nutr Metab 2005; 49:77-82.
25. Fakhrzadeh H, Larijani B, Sanjari M, Baradar-Jalili R, Amini MR. Effect of Ramadan fasting on clinical and biochemical parameters in health adults. Ann Saudi Med 2003; 23:223-6.
26. Rolfes SR, Pinna K, Whitney E. Understanding Normal and Clinical Nutrition. 7th ed. Belmont, CA: Thomson Wadsworth, 2006.
27. Briefel RR, Sempos CT, McDowell MA, Chien S, Alaimo K. Dietary methods research in the third National Health and Nutrition Examination Survey: underreporting of energy intake. Am J Clin Nutr 1997; 65 suppl 4:1203S-9S.
28. Ferrari P, Slimani N, Ciampi A, et al. Evaluation of under- and overreporting of energy intake in the 24-hour diet recalls in the European Prospective Investigation into Cancer and Nutrition (EPIC). Public Health Nutr 2002; 5:1329-45.
29. Pikholz C, Swinburn B, Metcalf P. Under-reporting of energy intake in the 1997 National Nutrition Survey. N Z Med J 2004; 117:U1079.
30. Human Energy Requirements. 2004; Report of a Joint FAO/WHO/UNU Expert Consultation. FAO Food and Nutrition Technical Report Series 1. Rome: Food and Agricultural Organization.
31. Energy and Protein Requirements. 1985; Report of Joint FAO/WHO/UNU Expert Consultation. Technical report Series 724. Geneva: World Health Organization.
32. Erlichman, J, Kerbey A, James P. Are current physical activity guidelines adequate to prevent unhealthy weight gain? A scientific appraisal for consideration by an Expert Panel of the International Obesity Task Force (IOTF). London: IOTF, 2001.
33. American College of Sports Medicine Position Stand. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. Med Sci Sports Exerc 1998; 30:975-91.
34. Black AE, Coward WA, Cole TJ, Prentice AM. Human energy expenditure in affluent societies: an analysis of 574 doubly labelled water measurements. Eur J Clin Nutr 1996; 50:72-92.
35. Saris WH, Blair SN, van Baak MA, et al. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. Obes Rev. 2003; 4:101-14.
36. Bahammam A. Assessment of sleep patterns, daytime sleepiness, and chronotype during Ramadan in fasting and nonfasting individuals. Saudi Med J 2005; 26:616-22.
37. Marqolis SA, Reed RL. Effect of religious practices of Ramadan on sleep and perceived sleepiness of medical students. Teach Learn Med 2004; 16:145-9.