Ramadan Fasting: Effect on the Metabolic Profile of Healthy Medical Students in north east, Nigeria

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Abstract: The voluntary religious undertaking of fasting has attracted scientific, religious and popular interest due to its supposed health benefits. The objective of this study was to determine the effects of intermittent fasting on such parameters as body weight, blood glucose, uric acid and blood lipid profile among healthy volunteers.Seventy-five consenting Muslim medical students resident in the medical students' hostel of the College of Medical Sciences, University of Maiduguri, Nigeria were recruited during the month of Ramadan 1428AH corresponding to September 2007. Anthropometric measurements and biochemical indices including plasma glucose, triglyceride (TG), cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL) and uric acid were evaluated a week before, three weeks into and a month after Ramadan.BMI showed significant difference in all subjects during and after Ramadan fasting, however the body weight and BMI parameters were insignificant in gender analysis. We also recorded no overall changes in total cholesterol, TG and LDL during Ramadan. However, significant increase in HDL and a slight increase in plasma glucose levels were noted during Ramadan. Further, there weresignificant increases in TG level during Ramadan and in both TG and total cholesterol after Ramadan in females. However, the atherogenic index decreased in males. BMI, total cholesterol, LDL, uric acid and atherogenic index were all decreased in overweight subjects.Females demonstrated increases in TG before Ramadan and in both TG and total cholesterol after Ramadan. Differences in the levels of physical activity, eating pattern and the fact that not all females completed the Ramadan fasting may be responsible for this observation.

Keywords: Ramadan, fasting, cholesterol, high density lipoprotein, low density lipoprotein, atherogenic index

INTRODUCTION

Fasting, the willing abstention from all restricted foods for a specified period of time is a recognized feature of many religions [1].The Islamic fast during the Muslim month of Ramadan is an obligatory duty enjoined on all healthy, sane, mature and resident Muslims. It is intended to inculcate self-restraint[2].Muslims are required to abstain not only from eating and drinking but also from ingesting oral medications and receiving intravenous nutritional fluids. The month of Ramadan contains either twenty-nine (29) or thirty (30) days. Since it is based on the lunar calendar, the dates of observance differ each year. Fasting extends each day from dawn until sunset, a highly variable period depending on geographical location and seasons [3, 4]. This voluntary religious undertaking has attracted scientific, religious and popular interest due to its supposed health benefits. A number of studies have been carried out to detect the effects of fasting on several clinical and laboratory

parameters [5-8]. Conflicting results have been reported on the effect of Ramadan fasting on changes in lipid profile and other biochemical parameters among healthy volunteers [9-11]. Studies on the metabolic effects of Ramadan fasting in healthy subjects are scarce in Nigeria. We, therefore, set out to determine the effect of Ramadan on the lipid profile of healthy young Nigerian volunteers.

METHODS

This cross-sectional study was performed during the Ramadan of 1428AH (Islamic Year) corresponding to September 2007. The study subjects were a randomly selected sample of Muslim medical students resident in the medical student's hostel of the College of Medical Sciences, University of Maiduguri (UNIMAID). The inclusion criteria for the study were as follows: residence in the medical students' hostel of UNIMAID and must have indicated that they were going to observe the Ramadan fast. In addition, subjects must be between

18-30 years old as at their last birthday. We excluded students with any acute or chronic disease and females who were pregnant or using oral contraceptives. The study was approved by the ethical committee of the University of Maiduguri Teaching Hospital (UMTH). Informed consent in writing was obtained from each subject before enrolment. Data was obtained using a questionnaire containing details of a subject's name, age, sex and past medical history.Physical measurements (weight and height) were then carried out. Weight (in kilograms) was measured with the patients in light-clothed and height determined (in metres) without shoes or head gear. Body mass index (BMI) was calculated as BMI=weight $(kg)/height^2$ (m^2).Fasting blood samples were drawn from all subjects a week before, three weeks into and a month after Ramadan. Serum total cholesterol (Tch) and high density lipoprotein (HDL) were measured by an enzymatic colorimetric method using cholesterol esterase, cholesterol oxidase, peroxidase andthe chromagen 4-aminophenazone/phenol [12]. Plasma triglyceride (TG) levels were determined by an enzymatic colorimetric method using lipoprotein lipase glycerokinase, glycerophosphate oxidase and the chromagen 4-aminophenazone/N-ethyl-N-(3-sulphopropyl)-nramisidine [13]. Low density lipoprotein (LDL) was calculated using Friedewald equation [14]. The glucose oxidase method was used for plasma glucose estimation [15]. Analysis of data was done using SPSS version 16.0 statistical program. Means ± standard deviation (SD) was used to describe continuous variables while proportion was used for categorical data. Student's *t* was used to determine the significance of differences between groups. In all statistical comparisons, p-value of <0.05 was considered significant.

RESULTS

The study group consisted of 75 subjects made up of 47(62.6%) males and 28(37.3%) females. The mean age of the subjects was 25 ± 2.0 years (males- 25.6 ± 2.0; females- 23.8 ± 1.4; p< 0.001). The means of weight and BMI before Ramadan were 59.1 ± 10.4 kg and 20.8 ± 3.0 kg/m^2 respectively. An overall significant change in BMI was noted however, there was no significant change in both parameters in both males and females during and after Ramadan as shown in Table 1.

Table 1: Changes in body weight and BMI during and after Ramadan fasting

	Mean			*P* value	
	before Ramadan	during Ramadan	after Ramadan	(before *vs.* during)	(before *vs.* after)
Weight (kg)					
Male	60.0 ±9.7	57.7 ± 8.7	58.3 ± 7.7	0.22	0.43
Female	57.7 ± 11.5	53.2 ± 9.4	54.0 ± 9.9	0.14	0.20
Total	59.1 ± 10.4	56.8 ± 8.9	57.2 ± 8.4	0.25	0.22
BMI (kg/m^2)					
Male	20.5 ± 2.4	19.8 ± 2.4	19.7 ± 2.1	0.16	0.09
Female	21.8 ± 4.1	20.1 ± 3.1	20.3 ± 3.3	0.08	0.14
Total	20.8 ± 3.0	19.8 ± 2.5	19.9 ± 2.4	<0.001*	0.04*

* = significant *p* value

Glucose levels increased during Ramadan but returned to pre-Ramadan values after. There were no significant correlation between weight and BMI changes and the fasting plasma glucose (r=0.08, p=0.67).No significant changes in total cholesterol, LDL and uric acid was observed during and after Ramadan fasting. An increase in TG was observed in females (Table 2) during the fasting period.

Table 2: Changes in glucose, uric acid and lipid profile during and after Ramadan fasting

	Mean			P value	
	before Ramadan	during Ramadan	after Ramadan	(before *vs.* during)	(before *vs.* after)
Glucose (mmol/l)					
Male	4.4 ± 0.4	4.8 ± 1.1	4.5 ± 0.8	0.02*	0.45
Female	3.6 ± 0.3	4.7 ± 0.8	5.2 ± 0.9	<0.001*	<0.001*
Total	4.0 ± 0.5	4.8 ± 1.0	4.7 ± 0.9	<0.001*	<0.001*
Triglycerides (mmol/l)					
Male	1.3 ± 0.4	1.3 ± 0.7	1.3 ± 0.2	1.00	1.00
Female	1.0 ± 0.2	1.2 ± 0.2	1.3 ± 0.3	<0.001*	<0.001*
Total	1.2 ± 0.4	1.3 ± 0.6	1.2 ± 0.3	0.23	1.00
TC (mmol/l)					
Male	4.7 ± 1.2	4.8 ± 1.0	4.2 ± 0.9	0.66	0.02*
Female	4.6 ± 1.1	4.9 ± 0.6	5.4 ± 1.0	0.21	<0.001*
Total	4.6 ± 1.1	4.8 ± 0.9	4.5 ± 1.0	0.22	0.56
LDL (mmol/l)					
Male	2.8 ± 1.0	2.8 ± 0.8	2.4 ± 0.8	1.00	0.03*
Female	2.9 ± 0.9	2.9 ± 0.7	2.9 ± 1.3	1.00	1.00
Total	2.8 ± 0.9	1.6 ± 0.4	2.5 ± 0.9	<0.001*	0.04*
HDL (mmol/l)					
Male	1.3 ± 0.3	1.6 ± 0.4	1.3 ± 0.2	<0.001*	1.00
Female	1.4 ± 0.3	1.6 ± 0.3	1.4 ± 0.3	0.01*	1.00
Total	1.4 ± 0.3	1.6 ± 0.4	1.3 ± 0.2	<0.001*	0.02*
Uric acid (mmol/l)					
Male	295 ± 60	310 ± 67.2	309 ± 51.3	0.25	0.22
Female	311 ± 105	315 ± 46.2	399 ± 198	0.85	0.05*
Total	300 ± 79	311 ± 79	332 ± 113	0.39	0.04*
Atherogenic Index					
Male	3.6 ± 0.7	3.1 ± 0.9	3.4 ± 0.6	<0.001*	0.14
Female	3.3 ± 0.9	3.2 ± 0.7	3.8 ± 0.5	0.64	0.01*
Total	3.5 ± 0.8	2.8 ± 0.8	3.5 ± 0.6	<0.001*	0.26

TC=Total cholesterol; LDL=Low density lipoprotein cholesterol; *= significant *p* value

We found no correlation between these parameters and age, changes in body weight or BMI. There was negative correlation between LDL and total cholesterol (r=−0.79, p<0.001), TG (r= −0.49, p<0.001) and fasting plasma glucose (r= −0.30, p=0.05) during Ramadan. Triglyceride also had a negative correlation with plasma glucose (r= −0.53, p<0.001). HDL increased significantly during Ramadan in both genders (Table 2). Atherogenic index (AI), which is the ratio of Tch: HDL, decreased significantly in males (p<0.001) but not in females (p=0.64) during Ramadan. All the males (n=47) in the study completed 29 days of Ramadan fasting compared with 12 females (n=28).

DISCUSSION

Ramadan fasting is one of the five pillars of Islam, and is observed by millions of Muslims all over the world [3]. Believers are commanded to abstain from food, drink and conjugal relationships from dawn to sunset as a sign of restraint and introspection.Food and fluid intake are mainly nocturnal and usually, food frequency and quantity, sleep duration at night and daily physical activity are reduced [16]. These behavioural changes may be accompanied by alterations in lipid and other biochemical parameters [17]. Our study showed no significant change in weight and BMI during Ramadan in both males and females. This is similar to the findings of Maislos *et al* [11]. It however, contrasts with the findings in other studies [18-20]. Although baseline mean plasma glucose was higher in the males, we found a significantly (p<0.001) greater increase in plasma glucose among females both during and after Ramadan. The females also had increased TG levels during Ramadan which persisted up till 4 weeks post-Ramadan. Elevated TG levels during Ramadan have been reported previously [21]. This may be due to the increased consumption of high-carbohydrate diets and decreased physical activity during this month. Hallak and Nomani [19] found that the TG level at the 14th day of Ramadan correlated positively with sugar intake (g/day) during Ramadan.The increase in blood TG with high sucrose intake was also observed by Albrink and Ullrich [18]. Serum total cholesterol, LDL and uric acid remained unchanged during Ramadan in our subjects, a finding similar to what was reported by Maislos *et al* [11]. There was no correlation between these parameters and BMI. We found a significant increase in HDL during Ramadan ─ +15% (p<0.001).This concurs with reports by other workers [22,-24]. One study, however, showed no change in

HDL levels during and after Ramadan [25]. Others observed significant decrease in HDL among their subjects [26]. The elevated HDL demonstrated in our study during Ramadan was lost after the fasting period. This finding has previously been documented by Lamine *et al* [24]. The ratio of Tch: HDL (atherogenic index), decreased significantly among males (p<0.001) during Ramadan, while no change was observed among the females. Interestingly, the index was found to have increased at 4 weeks after Ramadan in the females (p=0.01), when it had reverted to pre-Ramadan level in the males. This increase was however < 4.5, a ratio above which cardiovascular disease risks are enhanced [20, 26, 27]. Aksunger *et al* [28] on their part reported decreased AI during and after Ramadan in both genders. This study was not without limitations. Females are exempted from Ramadan fasting during their menstrual periods, thus only 12 out of the 28 females who took part in our study completed 29 days of fasting. In addition, physical activity may affect lipid profile. We did not critically evaluate this item; neither did we analyze the possible effect of changes in eating pattern during Ramadan on the metabolic profile of our subjects. Furthermore, this study represents a healthy population and it is not representative for diabetic or hyperlipidaemic patients. We conclude that Ramadan fasting in healthy subjects is associated with significant increase in HDL and decreased atherogenic index of the same magnitude, particularly among males. Ramadan fasting led to an increase in TG levels in females. It is possible that other factors apart from the ones proposed, may be responsible for this observation. Further studies are needed to unravel the mechanisms underlying the metabolic alterations associated with Ramadan fasting.

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