The interaction between physical activity and fasting on the serum lipid profile during Ramadan

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ABSTRACT

Introduction: The serum lipid profiles in Muslims change during the fasting month of Ramadan, but it is not clear whether this change is due to changes in their physical activities. In this study, we compared the patterns of the lipid profile changes in those who engaged in regular physical activity with those who did not.

Methods: In a randomised trial, we assigned 93 students who took a physical education course into two groups – those who had regular physical activity after Ramadan and those who had physical activity during Ramadan. Venous blood (5 ml) was taken just before, at the end, and 40 days after Ramadan, and the fasting glucose sugar and lipid profile were measured.

Results: Fasting with physical activity decreased body weight by 1.2 kg (p-value is 0.03). Fasting blood sugar also decreased by 7 mg/dL during Ramadan, but this drop was observed in both groups. Triglyceride decreased in both groups during Ramadan, but cholesterol levels dropped considerably during and after Ramadan for those who concurrently engaged in physical activity and fasted (−12.24 and −8.4 mg/dL, respectively). The patterns of changes in the high-density lipoprotein (HDL), low-density lipoprotein (LDL) and HDL/LDL values were more or less comparable in both groups (p is greater than 0.5).

Conclusion: Usually, people are less physically active during Ramadan, but our findings show that physical activity alone cannot explain the variations in the lipid profile. Other factors, such as changes in the diet and sleeping hours, may have more important roles.

Keywords: fasting, lipid profile, physical activity, Ramadan

Singapore Med J 2009;50(9):897-901

INTRODUCTION

Most Muslims fast during the holy month of Ramadan from dawn till sunset, when they neither eat nor drink, as it forms one of the fundamental obligations of the Muslim faith. Fasting Muslims tend to alter their dietary habits and their physical activities. This involves changes in eating times and the content of food. During the Ramadan fast, Muslims eat two meals a day, one before dawn and the other shortly after sunset. In addition, there is a tendency to consume foods that are richer in carbohydrate and lipids, particularly mono- and polyunsaturated fatty acids.[1,2] This change in the meal schedule is accompanied with changes in sleeping habits and physical activities, and hence the lifestyle change during Ramadan, as sleep duration at night and daily physical activities are reduced. They also smoke less and overall, their psychological stress is reduced.[1,3-5]

These changes in diet and lifestyle have remarkable effects on the body metabolism. Nonetheless, the directions of these changes were reported differently in various studies. A few studies reported weight loss during Ramadan.[5-9] In addition, some studies showed positive effects of fasting on the lipid profile,[2,3,6,10,11] while opposite effects were observed in others.[9,12,13] Less physical activity during Ramadan is one of the possible explanations in the reduction of high-density lipoprotein (HDL)/low-density lipoprotein (LDL) values, although the impact of modifications in the diet and eating schedules should not be ignored. It is well-documented that physical activity increases HDL and decreases LDL considerably.[14,15] In addition, the lipid profile is affected by dietary habits, the percentage of fat and type of fat saturation, and the percentage of simple sugar in the daily diet.[16] Therefore, most of the papers presented the combined effects of these two factors, physical activity and diet, on the body weight and lipid profile of healthy Muslims during Ramadan. To address the interaction between physical activity and fasting on the lipid profile in healthy individuals, we carried out this experimental study in male students. The main objective of our study was to address whether the patterns of variations in the lipid profile during Ramadan and one month after Ramadan, had any association with physical activity.

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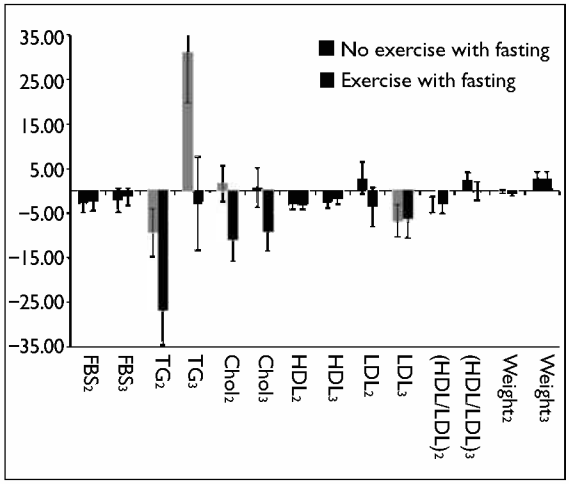

Fig. 1 Box plot shows the differences in the FBS, TG, Chol, HDL and weight at the end of, and 40 days after Ramadan (second and third measurements) compared with their baseline values (just before Ramadan) in subjects who fasted more than 20 days.

FBS: fasting blood sugar; TG: triglyceride; Chol: cholesterol; HDL: high-density lipoprotein; LDL: low-density lipoprotein

The differences were not statistically significant, except in TG_2 ($p = 0.02$), TG_3 ($p = 0.007$), $Chol_2$ ($p = 0.01$) and $Chol_3$ ($p = 0.03$).

METHODS

We conducted a randomised trial, where our subjects were selected from male students at Kerman University of Medical Sciences, Iran. The sampling was limited to males, because of the impact of menstruation, as women do not fast during their period and their body metabolisms also change. At the beginning of the study, two days before Ramadan, all male students who had taken a physical education course just before Ramadan, filled an informed consent form and answered a few questions about their general health and their regular dietary habits. Excluded from the study were students with medical problems, regular cigarette smokers and those who engaged in regular physical activity before Ramadan. In that session, we measured the subjects' weight and height, and obtained blood samples to quantify their LDL, HDL and fasting blood sugar (FBS) to establish their baseline values. The students were then randomly divided into two groups. Students in Group I had their physical activity sessions postponed to the end of Ramadan, i.e. they did not have any formal and regular practical sessions during the fasting month. Students in Group II attended physical activity sessions only during Ramadan, i.e. their practical sessions ended by the end of the fasting month.

The students had three practical sessions per week, each lasting 45–60 minutes. Their activities were under the supervision of a coach who was familiar with the objectives of the study. He was requested to ensure that students in both groups exercise comparably and follow a similar course plan. Each session started with a warm-up phase lasting ten minutes. The second and third measurements of weight, FBS, LDL and HDL were in the last three days of Ramadan and 40 days after Ramadan, respectively. Since most of the fasting students consumed food just before dawn, we took their blood samples between 10 and 11 am to make sure they were fasting for around eight hours. In addition, those who did not fast were told not to have food before their blood samples were taken, and breakfast was served thereafter, to encourage them to follow the recommendation.

In the second visit, we asked all the subjects in both groups for the number of days they had fasted. To improve the validity of their responses, this question was raised in a friendly environment and the importance of the accuracy of their responses for our study results was explained. We classified the subjects into two subgroups: those who fasted < 20 days and those who fasted ≥ 20 days. Fortunately, there were only two subjects who fasted between 11 and 19 days, meaning that the total number of fasting days in the first subgroup was clearly lower than that in the second subgroup. Questions regarding the subjects' diets were also raised during their second and third visits. Our sample size calculation showed that at least 49 subjects were needed in each group in order to find at least a 30% difference in the ratio of HLD/LDL, with a maximum Type I and Type II statistical error of 5% and 20%, respectively. Since three measurements were taken per subject, this sample size was expected to give a greater statistical power, even with a high intrasubject correlation. Venous blood samples (10 ml per draw) were taken from the subjects' forearm. Sera were extracted from whole blood within ten minutes and transferred to the laboratory within an hour in cold pack. All the sera were kept at –20°C. We measured the FBS, cholesterol, triglyceride, LDL and HDL of all the sera in one session using the enzymatic method.

The study protocol was approved separately by the research and ethical committees of Kerman University of Medical Sciences, Iran. With respect to the methodological and ethical issues, the samples had only a unique code and the laboratory staff was blinded to the subjects' personal information. The data was analysed using Stata version 8 (Stata Corporation, College Station, TX, USA). In the first step, the baseline information of the two groups was compared using *t*-test and chi-square test. Then, the data of the second and third measurements was compared with the baseline values, classified by group. A multiple linear regression model was used for the comparison and also to assess the interaction between fasting and physical

Table I. The characteristics of students classified according to two groups.

Demographics	Mean (SD) of Group I (n = 51)	Mean (SD) of Group II (n = 42)	p-value
Height (cm)	175.9 (6.3)	175.8 (7.1)	0.9
Age (years)	19.25 (3.5)	20.4 (3.2)	0.1
No. of fasted days	18.3 (13.7)	23.1 (11.9)	0.09
Living in the dormitory (%)	27 (54)	27 (64.3)	0.32
Baseline values			
Fasting blood sugar (mg/dL)	72.8 (13)	69.1 (11.4)	0.17
Cholesterol (mg/dL)	173.2 (31.4)	172.4 (31.1)	0.9
Triglyceride (mg/dL)	107.5 (94.4)	103.8 (48.3)	0.82
High-density lipoprotein (mg/dL)	41.2 (8.6)	42.1 (8.2)	0.6
Low-density lipoprotein (mg/dL)	111.5 (25.33)	109.5 (28.5)	0.75
HDL/LDL ratio	0.39 (0.12)	0.41 (0.13)	0.4
Weight (kg)	70.7 (12.3)	71.6 (12.6)	0.73
Body mass index (kg/m^2)	22.8 (3.6)	23.2 (3.6)	0.65
% BMI > 25 kg/m^2	25.5	28.6	0.74

Group I comprised students who engaged in physical activity after Ramadan, while Group II comprised students who engaged in physical activity during Ramadan.
Only two subjects in Group II had a fasting blood sugar > 126 (128 and 131 mg/dL).
SD: standard deviation

activity. A random effect model was used to adjust our findings for the effect of the repeated measurements, i.e. the intrasubject correlations. In order to simplify the results, we presented the differences between the variables in the second and third measurements and their baselines only in those who fasted for more than 20 days. In all the analyses, 5% was defined as the significance level.

RESULTS

We obtained three blood samples from 51 and 42 students in Groups I and II, respectively. Table I shows the baseline characteristics of students classified by group. The baseline lipid profiles of these two groups were comparable. Although the average FBS in the first group was slightly greater, it was not statistically significant (72.8 vs. 69.1 mg/dL; p = 0.17). In addition, their weights, heights and ages were comparable and did not have statistically significant differences. On average, Group I students fasted five days less than Group II students, but this difference was also not statistically significant (p = 0.09); 61% and 76% of students in the respective groups fasted for more than 20 days during the Ramadan (chi-square 2.5, p = 0.11). In addition, the frequency of students who lived on campus were relatively comparable (54% vs. 64.3%; p = 0.32), and so were the diets of the students in both groups.

It was observed that the students' weight increased after Ramadan by 1.12 kg (p < 0.001) and 0.62 kg (p = 0.07) in Groups I and II, respectively; while it decreased slightly for those who fasted ≥ 20 days (Fig. 1). Our model showed that fasting on its own had negative effects on the body weight, particularly in Group II (weight loss 1.2 kg, p = 0.03). FBS in both groups decreased significantly during Ramadan (7 mg/dL), but it increased slightly after Ramadan only in Group II. Our model showed that fasting and physical activity did not have any significant impact on FBS, and their interaction was also not significant (p = 0.81). We observed different patterns of changes in the serum triglyceride in both groups, where it decreased during Ramadan but increased after Ramadan, particularly in Group I (p < 0.001). We did not find any interaction between physical activity and fasting on the serum triglyceride level (p = 0.4).

In contrast to FBS, physical activity decreased the serum cholesterol level. We found a considerable decrease in the serum cholesterol level of Group II subjects during and after Ramadan (–12.24 and –8.4 mg/dL, respectively), where there was a significant difference (p = 0.01) in both groups at the end of Ramadan. This indicates that the interaction between physical activity and fasting was significant (p = 0.03). The HDL level, decreased during and after Ramadan in both groups. Although the drop was slightly greater in Group I, the differences were not statistically significant (p = 0.67), and the interaction between physical activity and fasting on the level of HDL was also not significant (p = 0.5). The serum LDL also decreased in Group II during and after the Ramadan. Although fasting on its own increased LDL slightly, engaging in physical activity decreased LDL levels (–8.8 mg/dL, p = 0.09). Again, the interaction between

physical activity and fasting on serum LDL was not significant. Finally, the HDL/LDL ratio decreased during, but increased after Ramadan. The interaction between physical activity and fasting on the HDL/LDL ratio was not significant ($p = 0.98$).

DISCUSSION

We did not find a considerable interaction between physical activity and fasting on the serum lipid profile, except on the total serum cholesterol in healthy individuals. Overall, concurrent physical activity and fasting in Group II did not have any considerable effect on the body weight and FBS; it decreased the serum cholesterol but did not have considerable positive impact on the HDL and the HLD/LDL ratio. The impact of fasting on the body metabolism is very complicated; many pathways alter to keep the body in balance. Physical activity,[14-16] diet,[9,16,17] and sleeping hours[1,18] change the body metabolism substantially. During Ramadan, all of these three main factors are changing,[3,9] and it is difficult to obtain a deep and comprehensive view on the impact of each factor alone. Most papers reported the impact of fasting during Ramadan in observational studies.[9,11-13,19,20] This study is one of a few which explored the interaction between fasting and physical activity on the lipid profile in an interventional study. Nonetheless, the sample size was enough to detect only a strong effect, which is the main limitation in our study.

The majority of the interactions were far from the statistical significance level. The patterns of changes in both groups (fasting and physical activity, and fasting alone) were more or less comparable. Many authors such as Ziaee et al explained that the changes in lipid profile during Ramadan might be due to the changes in physical activity, although they did not have any explicit findings to support their hypothesis.[9] However, our findings do not support such an explanation and it seems that most of the changes in the lipid profile of healthy individuals during Ramadan were due to changes in other factors, such as diet and sleeping hours. Moreover, the changes in the lipid profile of our subjects in both groups after Ramadan were comparable. This finding also supports the idea that other factors, such as change in diet or sleeping hours, may play an important role and explain the impact of fasting on the lipid profile in healthy individuals.

We did not check the precise diet of our subjects, as this would have required a different study design. However, our findings did not show any significant differences between the diets of the subjects in both groups. Although there is a large number of observational studies on the changes of dietary habits during Ramadan,[1,3,6,7,11,17,21,22] there is a need for more well-designed and interventional studies to assess the interactions between the nutritional status and fasting on the body metabolisms and lipid profiles in healthy individuals, as well as in special subgroups, such as obese or diabetic patients. In conclusion, the serum lipid profile in healthy fasting individuals are considerably altered during Ramadan, but the interaction between fasting and physical activity was not considerable, indicating that the changes in physical activity during Ramadan could not account for most of the changes in the serum lipid profile.

ACKNOWLEDGEMENTS

This study was funded by the Vice-Chancellor for Research at the Kerman University of Medical Sciences, Iran. We are grateful to the students who participated in this study.

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