

## A Prospective Study Comparing the Effects of Ramadan Fasting on Metabolic Parameters in Healthy Muslims from Three Different Nationalities in Dubai

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### Abstract

**Objective:** Many studies have evaluated the effect of Ramadan fasting on metabolic parameters. None of the previous studies compared the effect of fasting on people from different ethnic backgrounds. We conducted this prospective study to assess fasting Ramadan on Body Mass Index (BMI) and metabolic parameters in healthy volunteers from different ethnic backgrounds.

**Methodology:** We studied the effect of fasting during Ramadan on body mass index, fasting lipid profile, blood glucose and HbA1c in 49 healthy Muslim volunteers. These individuals belong to three different ethnicities; Pakistanis, Sudanese and Emiratis. The blood samples and anthropometric measurements were taken on two occasions; one week before Ramadan and the second was collected with in two weeks after Ramadan.

**Results:** There was a significant difference in body weight and BMI in all subjects of three nationalities at in of Ramadan fasting. There was no significant difference in fasting total cholesterol, triglyceride, HDL and LDL observed in Sudanese and Emiratis group, but subjects belong to Pakistani group showed statistically significant rise in total cholesterol by end of Ramadan. HDL has significantly reduced while total cholesterol has increased significantly in females compared to males. There were no reported hypoglycaemic events.

**Conclusion:** Fasting Ramadan led to a statistically significant reduction in weight and BMI in all participants in same model of fasting. Total cholesterol has increased significantly in the Pakistani group compared to other population at the end of Ramadan. We observed a statistically significant increase in the HDL in females in comparison to males by the end of Fasting Ramadan.

**Keywords:** Ramadan; BMI; Fasting; Lipids; Metabolic parameters; Blood glucose; HbA1c

### Introduction

According to statistical estimates, Muslims numbers are growing all over the globe, different estimates put range between 1.7 to 2.08 billion individual, in the 2.08 case scenarios, The Muslims number might outweigh all other religious populations when taken separately [1]. Fasting in Ramadan is an obligatory Islamic ritual and is mandatory for all healthy Muslims men and women to fast between sunrises to sunset in this month, except those with religious exemptions [2]. The days and timing of this holy month is decided according to Islamic lunar calendar, which is eleven days shorter than solar calendar, so in every year timings of Ramadan is variable and come in different seasons in different countries. This geographic and seasonal variation determines the duration of fast in different parts of world and on average the time period between sunrise and sunset ranges from 12 to 19 hours, in 2014 the time of fasting varied from 9:59 hours in Sydney, Australia to 21:57 hours in Reykjavik, Iceland [3]. Muslims eat two meals in a day, one before sunrise and one after sunset, there is great variation in food components and amount consumed according to cultural background [4].

Logically, it goes without saying that the metabolic parameters should improve with this long abstinence from food intake, but unfortunately, it became an inappropriate habit; when people start eating from the sunset to, almost, sunrise time that justifies why the month of Ramadan is recently being called the month of Fast and Feasts.

There are many studies carried out to look at the effect of fasting

in different components of metabolic biomarkers. The results were similar with regard to weight reduction and some reduction in systolic blood pressure, but there were some differences in changes in total cholesterol and HDL-C. The heterogeneous results observed in these studies may be due to several confounding variables including different eating habits, various diets, physical activity, different ethnical and cultural habits and duration of fasting hours [5].

Shehab et al. have conducted a study in Al-Ain city of UAE, where they evaluated 65 healthy volunteers, they found significant and beneficial changes in systolic blood pressure (SBP), body weight, waist circumference, TG, HDL-C and LDL-C, at the end of Ramadan, but not in TC at the end of the study. Although this trial has included patients from different ethnic background but the authors did not look at ethnic variation during the month of Ramadan [6].

Sadiya et al. who evaluated the effect of fasting Ramadan on 19 Emirati patients with metabolic syndrome conducted another study

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from the region. The weight and weight circumference has dropped significantly during Ramadan ( $103.9 \pm 29.8$  vs  $102.1 \pm 29.0$  kg,  $P=0.001$  and waist circumference  $123 \pm 14$  vs  $119 \pm 17$  cm,  $P=0.001$ ), in this study there was a non-statistically significant increase in fasting blood glucose and HbA1c [7].

Jamil-ur-Rehman et al. studied 24 healthy males who fasted the month of Ramadan, and assessed their metabolic profiles before and after Ramadan. They concluded that fasting Ramadan results in a significant decrease in blood glucose, cholesterol, triglycerides and LDL-C levels, while HDL-C level rose considerably at the end of month. These changes were only transient as they reversed two weeks after Ramadan [8]. Shaheena et al. conducted another study that showed similar results with the exception that there was no significant change in cholesterol [9].

None of the previously mentioned studies have evaluated the racial variations, neither they looked at metabolic differences between males and females. We conducted this study to observe the effect of fasting in different metabolic parameters in healthy volunteers from different racial backgrounds in Dubai. Moreover we compared the changes during the month of Ramadan between males and females. It gave us important insight into effect of Ramadan fasting on body weight and metabolic parameters in different nationalities fasting with in same climate.

## Study Population and Methods

55 healthy volunteers from both sexes, who were not having any previous medical problems, planning to fast the month of Ramadan, and are not on any medications were selected randomly to be included in the trial. Exclusion criteria included any metabolic or chronic medical disease, pregnancy or any acute illness that may result in breaking the fast for more than five days during Ramadan. All of volunteers are staff in our institution and they were recruited after full explanation of the study and its purpose. Complying with our local ethical committee written informed consents were obtained from all participants. The primary end point of the study was to estimate the effect of fasting the month of Ramadan on the lipid profile in healthy individuals, while secondarily we wanted to evaluate the effect of fasting the month of Ramadan on body weight, HbA1c and fasting blood glucose.

All subjects were instructed to adhere to their usual life style and not to initiate any particular new diet or exercise plan during the month of Ramadan. Anthropometric readings for BMI, fasting blood

glucose, lipid profile and HbA1c were done two times; during the week preceding Ramadan and during two weeks after Ramadan.

Body weight and height were measured in the same calibrated electronic scale and stadiometer (TONITA CEMMS NO 141-305-58-004 WB3000). Readings were taken in kilogram and height in centimetres and later BMI was calculated by weight in kg divided by height in squares meters.

## Statistical analysis

Statistical calculation done by IBM computer using SPSS (statistical program for social science version 16), we conducted both descriptive quantitative and qualitative analysis. Paired t-test, ANOVA (analysis of variance) and Kruskal Wallis test were used in different areas of the analysis process. P value of  $<0.05$  was considered significant, and  $<0.01$  was considered as highly significant.

## Results

Total number of volunteers included in the study were fifty five, 6 of them were withdrawn from the final analysis, 5 of them failed to give blood samples at the end of the study, and one volunteer was withdrawn from the study as he did complete fasting during Ramadan due to acute medical illness. Of the remaining 49 volunteers 57.1% ( $n=28$ ) were females and 42.9% ( $n=21$ ) were males. The mean age of participants was  $30 \pm 10$  years. Participants belonged to 3 different nationalities (Emirati, Sudanese and Pakistani); Table 1 shows base line characteristics of the participants.

There was a significant weight reduction during the month of Ramadan; it has changed from  $77.7 \pm 13.6$  kg to  $76.3 \pm 12.5$  kg with a percentage change of  $1.6 \pm 1$  kg and  $P<0.001$ . This has been reflected on BMI that showed reduction from 27.34.1 (mean  $\pm$  SD) to  $26.9 \pm 3.8$  (mean  $\pm$  SD) with a percentage of change of  $1.5 \pm 1.2$  and a  $p<0.001$ . The fasting blood glucose has improved from  $94.1 \pm 10.4$  mg/dl to  $93.9 \pm 9.1$  mg/dl with a percentage change of  $0.4 \pm 0.2$  mg/dl and  $p=0.24$ , which was not significant. There was no statistically significant change in HbA1c, Total cholesterol, Triglycerides, HDL and LDL levels before and after the month of Ramadan (Table 2).

When we evaluated each nationality separately, we noticed that among the three nationalities, weight loss was significant in Sudanese and Emiratis group. The mean weight dropped from  $82 \pm 11$  kg to  $80.7 \pm 9.6$  kg and the percentage change was  $1.3 \pm 1$  kg and  $P=0.012$  in Sudanese subjects. The Emirati participants had their weight reduced

Variables	All patients (Mean $\pm$ SD)	Range	Emirati N=14	Pakistani N=16	Sudanese N=19	P	LSD*
Males	N=21 (42.9%)						
Females	N=28 (57.1%)						
All	N=49 (100%)		N=14 (28.6%)	N=16 (32.7%)	N=19 (38.8%)		
Height (CM)	$168.4 \pm 8.9$	149-187	$169.5 \pm 7.8$	$164 \pm 7$	$170.7 \pm 8$	0.11NS	
Weight (Kg)	$77.7 \pm 13.6$	51-107	$78.9 \pm 12.8$	$71.5 \pm 23$	$82 \pm 11$	0.05S	Sudanese versus Pakistani ( $p=0.02$ )
BMI	$27.3 \pm 4.1$	18-34	$27.5 \pm 3.6$	$26.2 \pm 4$	$28.2 \pm 3$	0.35NS	
HbA1C (%)	4.8-6.2	$5.4 \pm 0.33$	$5.4 \pm 0.3$	$5.5 \pm 0.4$	$5.4 \pm 0.3$	0.74NS	
FBS (mg/dl)	73-123	$94.1 \pm 10.4$	$92.5 \pm 8$	$98.3 \pm 10$	$91.8 \pm 7$	0.14NS	
Total cholesterol (mg/dl)	132-277	$194 \pm 32$	$203 \pm 36$	$182.6 \pm 26$	$198.5 \pm 30$	0.18NS	
TG (mg/dl)	34-245	$108.4 \pm 54$	$107 \pm 50$	$102 \pm 59$	$114.4 \pm 47$	0.78NS	
HDL (mg/dl)	32-88	$55.8 \pm 14.9$	$52 \pm 13$	$56.2 \pm 15.8$	$58.2 \pm 17$	0.51NS	
LDL (mg/dl)	62-231	$120.9 \pm 34$	$132 \pm 31$	$106.5 \pm 28$	$120.7 \pm 22$	0.13NS	

\* LSD= least significant difference post hoc test

**Table 1:** Shows the base line characteristics of the healthy volunteers.

Variables	Before	After	% of change	t	P
Weight (Kg)	77.7 ± 13.6	76.3 ± 12.5	1.6 ± 1	4.5	0.000HS
BMI	27.3 ± 4.1	26.9 ± 3.8	1.5 ± 1.2	3.7	0.000HS
HBA1C (%)	5.4 ± 0.33	5.5 ± 0.4	0.6 ± 0.5	1.2	0.24NS
FBS (mg/dl)	94.1 ± 10.4	93.9 ± 9.1	0.4 ± 0.2	0.14	0.88NS
T. Cholesterol (mg/dl)	194 ± 32	195.9 ± 34	1.1 ± 0.7	0.42	0.68NS
TG (mg/dl)	108.4 ± 54	110.5 ± 60.4	4.9 ± 4	0.38	0.70NS
HDL (mg/dl)	55.8 ± 14.9	56.3 ± 14.2	1.9 ± 1.5	0.38	0.70NS
LDL (mg/dl)	119 ± 33.7	120.9 ± 34	3.7 ± 2.5	0.55	0.58NS

**Table 2:** Anthropometric and Lab data before and after Ramadan among total group.

from  $78.9 \pm 12.8$  kg to  $76.6 \pm 11.8$  kg and a percentage change of  $2.8 \pm 2$  kg and  $p < 0.001$ , while no significant change was seen in Pakistani participants (Figures 1 and 2). The HDL has dropped significantly in Sudanese population from  $58.2 \pm 17$  mg/dl to  $54.8 \pm 12$  mg/dl and percentage change of  $3.8 \pm 2$  mg/dl and  $P = 0.04$ .

The total cholesterol has significantly increased in the Pakistani population from  $182.6 \pm 26$  mg/dl to  $198.2 \pm 47$  mg/dl and a percentage of change of  $8 \pm 4$  mg/dl and  $P = 0.02$ . There were no other significant changes in all other parameters.

When comparing males and females, there was a significant difference in weight at baseline, that difference remained significant despite the fact that males lost more weight during the month of Ramadan compared to females (Table 3). Females had increase in their HDL by about 6%, while decreased by 3.7% among males. This difference was statistically significant using Mann Whitney test.

## Discussion

Many studies have been done previously in different healthy Muslim population to see the effects of intermittent fasting on cardio metabolic parameters like lipid profile, fasting blood glucose, body weight and blood pressure and no definite conclusion could be drawn out of these studies until now [5]. The variable results could be due to different attributes of ethnic groups, their dietary habits and physiological conditions.

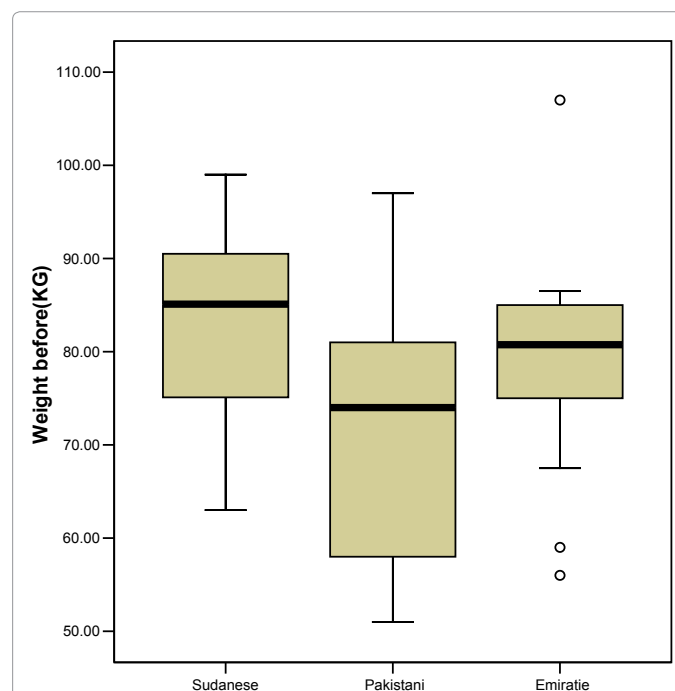
To see the effect of Ramadan fasting in people with different ethnic background in same model of fasting, we conducted this study in Dubai, which is known to be the hub of multiple nationalities. The results of our study showed that there is reduction in weight and BMI reaching to significant value, at the end of Ramadan in all participants. There is no significant improvement noted in serum lipoprotein values, HBA1c, and fasting plasma glucose level after Ramadan.

Few studies have demonstrated that persistent fasting during the month of Ramadan resulted in mild weight loss but this reverted back to normal after Ramadan is over [10]. Another recent trial that evaluated the effect of fasting on weight, blood pressure and total cholesterol in hypertensive patients has shown no change in total cholesterol but improvement in blood pressure and weight [11].

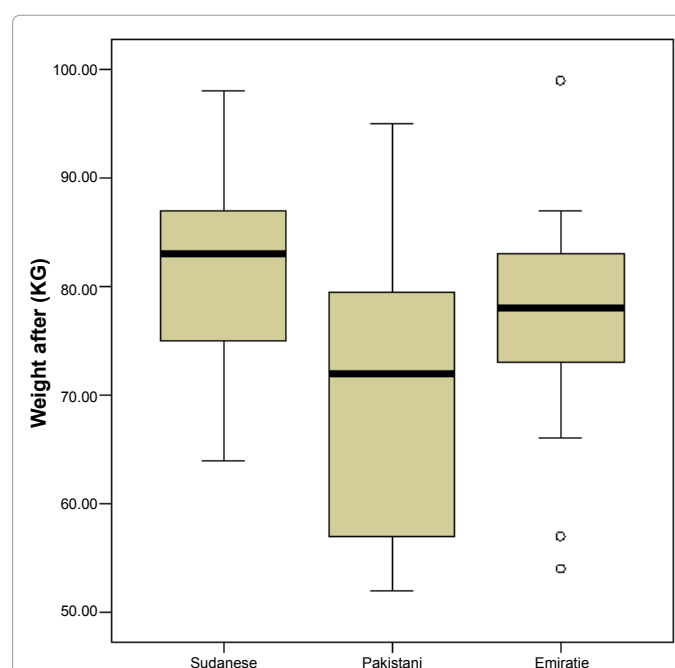
The non-beneficial effect of Ramadan fasting on lipid and HBA1c and weight observed in our study has been seen before in earlier studies [12,13]. In contrast to our findings, some studies showed favourable lipid profile manifested as a rise in HDL and decrease level of LDL level [14,15]. While some studies showed no measurable difference in all these parameters [16].

One trial done in Morocco in 32 healthy male subjects showed contrary findings from our study as they demonstrated significant

beneficial effect on lipoproteins like raised HDL and decrease in LDL level, which persist even after 4 weeks post Ramadan [17] Same findings also reported in a prospective observational study from Iran [18]. A study done in Jordan showed non-significant rise in triglyceride and



**Figure 1:** Box plot for comparison between different groups as regard weight before represented by dark line in the middle, lower limit of the square is for 25th percentile, the upper one for 75th percentile and upper and lower cross for extreme values.



**Figure 2:** Box plot for comparison between different groups as regard weight after represented by dark line in the middle, lower limit of the square is for 25th percentile, the upper one for 75th percentile and upper and lower cross for extreme values.

Variables	Gender		t	P
	Male	Female		
Height (cm)	172.5 ± 8.5	165.3 ± 8	2.2	0.03S
Weight before (kg)	82.2 ± 13	74.4 ± 17	2.4	0.02S
Weight after (kg)	80.2 ± 12	73 ± 12	2.1	0.05S

**Table 3:** Comparing differences in weight between males and females before and after the month of Ramadan.

blood glucose at end of fasting [19], which is also a non- significant finding in our study.

Some previous studies showed the completely opposite effects and rather worsening metabolic profile as reported by Bakhotmah and his group in western Saudi Arabia after a month of Ramadan fasting [20]. Hallak and colleagues also explored the complex relationship of weight loss with heterogeneous change in lipoproteins and explained it by linear and curvilinear model of regression [21].

Our main objective was to see the effect of Ramadan fasting in different nationalities. We believed typical diet consumed in Gulf region in Ramadan that is rich in saturated fat and carbohydrate, may ameliorate the weight loss and metabolic effect of fasting [22,23]. We kept in mind also that people from different cultural background usually remain adherent to their own native dietary choices especially during month of Ramadan.

Separate data analysis was done with respect to each nationality. Our results showed that subjects belong to United Arab Emirates showed a significant loss in weight, but no significant improvement in total cholesterol and HDL level. These results are in accordance with previous research done before in UAE by Sadiya and her group, where follow-up of 19 native Emiratis with metabolic syndrome showed significant decrease in body weight and waist circumference, slight increase in fasting glucose and HBA1c but no change in lipid parameters after Ramadan fasting [7].

One recent regional study done in 65 multi-ethnic healthy subjects from al-ain, UAE showed favourable effect on LDL and HDL at end of Ramadan, their study subjects showed even progressive improvement in LDL and HDL concentration even after 4 weeks of Ramadan fasting. They also observed that reduction in weight, blood pressure, Total Cholesterol and Triglycerides observed during Ramadan, which did not last 4 weeks after Ramadan, these data was not separately analysed in different ethnic groups [6].

Data comparison in Sudanese community showed a favorable effect on weight and BMI and non-significant drop in HDL level. The difference in their weight loss is significant compare to Pakistanis (Table 3). In addition the dietary habits and type of food, we could also attribute this difference to the fact that most of the Pakistani volunteers were females, while most of the Sudanese were males.

Concerning to our finding of a rise in total cholesterol in Pakistani participants, previous studies in this population showed contradictory result, as shown in one study from Pakistan (2000) which is done in healthy volunteers, found that total cholesterol, triglyceride and LDL levels decreased significantly, while HDL showed a significant rise at the end of the Ramadan [8]. Similarly one study by Shaheena et al. conducted in India included 30 young Indian individuals showed significant decrease in body weight, Triglycerides, LDL and systolic blood pressure with significant rise in HDL [9]. This is contradicting our results in Pakistani population who showed rather a significant rise in total cholesterol and no change in HDL. Although the dietary habits may have resemblance due to being common origin from South East

Asia, still geographical variation or physical activity may explain the different results.

Our data also showed gender related difference in lipoproteins level as a rise in HDL level but with no improvement in other lipoproteins and glycemic control in female participants which has been demonstrated in few studies before but not as an isolated phenomena. One such study in Algerian adults (2009), where LDL and HDL levels were analyzed separately in males and females but their study showed rise in HDL in both males and females while LDL declined in both sex with significant drop in male by 55% and 20% decline in females by end of Ramadan. Similar significant rise in HDL cholesterol has been shown in other studies before but in both males and females [12].

## Conclusion

Our study showed the significant reduction in weight and BMI, which is more marked in Emiratis and Sudanese compared to Pakistani group. Total cholesterol was significantly higher in Pakistani population compared to Sudanese and Emiratis by the end of Ramadan. Female participants showed a significant positive rise in HDL level compare to males participants. These results address the significant issue of dietary choices in certain ethnic population, which are even ameliorating the beneficial effect of a full month of prolonged fasting.

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