EFFECT OF RAMADAN FASTING ON SERUM INSULIN AND FASTING BLOOD GLUCOSE IN ADULT OBESE AND OVERWEIGHT POPULATION OF KARACHI, PAKISTAN

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خلاصہ

زیادہ وزن اور پے کا شکار خواتین و مرد حضرات پر رمضان کے روزوں کے اثرات فاسٹنگ بلڈ شوگر (FBG) اور انسولین لیول پر دیکھے گئے۔ 20 سے 40 سال کی عمر کے 55 بالغ مردوں اور 55 بالغ عورتوں کو تحقیق میں شامل کیا گیا۔ ان مردوں اور عورتوں کو تین BMI گروہ میں تقسیم کیا گیا جن میں Control , Over weight اور موٹے (Obese) لوگ شومل تھے۔ Over weight اور Obese مردوں اور عورتوں دونوں میں رمضان کے آخری BMI میں نمایاں کمی دیکھی گئی (P<O.001) مردوں اور عورتوں کے (FBG) میں بھی رمضان کے آخر میں واضح فرق پایا گیا (P<0.01). سیرم انسولین لیول بھی مردوں میں کم ہو (P<O.05) اسی طرح عورتوں میں بھی رمضان کے روزوں کی وجہ سے کم ہوا (P<0.01)۔ انسولین حساسیت انڈکس (Insulin Sensivity Index) مردوں اور عورتوں میں نمایاں طور پر بڑھا۔ یعنی رمضان کے روزوں کا زیادہ وزن اور موٹاپے کا شکار لوگوں پر مثبت اثر ہوا۔ FBG,BMI اور سیرم انسولین کم کرنے میں مدد ملی۔

Abstract

The purpose of this study was to determine the changes caused by Ramadan fasting on the body weight, glucose homeostasis, insulin resistance and insulin sensitivity index in overweight, obese, and non-obese adult subjects of both the sexes. A total of 55 Muslims adult female volunteers and 55 male volunteers whose ages ranged between 20 and 40 years, were folat first day of Ramadan and during the last week of Ramadan. Fasting blood glucose (FBG) was analyzed by GOD-PAP method, Serum insulin were estimated with the help of human ELISA kit and insulin sensitivity indices were analyzed through QUICKI. Overweight and obese male subjects were observed with significant decrease in body mass index as compared to normal weight subjects (P<0.001; P<0.001), reduction in BMI was also noted in overweight and obese female subjects (P<0.001; P<0.001). Fasting blood glucose exhibited significant decrease in pre and post over weight and obese males (P<0.001; P<0.001), same pattern were experienced among overweight and obese females (P<0.001; P<0.001). Serum insulin levels in pre and post overweight males were significantly reduced (P<0.05; P<0.05), similarly, pre and post Ramadan obese males were also observed with significantly reduced serum insulin (P<0.001; P<0.01). In female group serum insulin level reduced significantly in post overweight (P<0.01), Pre obese (P<0.001) and post obese (P<0.001) towards the end of the Ramadan. A significant improvement was also observed in insulin sensitivity of overweight and obese group of both the genders. Pre and post overweight males showed significantly increased insulin sensitivity (P<0.05; P<0.01) respectively. Pre and post obese males showed highly significant results of insulin sensitivity index (P<0.001; P<0.001). Likewise, pre and post overweight (P<0.05; P<0.05), pre and post-obese females (P<0.001; P<0.001) showed significant improvement in their insulin sensitivity indices. Ramadan fasting in overweight and obese subjects as compared to non-obese has a beneficial effect on blood glucose homeostasis. Result of our study also shows that serum insulin levels as well as BMI significantly decreased. Dietary and caloric control during Ramadan is very helpful to promote insulin sensitivity in obese people.

Introduction

Fasting during Ramadan is obligatory for all healthy grown-up Muslims. In Ramadan, Muslim grown-ups fast from dawn to dusk and are forbidden from intake of food, water, refreshments, smoking and sex. Ramadan fasting is being observed by whole Muslim world every year (Aadil *et al*., 2004).

Ziaee *et al.,* (2006) and Larijani *et al.,* (2003) reported that Ramadan fasting has positive effects on blood glucose and lipid profile. While other studies have detected no change by fasting on these parameters (Bouguerra *et al*., 2006). During the month of Ramadan the sleeping and awaking timings are also changed, this alteration leads to changes in concentration of leptin, neuropeptide-Y and insulin that regulate the cycle of food intake and energy expenditure (Kassab *et al*., 2004). Since fasting during Ramadan influences a vast population, different studies were done in the most recent 20 years to see the impact of intermittent fasting on different variables in healthy (Dewanti *et al.,* 2006; Ziaee *et al*., 2006) and unhealthy population groups (Khafaji *et al*., 2012; Sadiya *et al.,* 2011). The majority of the studies described that Ramadan fasting prompts to improvement in the metabolic profile of the body like blood glucose, lipid profile, hematological factors and body weight (Savas *et al*., 2012; Ziaee *et al*., 2006).

The adjustments in dietary habits, meal frequencies and way of life changes during Month of Ramadan are an amazing model to evaluate the influence of Islamic fasting on the body and blood composition of overweight and obese people. Shariatpanahi *et al*., (2008) demonstrated a huge decrease in the mean of body weight toward the end of Month of Ramadan in overweight grown-ups with metabolic disorder. The weight diminishment was disclosed by the scientists to be an aftereffect of skirting the mid day meal when the body is metabolically dynamic (Al-Numair 2006; Adlouni *et al*., 1997).

Insulin is a fundamental hormone, feeding stimulates the discharge of insulin in healthy individual. Insulin converts excess of blood glucose into glycogen and store inside liver and muscles. In contrast during fasting the blood glucose concentrations decrease, leading to decreased release of insulin. Meanwhile glucagon hormone and catecholamine's level elevated which enhance the breakdown of glycogen, while gluconeogenesis is increased (Maislos *et al*., 1993).

In normal weight people the glucose concentration is kept in the normal physiological range by delicate agreement between flowing levels of insulin and glucagon. In diabetic patients the fundamental pathophysiology and frequently by pharmacological administrators expected to enhance or increased insulin emission (Gisela, 2005). In diabetic patients with severe insulin lack, a extended fast without satisfactory insulin can cause glycogen breakdown and expanded gluconeogenesis and ketogenesis, thus prompting to hyperglycaemia and Ketoacidosis (Maislos *et al*., 1993). Consequently diabetic patients ought to counsel their doctor a month before Ramadan.

The drop in the insulin secretion and rise in glucagon levels during the Ramadan fasting are certainly the major components allowing the stimulation of lipolysis, the start up of gluconeogenesis and muscular proteolysis (Barrè *et al*., 2001; Basdevant *et al*., 2007). Improvement in insulin sensitivity during Ramadan may because of alteration in timings and numbers of meals intake (Shariatpanahi *et al*., 2008).

Intermittent fasting has two important beneficial effects on human body, which are autophagy and generation of new cells by stimulation of growth hormone. This pathway is demonstrated by Japanese scientist Dr Yoshinori Oshsumi's Nobel prize-winning work on autophagy. Autophagy is a natural process, which clear the damaged, dead and diseased cells in body. Autophagy is triggered by nutrient deprivation (during fasting), brain get signaled that there is not enough food available and then body steps for stored food. Then autophagy starts attacking old and junky proteins in the body. This mechanism is carried out through drop in insulin levels and of glucagon. When glucagon is stimulated, it starts phagocytosis of old, damaged cells and junk in the body, which need to clear. But even the smallest quantity of food is enough to stop secreting the glucagon. It requires entirely self-restraint from food for about 12 to 36 hours, which is generally seen in many fasting specialists, but they must remain hydrated through drinking adequate amount of water (https://www.nobelprize.org/nobel_prizes/medicine/laureates/2016/press.html).

Objective of this study was to describe the impacts of Islamic fasting on body weight, FBG and Serum insulin level in normal weight, over-weight and obese adult Muslim volunteers of both the sexes.

Methodology

This study was conducted during the month of Ramadan, (June and July 2014). Participants for this were recruited from Federal Urdu University of Arts Science and Technology (FUUAST), Karachi, Pakistan. A total of 55 Muslims adult female volunteers and 55 male volunteers whose ages ranged between 20 and 40 years, and reported no history of chronic diseases underwent anthropometric, and biochemical evaluation on first day and at the end of last week of Month of Ramadan. Both males and females were grouped into three BMI categories i.e., control, overweight and obese. Among males (15 control: mean age 24.73 ± 0.65), 10 overweight: mean age 32.10 ± 1.58 and 30 obese with mean age 33.90 ± 1.38). While Among females (15 Control females: mean age 21.80 ± 0.44; 10 overweight: mean age 30.70 ± 1.42 and 30 obese females: mean age 31.83 ± 1.16).

All the subjects fasted throughout the Ramadan, and average Fasting time was about 15 hours a day. As females do not fast during menstruation according to Islamic rules but they followed the same 15 hours fasting routine for experiment. Group of volunteers participated in the study was appeared at 1st day of Ramadan was labeled as Pre while the same group of volunteers both males and females appeared at last day of Ramadan were

labeled as Post. Anthropometric measurements like weight and height were taken then BMI was calculated. An intravenous blood sample was taken before Iftar from each subject. Blood samples were centrifuged for serum separation. FBG and serum insulin was estimated by GOD-PAP method and human ELISA kit used: INS-EASIAKAP1251 (DIA source Immuno-Assays S.A-Belgium), respectively. Insulin sensitivity index was calculated by QUICKI by using formula. QUICKI = $1/(\log I_0+\log G_0)$
Where I_0= Fasting serum insulin and G_0= Fasting blood glucose.

All the subjects were kept on caloric restriction, all of them were suggested to avoid oily foods stuff at Iftar as well as provided with white oats for Sahar meal. Main objective of the study was to check the impact of Ramadan fasting on Serum insulin and FBG.

Statistical analysis was performed using the SPSS statistical software (SPSS, Chicago, IL, USA). All values were calculated and presented as mean ± standard error of the mean (SEM). One-way ANOVA was use to compared the means of study groups. P values < 0.05 were accepted as significant.

Results

We have compared the Pre and post Ramadan groups in the following manner:

1. Comparison of Pre Ramadan males with Post Ramadan males.

BMI (Kg/m^2) of Pre Ramadan control males (PRCM) (21.56 ± 1.11) and post Ramadan control males (PsRCM) (21.25 ± 1.07) were compared with Pre Ramadan overweight males (PROM) (24.75 ± 0.33) and Post Ramadan overweight male (PsROM) (23.83 ± 1.00), mean BMI values were higher significantly in PROM and PsROM than control subjects (P<0.001; P<0.001). Similar pattern was seen among pre Ramadan obese males (PRObM) BMI (34.90 ± 4.11) versus Post Ramadan (PsRObM) BMI (32.78 ± 3.85) mean values (P<0.001; P<0.001). BMI of pre and post control male showed no significant changes (P>0.05), BMI values of post overweight and post obese males were significantly lower than their respective pre group (P<0.05; P<0.05) (Table 1 and 2).

FBG (mg/dL) level of PRCM and PsRCM were ranged at 86.26 ± 4.49 and 84.53 ± 6.97 respectively, while mean values of pre and post overweight and obese male subjects were 99.00 ± 9.70 and 98.10 ± 7.95, 111.10 ± 11.99 and 104.63 ± 11.97 respectively. Comparison of pre and post overweight and obese males with pre and post control males showed significant results (P<0.001). Our result showed no significant difference in average FBG level of pre and post control and overweight males (P>0.05). While post Ramadan obese males showed significant lower FBG value than pre obese males (P<0.05) (Table 1 and 2).

The serum insulin (μLU/mL) concentration of pre and post control, overweight and obese males were 7.54 ± 4.36 and 7.12 ±5.19, 12.47 ± 5.06 and 11.25 ± 2.90, 17.05 ± 8.06 and 12.20 ± 6.58 respectively. Significant results were found in Pre and post overweight (P<0.05; P<0.05) as well as in obese males (P<0.001; P<0.01). Serum insulin concentration of pre and post control and overweight males were not related significantly (P>0.05), while that of post-obese males were significantly lower (P<0.05) (Table 1 and 2).

Insulin sensitivity Index mean values of pre versus post normal weight, overweight and obese males were averaged at 0.36 ± 0.02 versus 0.37 ± 0.03, 0.33 ± 0.031 versus 0.33 ± 0.01 and 0.31 ± 0.02 versus 0.33 ± 0.03. Insulin sensitivity index ratio was significantly lower in pre and post Ramadan overweight (P<0.05; P<0.01) and obese male (P<0.001; P<0.001). Insulin sensitivity index of pre and post control and overweight males groups were not significantly different from each other (P>0.05) while insulin sensitivity index ratio were significantly higher in post Ramadan obese males (P<0.05) (Table 1 and 2).

2. Comparison of Pre Ramadan females with Post Ramadan females.

The average BMI values of pre and post females control were 19.84 ±1.73 and 19.28 ± 1.50 respectively. Mean BMI values of pre overweight (24.36 ± 1.10) and post overweight was (24.13 ± 1.06) statistically significant (P<0.001; P<0.001). Similar patterns were seen in pre obese (33.80 ± 5.26) and post obese females (31.06 ± 4.57) (P<0.001; P<0.001). BMI of Pre and post Ramadan control and overweight females were non-significant (P>0.05). While BMI of post-obese females significantly reduced (P<0.05) (Table 3 and 4).

FBG average level of pre control females and post were 97.67 ± 13.85 and 81.80 ± 2.88 mg/dL respectively. Significant differences were noted in Pre overweight (109.60 ± 10.51) (P<0.05), post overweight (108.10 ± 8.52) (P<0.001), pre obese (110.67 ± 15.01) (P<0.05) and post obese females (101.17 ± 16.95) (P<0.001). The comparison of FBG (mg/dL) levels of pre and post Ramadan control female subjects presented significantly lower FBG levels (P<0.001), non-significant in overweight (P>0.05) and significant reduction was observed in post obese females (P<0.05) (Table 3 and 4).

Serum insulin averaged level of pre and post control females were 9.84 ± 4.94 and 7.53 ± 3.43, respectively. While those of pre and post overweight were 13.08 ± 2.99 and 11.45 ± 2.95 respectively. While obese pre was 19.65 ± 7.20 and post was 18.84 ± 8.30. Significant outcomes were obtained only in post overweight females group (P<0.01). While both obese group showed significant difference than control females (P<0.001; P<0.001). Mean serum Insulin level of pre control, pre overweight and pre obese female were not different significantly from their post groups (P>0.05) (Table 3 and 4).

Table 1: - Mean values of control males (Pre and Post Ramadan) compared with overweight male subjects of Pre and Post Ramadan

Variables	Control males (n=15)	Overweight males (n=10)	P-Value
Age (Years)	24.73 ± 0.65	32.10 ± 1.58	
BMI (Kg/m^2) Pre	21.56 ± 1.11	24.75 ± 0.33	0.000
Post	21.25 ± 1.07	23.83 ± 1.00	0.000
P-Value	0.449	0.013	
FBG (mg/dL) Pre	86.26 ± 4.49	99.00 ± 9.70	0.000
Post	84.53 ± 6.97	98.10 ± 7.95	0.000
P-Value	0.425	0.823	
Insulin (µLU/mL) Pre	7.54 ± 4.36	12.47 ± 5.06	0.016
Post	7.12 ± 5.19	1125 ± 2.90	0.032
P-Value	0.815	0.516	
Insulin Index Pre	0.364 ± 0.02	0.331 ± 0.03	0.015
Post	0.373 ± 0.03	0.330 ± 0.01	0.001
P-Value	0.413	0.918	

Table 2: - Mean values of control males (Pre and Post Ramadan) compared with obese male subjects of Pre and Post Ramadan

Variables	Control males (n=15)	Obese males (n=30)	P-Value
Age (Years)	24.73 ± 0.65	33.90 ± 1.38	
BMI (Kg/m^2) Pre	21.56 ± 1.11	34.90 ± 4.11	0.000
Post	21.25 ± 1.07	32.78 ± 3.85	0.000
P-Value	0.449	0.046	
FBG (mg/dL) Pre	86.26 ± 4.49	111.10 ± 11.99	0.000
Post	84.53 ± 6.97	104.63 ± 11.97	0.000
P-Value	0.425	0.044	
Insulin (µLU/mL) Pre	7.54 ± 4.36	17.05 ± 8.06	0.000
Post	7.12 ± 5.19	12.20 ± 6.58	0.009
P-Value	0.815	0.018	
Insulin Index Pre	0.364 ± 0.02	0.312 ± 0.02	0.000
Post	0.373 ± 0.03	0.330 ± 0.03	0.000
P-Value	0.413	0.019	

Table 3: - Mean values of control females (Pre and Post Ramadan) compared with overweight female subjects of Pre and Post Ramadan

Variables	Control females (n=15)	Overweight females (n=10)	P-Value
Age (Years)	21.80 ± 0.449	30.70 ± 1.42	
BMI (Kg/m^2) Pre	19.84 ± 1.73	25.36 ± 1.10	0.000
Post	19.28 ± 1.50	25.13 ± 1.06	0.000
P-Value	0.354	0.641	
FBG (mg/dL) Pre	97.67 ± 13.85	109.60 ± 10.51	0.030
Post	81.80 ± 2.88	108.10 ± 8.52	0.000
P-Value	0.000	0.730	
Insulin (µLU/mL) Pre	9.84 ± 4.94	13.08 ± 2.99	0.078
Post	7.53 ± 3.43	11.45 ± 2.95	0.007
P-Value	0.148	0.237	
Insulin Index Pre	0.356 ± 0.03	0.318 ± 0.01	0.002
Post	0.354 ± 0.02	0.325 ± 0.01	0.004
P-Value	0.872	0.304	

Table 4: - Mean values of control females (Pre and Post Ramadan) compared with obese female subjects of Pre and Post Ramadan

Variables	Control females (n=15)	Obese females (n=30)	P-Value
Age (Years)	21.80 ± 0.449	31.83 ± 1.16	
BMI (Kg/m^2) Pre	19.84 ± 1.73	33.80 ± 5.26	0.000
Post	19.28 ± 1.50	31.06 ± 4.57	0.000
P-Value	0.354	0.036	
FBG (mg/dl) Pre	97.67 ± 13.85	110.67 ± 15.01	0.007
Post	81.80 ± 2.88	101.17 ± 16.95	0.000
P-Value	0.000	0.025	
Insulin (µLU/mL) Pre	9.84 ± 4.94	19.65 ± 7.20	0.000
Post	7.53 ± 3.43	18.84 ± 8.30	0.000
P-Value	0.148	0.690	
Insulin Index Pre	0.356 ± 0.03	0.30 ± 0.01	0.000
Post	0.354 ± 0.02	0.31 ± 0.02	0.000
P-Value	0.872	0.192	

The controls females have mean value of insulin sensitivity index was ranged at 0.35 ± 0.03 versus 0.35 ± 0.02. Pre and post overweight females have mean values ranged between 0.31 ± 0.01 and 0.32 ± 0.01. Mean values of obese females were ranged at 0.30 ± 0.01 and 0.31 ± 0.02. Significant improvement was noted in pre and post overweight ($P<0.01$; $P<0.01$) and obese females ($P<0.001$; $P<0.001$). Non-significant results were exhibited by insulin sensitivity index of control, overweight and obese females ($P>0.05$) (Table 3 and 4).

Discussion

BMI is a good anthropometric indicator of visceral body fat, which showed a considerable change in BMI at the end of fasting when compared to pre Ramadan values in the present study. Our findings showed significant weight loss due to Ramadan fasting. It is in line with the results of other studies. Weight loss during Ramadan is observed in both males and females. Temizhan *et al*., (2000) also found decrease in BMI. Shehab *et al*., (2012) observed a significant loss in BMI among the participants. This reduction in BMI might be caused by the mild dehydration (Shehab *et al*., 2012). The results of our study are in accordance with previous studies in term of weight loss status (Faris *et al*., 2012; Al-Hourani *et al*., 2009).

Our findings showed that the mean of FBG levels was reduced significantly at the end of Ramadan. It indicated a decreased risk of developing Diabetes. These outcomes are in harmony with the majority of the studies reported in literature (Furuncuoglu *et al*., 2007; Ibrahim *et al*., 2008). The study of Azizi (2010) demonstrated that in the total energy intake during Month of Ramadan and the subsequent depletion in glycogen stores could contribute to the reduction in FBG levels (Azizi, 2010). Therefore, overweight and obese people, who are at greater risk for developing DM, are encouraged to take Month of Ramadan as a dietary model that can help in regulation of blood glucose levels through lowering the total energy intake.

Decrease in body weight due to dietary limitations (Weiss *et al*., 2014), intermittent fasting (Dube *et al*., 2012) or exercise (Mendelson *et al*., 2014) has been shown to increase insulin uptake by peripheral tissues. According to results of our study a significant reduction was noticed in fasting blood glucose levels. Previous literature suggested the variety of findings like some studies have no change (Unalacak *et al*., 2011) or even increase (Nematy *et al*., 2012) in glucose level after Ramadan. Our results are in harmony with previous studies (Faris *et al*., 2012; Larijani *et al*., 2003). The dissimilarity in discoveries between studies about blood glucose concentration towards the end of Ramadan fasting might be because of individual differences in stored glycogen, physical activity, feeding habits and life style.

We observed reduction in fasting serum insulin concentration, like fasting blood glucose levels. Our findings were in line with the study conducted by Sadr *et al*., (2001) and Al arouj *et al*., (2005). The reason for this reduction in serum insulin level is less blood glucose used by the peripheral tissue, thus low volume of insulin is required. Thus the studied subjects were also observed with improved insulin sensitivity. Insulin sensitivity has been shown to increase at the end of Ramadan fasting among patients with MS (Shariatpanahi *et al*., 2008) and in type 2 DM patients (Yarahmadi *et al*., 2003).

Our study did not support the previous reports by various authors described no noteworthy change in FBG, serum fasting insulin and insulin-resistance at the end of Ramadan. (Nematy *et al*., 2012; Sarraf-Zadegan *et al*., 2000; Ramadan, 2002; Yarahmadi *et al*., 2003). While, others reported higher (Bouguerra *et al*., 2006) or lower

(Ziaee *et al*., 2006; Khaled *et al*., 2006; Khatib and Shafagoj, 2004) FBS at the end of Ramadan. These disagreements may be due to different eating habits, amount of calorie intake (Fakhrzadeh *et al.*, 2002).

Schenk *et al*., (2009) demonstrated that modified weight reduction causes a lessening in unsaturated fat assembly (30%) and a change of 60% of insulin sensitivity is not because of exercise (Schenk, *et al*., 2009). Thus improvement in insulin sensitivity may be to weight loss rather the reason for weight reduction.

Conclusion

Ramadan fasting has a favorable effect on body weight and metabolism of adult overweight and obese subjects. As the subjects were kept on dietary limitations, a considerable loss in body weight and BMI was noted. Additionally, decrease in fasting blood glucose, serum insulin and enhanced insulin sensitivity were also observed at the end of Ramadan. Reduction in FBG and serum insulin concentration could be beneficial in terms of diabetes and further studies to investigate the mechanism of increased insulin sensitivity and reduction in FBG and serum insulin levels in the overweight and obese adult subjects.

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