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ORIGINAL ARTICLE

Effect of Ramadan Fasting on Body Weight and Serum Leptin Level: A Prospective Study

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ABSTRACT

Objective: To evaluate the changes caused by Ramadan fasting on body weight and serum leptin level in normal, overweight and obese individuals.
Methods: This prospective observational study was conducted from June to July 2014 among individuals who fasted throughout the month of Ramadan and had no known chronic disease. All individuals were categorized according to Body Mass Index (BMI) categories for Asians, i.e., normal weight (18.5-22.9 Kg/m2), overweight (23-24.9 Kg/m2) and obese (>25Kg/m2). Anthropometric measurements and blood samples were obtained at first day of Ramadan (Pre Ramadan) and during the last week of Ramadan (Post Ramadan). Leptin hormone was analyzed by Human ELISA kit. Paired t-test was used for comparison, p-values <0.05 was considered as significant.
Results: Out of total, 110 patients (55 males and 55 females), 30 (27.27%) individuals had normal BMI, 20 (18.18%) were overweight while 60 (54.54%) were obese. Ramadan fasting caused significant reduction in BMI (Kg/m^2) of overweight (P=0.013) and obese (P=0.046) male individuals. Noticeable and significant reduction was also observed in BMI of obese females (P=0.036). A significant reduction in the mean serum leptin (ng/ml) level of overweight males (P=0.033), obese males (P=0.003) males, and obese females (P=0.041) was also observed at the end of Ramadan.
Conclusion: The findings of this study showed that the fasting during Ramadan is an excellent opportunity for overweight and obese people to lose body weight. The BMI and serum leptin concentration of obese and overweight individuals of both genders of our study significantly decreased due to fasting.
Keywords: Ramadan fasting, BMI, Serum Leptin.

INTRODUCTION

Fasting in Ramadan is obligatory for all healthy Muslim adults. They fast from dawn to dusk and are forbidden from intake of food and fluids, smoking and sex.[1] Islamic fasting causes numerous physiological, biochemical, and metabolic changes in the body. Ramadan fasting expands the complete blood count. Besides, it lessens body weight, waist size, BMI, muscle to fat quotients, blood glucose, and blood pressure.[2, 3] Various studies have reported that fasting helps in therapeutic treatment for different health issues including weight control.[4, 5] A consistent dietary limitation could decidedly impact the biochemical and physiological processes and the provocative condition of the body.[6]

Leptin plays an important role including maintaining body weight, energy homeostasis, stimulate hypothalamic responses, regulates energy intake and its consumption.[7, 8] Previous studies have shown that *Ramadan* fasting may affect the circadian rhythms of a number of

biological parameters, including different hormones.[9] Alzoghaibi et al noted a shift in the circadian rhythm of leptin but found no noteworthy variations in the average plasma leptin levels during the last week of *Ramadan* in male individuals.[8] Various factors like quantity and frequency of food intake, sleep/wake timings and sleep period, exposure to light and also exercise that occur during *Ramadan* may influence plasma leptin.[10, 11] Moreover, greater plasma leptin levels were discovered in obese as compared to lean subjects. Additionally, the higher levels of leptin were noted in women than in men.[12]

Incidence of obesity and overweight is growing issue of urban population. Leptin hormone involved in energy balance and food intake, its concentration is raised in obesity. Consequently, this study was planned to evaluate the impact of Islamic fasting on serum leptin level of normal, overweight and obese subjects of Karachi city.

METHODS

This prospective observational study was carried out during the holy month of Ramadan, which fell in 2014 of June – July. The Research Ethics Committee of Federal Urdu University of Arts Science and Technology (FUUAST) Karachi, Pakistan approved study protocol. Subjects for this study were recruited from FUUAST, and some other localities in Karachi, Pakistan. Participants were approached a week before Ramadan and a written informed consent was taken from all individuals.

Inclusion criteria for the study were participants who fasted throughout the month of Ramadan and had no known chronic disease. Subjects with age more than 40 years and who were underweight, i.e. BMI <18.5 kg/m^2 were excluded. A total of 55 female volunteers and 55 male volunteers whose ages ranged between 20 and 40 years, underwent anthropometric, and biochemical evaluation on first day (Pre-group) and at the end of last week (Post group) of Month of Ramadan were enrolled.

All the subjects fasted throughout the Ramadan, and average fasting time was about 15 hours a day. Whereas females do not fast during menstruation according to Islamic rules, but they followed the same fasting routine throughout the month for experiment. All the subjects were kept on dietary restrictions; all of them were suggested to avoid oily foods stuff at Iftar.

Anthropometric measurements like weight and height were taken and BMI was calculated. One observer took weight and height at the same sitting. For each variable, two measurements were taken, and the mean values were recorded. Weight was measured with a calibrated Seca scale (Itin Scale Co., Inc. Germany) with the precision of 0.1 kg. A cotton ruler that was attached to the wall, used to measured height. BMI was calculated as weight in kilograms (Kg) divided by height in meters squared (m^2). All individuals were categorized into three categories as per their BMI i.e., normal weight (18.5-22.9 Kg/m^2), overweight (23-24.9 Kg/m^2) and obese (>25Kg/m^2).[13]

An intravenous blood sample of 10-12 hours fasting was taken before Iftar from each subject. Blood samples were centrifuged for serum separation and stored at -80°C. Plasma leptin levels were determined using enzyme-linked immunoassays Human ELISA kit, Leptin-EASIA KAP2281 (DIA source Immunoassay S.A-Belgium).

Data were collected through a pre-structured questionnaire. The major outcome variables included in the study were BMI and serum leptin level. Statistical analysis was performed using the SPSS statistical software (SPSS, Version 23). All values were calculated and presented as mean ± standard error of the mean (SEM) and percentage. For comparison of pre and post group paired t-test was used, P values < 0.05 were accepted as significant. Percentage ratio (increase or decrease) of pre and post Ramadan of each variable was calculated as post Ramadan value divided by pre-Ramadan value multiplied by hundred (% ratio = Post / Pre-x 100). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

RESULTS

Comparison of overall Pre Ramadan-subjects with Post Ramadan subjects

Out of total, 110 patients (55 males and 55 females), 30 (27.27%) individuals had normal BMI, 20 (18.18%) were overweight while 60 (54.54%) were obese. Mean age of normal, overweight and obese individuals were 23.26 ± 0.47, 31.40 ± 1.04, 32.86 ± 0.90 years respectively. Mean BMI of pre and post normal weight were 20.70 ± 0.31 and 20.27 ± 0.29 Kg/m^2 respectively. Pre and post overweight subjects have BMI averaged at 24.95 ± 0.22 and 23.93 ± 0.21 Kg/m^2 respectively. Average BMI of pre-obese were 34.35 ± 0.22 and post obese subjects were 33.78 ± 0.59 Kg/m^2. Serum leptin level of pre-normal weight was 4.91 ± 0.38 and post was 4.28 ± 0.33 ng/ml. Pre and post overweight group was found with 13.00 ± 1.30 and 10.29 ± 1.34 ng/ml of serum leptin concentration. However, 27.33 ± 1.94 and 23. 42 ± 1.64 ng/ml leptin level was noted in pre and post obese subjects. Statistically significant difference was noted in BMI of pre and post obese individuals (P=0.043). Serum leptin concentration of both overweight (P=0.011) and obese individuals (P=0.002) significantly decreased towards the end of Ramadan (Table 1).

Comparison of Pre Ramadan-males with Post Ramadan males

Mean age (years) of normal weight, overweight and obese male subjects were 24.73 ± 0.65, 32.10 ± 1.58, 33.90 ± 1.38 years respectively.

Pre Ramadan-subjects of each BMI category was compared with their post Ramadan subjects. An insignificant reduction of 1.44% was noted in BMI (Kg/m^2) of normal weight individuals. Post overweight and post obese males were found with about 3.71% and 6.08% reduction in their BMI, and this reduction expressed in BMI of overweight (P=0.013) and obese (P=0.046) were statistically significant. Mean serum leptin (ng/ml) level of normal weight was non-significantly decreased (19.53%). While Ramadan fasting positively affected the serum leptin concentration of overweight and obese group and significant decreased was exhibited in overweight (35.89%; P=0.033) and obese (36.56%; P=0.003) respectively (Table 2).

Comparison of Pre Ramadan-females with Post Ramadan females

Age of normal, overweight and obese females were 21.80 ± 0.44, 30.70 ± 1.42 and 31.83 ± 1.16 years respectively. BMI (Kg/m^2) of normal weight females showed a non-significant reduction of 2.82%. Similarly, overweight

Table 1. Descriptive statistics of overall pre and post Ramadan normal, overweight and obese individuals (n=110)

Variables	Groups	Mean± SEM	% Difference in Pre and Post	p-value
BMI (Kg/m^2)	**Normal (n=30)**			
	Pre	20.70 ± 0.31	2.07	0.30
	Post	20.27 ± 0.29		
	Overweight (n=20)			
	Pre	24.95 ± 0.22	4.08	0.10
	Post	23.93 ± 0.21		
	Obese (n=60)			
	Pre	34.35 ± 0.22	4.44	0.043
	Post	33.78 ± 0.59		
Leptin (ng/ml)	**Normal (n=30)**			
	Pre	4.91 ± 0.38	12.83	0.21
	Post	4.28 ± 0.33		
	Overweight (n=20)			
	Pre	13.00 ± 1.30	23.07	0.011
	Post	10.29 ± 1.34		
	Obese (n=60)			
	Pre	27.33 ± 1.94	14.30	0.002
	Post	23.42 ± 1.64		

BMI: Body Mass Index, S. leptin: Serum leptin
Pre = Subjects appeared at 1st day of Ramadan, Post = Subjects appeared at last day of Ramadan

females also showed 0.95% decreased in their BMI. BMI of obese females were considerably reduced (8.11 %; P=0.036) at the end of Ramadan. The statistically significant (20.50%; P=0.041) reduction was observed in serum leptin concentration of obese females. Fasting of one month improved the leptin concentration in obese females (Table 3).

Pre and Post Ramadan Serum Leptin in Males and Females

The statistically significant higher level of leptin was found in overweight and obese females than males. Mean serum leptin concentration of pre and post overweight female subjects were significantly higher as compared to males (P=0.001). Similar pattern of serum leptin levels was also observed in pre and post obese females than males (P= <0.001) (Table 4) (Fig 1).

Table 2. Descriptive statistics of pre and post Ramadan normal, overweight and obese males (n=55)

Variables	Groups	Mean± SEM	% Difference in Pre and Post	p-value
BMI (Kg/m²)	**Normal (n=15)**			
	Pre	21.56 ± 1.11	1.44	0.449
	Post	21.25 ± 1.07		
	Overweight (n=10)			
	Pre	24.75 ± 0.33	3.71	0.013
	Post	23.83 ± 1.00		
	Obese (n=30)			
	Pre	34.90 ± 4.11	6.08	0.046
	Post	32.78 ± 3.85		
S Leptin (ng/ml)	**Normal (n=15)**			
	Pre	5.07 ± 2.34	19.53	0.204
	Post	4.08 ± 1.83		
	Overweight (n=10)			
	Pre	9.03 ± 3.04		
	Post	5.79 ± 3.22	35.89	0.033
	Obese (n=30)			
	Pre	25.06±13.67		
	Post	15.90 ± 9.72	36.56	0.003

BMI: Body Mass Index, S. leptin: Serum leptin
Pre: Subjects appeared at 1st day of Ramadan, Post: Subjects appeared at last day of Ramadan

Table 3. Descriptive statistics of pre and post Ramadan normal, overweight and obese females (n=55)

Variables	Groups	Mean± SEM	%	P-Value
BMI (Kg/m²)	**Normal (n=15)**			
	Pre	19.84 ± 1.73	2.82	0.354
	Post	19.28 ± 1.50		
	Overweight (n=10)			
	Pre	24.36 ± 1.10		
	Post	24.13 ± 1.06	0.95	0.641
	Obese (n=30)			
	Pre	33.80 ± 5.26	8.11	0.036
	Post	31.06 ± 4.57		
S Leptin (ng/ml)	**Normal (n=15)**			
	Pre	8.75 ± 1.86	14.51	0.698
	Post	7.48 ± 1.89		
	Overweight (n=10)			
	Pre	16.97 ± 5.20	18.73	0.237
	Post	13.79 ± 6.35		
	Obese (n=30)			
	Pre	35.56 ±14.63	20.50	0.041
	Post	28.27 ±13.62		

BMI: Body Mass Index, S. leptin: Serum leptin
Pre: Subjects appeared at 1st day of Ramadan, Post: Subjects appeared at last day of Ramadan

Table 4. Serum leptin levels of normal, overweight and obese males and females (n=110)

Groups	Mean± SEM	% Difference in Male and Female	p-value
Pre-Normal Males Pre-Normal Female	5.07 ± 2.34 8.75 ± 1.86	42.05	0.681
Post Normal Males Post Normal Females	4.08 ± 1.83 7.48 ± 1.89	45.45	0.553
Pre-Overweight Males Pre-Overweight Females	9.03 ± 3.04 16.97 ± 5.20	46.78	0.001
Post Overweight Males Post Overweight Females	5.79 ± 3.22 13.79 ± 6.35	58.01	0.002
Pre-Obese Males Pre-Obese Females	25.06±13.67 35.56 ±14.63	29.52	0.008
Post Obese Males Post Obese Females	15.90 ± 9.72 28.27 ±13.62	43.75	<0.001

S. leptin: Serum leptin, M: Males, F: Females

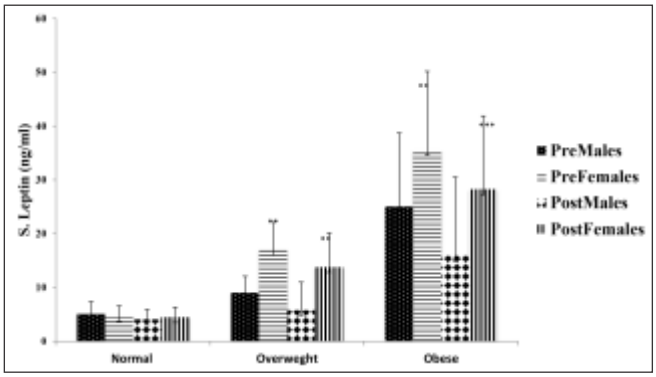

Figure 1: Serum Leptin (ng/ml) level of pre and post Ramadan males and females

DISCUSSION

This study has investigated the BMI and serum leptin concentration of obese, overweight and normal weight males and females and found that body weight as well as serum leptin level decreased significantly at the end of Ramadan. Our findings were consistent with past studies.[14-18] Sayedda et al and Saiyad et al also demonstrated the weight reduction in studied subjects due to Ramadan fasting.[14,15] Significant reduction in body weight has also been concluded by Salahuddin et al.[16] Sethi and Nagesh also observed the decrease in body weight at the end of Ramadan. [17] While Bakhotman observed no significant differences in weight and abdominal fat distribution during the fasting month.[18]

Butsch and Stanford showed that the caloric restriction for a long time decrease leptin level up to 30-66% from the baseline. While overeating for a longer span of time is significantly associated with increased Leptin, BMI and body fat percentage as well. [19] Chowdhury et al and Hoddy et al also demonstrated that Leptin secretion significantly decreases in obese males and females following different practices of intermittent fasting.[20, 21] Variety of results found about body weight changes and serum leptin level in Ramadan, like Bouhlel et al found that fasting cause significant reduction in BMI and body fat mass of male athletes but not in the adiponectin or leptin concentrations.[22] Ajabnoor et al noted that before Ramadan in early morning leptin level was significantly higher while during fasting leptin reduced significantly.[9] However, Khoshdel and colleagues noticed higher circulating leptin in pregnancy during Ramadan.[23] A study by Alzoghaibi et al revealed no notable difference was noted in leptin level of obese individuals During Ramadan.[8]The study of Çaklili ÖT et al contradicted to our study, they demonstrated that higher leptin level males and females during Ramadan as compared to non-Ramadan fasting.[24] While Ganjali et al found significantly lower leptin level in the subjects with normal BMI and no significant changes in obese people.[25]

The findings of the current study also found that women have higher serum leptin levels as compared to males. We have found 46% and 58% more serum leptin level in pre and Post overweight females than pre and post Ramadan males respectively. Similarly, pre and post obese females exhibited 29% and 43% higher values of serum leptin as compared to males of their BMI

category. These findings agree with previous research by Saad et al.[26] This sex difference is not seemingly explained by sex hormones or body fat distribution. Leptin's sexual dimorphism suggests that women may be resistant to its putative lipostatic actions and that it may have a reproductive function.[26] Women had higher leptin levels than men at any percent body fat or fat mass. Martin et al and Thomas et al also observed similar outcomes.[27, 28] A local study conducted by Rafique and Afzal also found twofold greater serum letpin concentration in females as compared to males. Increased leptin level in overweight and obese adults than lean and normal weight subjects.[12] This outcome verified that BMI and gender are the main determining factors of serum leptin concentration.

CONCLUSION

This study concludes that BMI and serum leptin concentration significantly reduced in both male and female subjects toward the end of Ramadan. Additionally, overweight and obese females were found with higher leptin concentration than overweight and obese males. Fasting during Ramadan is an excellent opportunity for overweight and obese people to lose body weight. Dietary restrictions also showed a beneficial effect on the health. Further studies are required to evaluate the mechanism of reduction in leptin levels and the effect of gender on its circulatory levels.

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AUTHORS' CONTRIBUTION: RM substantially contributed to the conception and design of the study AK worked in the acquisition, analysis, and interpretation of data and also drafted the manuscript, RM revised it critically for important intellectual content SH did data acquisition and drafted the manuscript SA gave the final approval of the manuscript.

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REFERENCES

1. Hassanein M, Al-Arouj M, Hamdy O, Bebakar WM, Jabbar A, Al-Madani A, et al. Diabetes and ramadan: practical guidelines. Diabetes Res Clin Pract 2017; 126:303-16.
2. Meo SA, Hassan A. Physiological changes during fasting in Ramadan. J Pak Med Assoc 2015; 65:S6-14.
3. Ongsara S, Boonpol S, Prompalad N, Jeenduang N. The effect of Ramadan fasting on biochemical parameters in healthy Thai subjects. J Clin Diagnos Res 2017; 11:BC14.
4. Kim KW, Song MY, Chung SH, Chung WS. Effect of modified fasting therapy on body weight, fat and muscle mass, and blood chemistry in patients with obesity. J Tradit Chin Med 2016; 36:57-62.
5. Norouzy A, Salehi M, Philippou E, Arabi H, Shiva F, Mehrnoosh S, et al. Effect of fasting in Ramadan on body composition and nutritional intake: a prospective study. J Hum Nutr Diet 2013; 26: 97-104.
6. Unalacak M, Kara IH, Baltaci D, Erdem O, Bucaktepe PG. Effects of Ramadan fasting on biochemical and hematological parameters and cytokines in healthy and obese individuals. Metab Syndr Relat Disord 2011; 9:157-61.
7. Hussain Z, Khan JA. Food intake regulation by leptin: mechanisms mediating gluconeogenesis and energy expenditure. Int J Mol Sci. 2014;15:6184-223.
8. Alzoghaibi MA, Pandi-Perumal SR, Sharif MM, BaHammam AS. Diurnal intermittent fasting during Ramadan: the effects on leptin and ghrelin levels. PloS One 2014; 9:e92214.
9. Ajabnoor GM, Bahijri S, Borai A, Abdulkhaliq AA, Al-Aama JY, Chrousos GP. Health impact of fasting in Saudi Arabia during Ramadan: association with disturbed circadian rhythm and metabolic and sleeping patterns. PlosOne 2014; 8:e96500.
10. Attarzadeh Hosseini SR, Sardar MA, Nematy M, Farahati S. The Effects of aerobic exercise during Ramadan on the levels of Leptin and Adiponectin in overweight women. J Fasting Health روزه داری و سلامت- 2015; 3.
11. Beshyah SA, Hajjaji IM, Ibrahim WH, Deeb A, El-Ghul AM, Akkari KB, et al. The year in Ramadan fasting research (2017): A narrative review. Ibnosina J Med Biomed Sci 2018; 10:39.
12. Rafique N, Afzal MN. Relationship of serum leptin levels with body mass index and gender. Rawal Med J 2009; 34:164-6.
13. Low S, Chin MC, Ma S, Heng D, Deurenberg-Yap M. Rationale for redefining obesity in Asians. Ann Acad Med Singapore 2009; 38:66.
14. Sayedda K, Kamal S, Ahmed QS. Effect of Ramadan fasting on anthropometric parameters, blood pressure, creatine phosphokinase activity, serum calcium and phosphorus in healthy students of Shri Ram Murti smarak institute of medical sciences, Bareilly-UP. Natl J Physiol Pharm Pharmacol 2013; 3:48.

15. Saiyad S, Saiyad M, Patel U, Verma A. Effect of Ramadan fasting on anthropological and physiological parameters. NHL J Med Sci 2014; 3.
16. Salahuddin M, Sayed AH, Syed SR, Badaam KM. Effect of Ramadan fasting on body weight, (BP) and biochemical parameters in middle aged hypertensive subjects: An Observational Trial. J Clin Diagn Res 2014; 8:16-8.
17. Sethi BK, Nagesh VS. Weight management in Ramadan. J Pak Med Assoc 2015; 65: S54-6.
18. Bakhotmah BA. The puzzle of self-reported weight gain in a month of fasting (Ramadan) among a cohort of Saudi families in Jeddah, Western Saudi Arabia. Nutr J 2011; 10:84.
19. Butsch WS, Stanford FC. Caloric restriction improves health-related quality of life in healthy normal weight and overweight individuals. BMJ Evid Based Med 2017; 22:33.
20. Chowdhury EA, Richardson JD, Tsintzas K, Thompson D, Betts JA. Effect of extended morning fasting upon ad libitum lunch intake and associated metabolic and hormonal responses in obese adults. Intl J Obes 2016; 40:305.
21. Hoddy KK, Gibbons C, Kroeger CM, Trepanowski JF, Barnosky A, Bhutani S, et al. Changes in hunger and fullness in relation to gut peptides before and after 8 weeks of alternate day fasting. Clin Nutr 2016; 35:1380-5.
22. Bouhlel E, Denguezli M, Zaouali M, Tabka Z, Shephard RJ. Ramadan fastings effect on plasma leptin, adiponectin concentrations, and body composition in trained young men. Int J Sport Nutr Exerc Metab 2008; 18:617-27.
23. Khoshdel A, Kheiri S, Nasiri J, Heidarian E. The effect of Ramadan fasting on serum leptin, neuropeptide Y and insulin in pregnant women. Med J Islam Repub Iran 2014; 28:92.
24. Telci Caklili O Isbilen B, Yauzu G, Tulu S, Mesci B, Oguz A Differences in leptin, ghrelin, and glucagon-like peptide-1 levels between religious fasting and normal fasting. Turk J Med Sci 2017; 47:1152-6.
25. Ganjali N, Mozzafri-Khosravi H, Afkhami-Ardekani M, Fallahzadeh H. Effects of Islamic Fasting on Glucose and Lipid Profiles, Body Mass Index, Adiponectin and Leptin Levels in Obese Individuals. J Fasting Health 2016; 4: 57-63.
26. Saad MF, Damani S, Gingerich RL, Riad-Gabriel MG, Khan A, Boyadjian R, et al. Sexual dimorphism in plasma leptin concentration. J Clin Endocrinol Metabol 1997; 82:579-84.
27. Martin LJ, Mahaney MC, Almasy L, MacCluer JW, Blangero J, Jaquish CE, et al. Leptin's sexual dimorphism results from genotype by sex interactions mediated by testosterone. Obes Res 2002; 10:14-21.