The Effect of Ramadan Fasting on the Body Composition, Blood Pressure, Heart Rate of Healthy Young Adults

B. Shruthi[1*], Abrar Hassan[2], B. V. Reddy[3]

[1,3]Professor, [2]Professor and Head, Department of Physiology, Bhaskar Medical College, Moinabad, R R. Dist, Andhra Pradesh, INDIA.

*Corresponding Address:

shruthi249@hotmail.com

Research Article

Abstract: During the month of Ramadan, Muslims refrain from drinking and eating between sunrise and sunset. This study is aimed to understand the effect of this long intermittent fasting schedule during Ramadan on body composition, and cardiovascular system in healthy young adults. Fifty healthy adults were included and were all tested before and on the 28th day of the Ramadan fast. The parameters studied were body composition, blood pressure and heart rate before and towards the end of the fasting. Significant changes were observed in the form of decreased body weight, Body Mass Index, Waist to Hip Ratio, body fat percentage, blood pressure and heart rate. Dominance of the sympathetic nervous system over the parasympathetic nervous system has been shown to be a strong risk factor for cardiovascular disease. Weight loss has a positive effect on this balance and is associated with significant improvement in autonomic cardiac modulation through enhancement of parasympathetic effect. This increase in vagal tone has shown its effects on the blood pressure and heart rate in this study. At the cellular level fasting reduces the levels of oxidative stress at the same time it acts as repeated mild stress that induces expression of genes that enhance the ability of cells to cope with more severe stress. The effect of fasting on cardiovascular function should be further explored to recognize fasting as a potential non-pharmacological intervention for improving cardiovascular health.

Keywords: Ramadan fasting, body composition, blood pressure, heart rate.

1. Introduction

Fasting is defined as a partial or total abstention from all foods, or a select abstention from prohibited foods. As a potential non-pharmacological intervention for improving health and increasing longevity, fasting has been the subject of numerous scientific investigations. As reviewed by Trepanowski et al [1] the three most commonly studied fasts are caloric restriction (CR), alternate-day fasting (ADF), and dietary restriction (DR). CR is the reduction of kilocalorie intake by a certain percentage (typically 20 - 40%) of normal consumption. ADF consists of alternating 24-hour periods: during the "feast period," fasters may consume food normally; during the "fast period," food consumption is restricted or halted altogether. Water is allowed during all times. DR is a reduction of one or more components of dietary intake (typically macronutrients) with minimal to no reduction in total kcal intake. While religious fasts are partaken primarily for spiritual purposes, they also have the potential to greatly affect one's physical health. Accordingly, the health effects of religious fasting have recently been the subject of scientific inquiry, with most of the research being performed in the last two decades.

Ramadan

Each year, millions of Muslims fast from sunrise (Sahur) to sunset (Iftar) during the holy month of Ramadan, which lasts between 28 and 30 days. Thus, Ramadan fasting is similar to ADF also considered by some as intermittent fasting(IF), because both fasts incorporate feast periods and fast periods. The feast periods and fast periods of Ramadan fasting are each 12 hours in length on average ,which amounts to half of the 24-hour length for both the feast periods and fast periods of ADF. Another important difference between the two forms of fasting is that fluid intake is forbidden during the fast periods of Ramadan, whereas it is permitted at all times under an ADF protocol [1]. Literally, fasting means to deprive oneself of food for a specific period, usually for therapeutic or religious purposes. Medical journals have presented articles that, therapeutically, support fasting as a means of ridding hazardous materials from the body. To understand the positive effects of fasting on various systems had been the lookout for many researchers. Michalsen et al [2] even suggested incorporating fasting as a therapy in integrated treatment. The objective of the present investigation was to establish the beneficial effects of fasting on the body composition and cardiovascular system in the form of decrease in the weight, BMI, WHR, and body fat percentage. This effect can open the road to health through fasting which can be considered as a medical tool apart from being a spiritual need.

2. Material and Methods

The study was done in the research lab of Department of Physiology Bhaskar Medical College during the month

of Ramadan in the year 2011(aug & sept).This study has been approved by the Institutional Ethical Committee. The study population was among the students and interns of Bhaskar Medical College & General Hospital who were practicing the fast during Ramadan.50 young adults in the age group 18-24yrs were included in the study after taking consent. Only normal adults with no medical history were included in the study.6 could not come back towards the end of the fast due to personal reasons. Data was collected from 44 men & women. Each subject was studied twice for each of the parameters mentioned below **f**irstly before the fasting and next on the 28th day of the fasting (3)**.**Morning hours were chosen for all the recordings. All the participants were healthy with no history of any medical illness. They all had been fasting every year following the regimen of Ramadan fasting.

2.1Body composition

Each subject's Height (in m) & weight (in kg) were recorded and the BMI (Body Mass Index) was calculated as: weight in kg/Height in m^2 .Waist circumference (WC) & Hip Circumference (HC) were measured using a measuring tape.WHR was calculated as the ratio of WC/HC.

2.1.1Body fat percentage

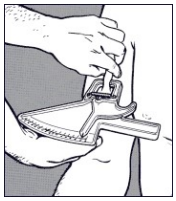
The body fat percentage is a measure of fitness level, since it is the only body measurement which directly calculates a person's relative body composition without regard to height or weight. The body fat percentage of is the total mass of fat divided by total weight. Body fat includes essential body fat and storage body fat. Essential body fat is necessary to maintain life and reproductive functions. The percentage of essential body fat for women is greater than that for men, due to the demands of childbearing and other hormonal functions. Storage body fat consists of fat accumulation in adipose tissue, part of which protects internal organs in the chest and abdomen. A number of methods are available for determining body fat percentage, such as measurement with calipers or through the use of bioelectrical impedance analysis. The skin fold estimation methods are based on a skin fold test, also known as a pinch test, whereby a pinch of skin is precisely measured by calipers at several standardized points on the body to determine the subcutaneous fat layer thickness. These measurements are converted to an estimated body fat percentage by an equation. Some formulas require as few as three measurements, others as many as seven. The accuracy of these estimates is more dependent on a person's unique body fat distribution than on the number of sites measured. As well, it is of utmost importance to test in a precise location with a fixed pressure.

2.1.1.1Skinfold Testing Location

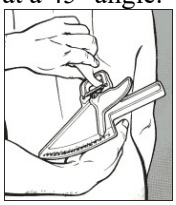
Skin fold thickness was measured using skin fold calipers. The sites selected were as per the requirements. Four sites were chosen on the front of the arm, back of the arm, at the back and sides. Measurements were taken on both sides by Slim Guide Skin fold Fat Caliper and the values were properly screened to calculate the fat %.Body fat percentage was calculated using the table provided in the manual given along with the instrument."How to Measure Your % Body fat" that provides body fat calculation charts for using 1, 2 and 4 testing locations. The following four sites were chosen:

a) The back of upper arm (Triceps) is located halfway between the shoulder and elbow joints. The skin fold is taken in a vertical direction on the center of the back of the arm.

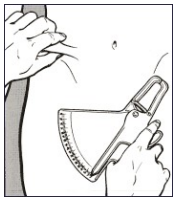
b) The Front of upper arm (Biceps) is located halfway between the shoulder and elbow joints. The skinfold is taken in a vertical direction on the center of the front of the arm.



c) Located just below the shoulder blade (Subscapular). The skinfold is taken at a 45° angle.

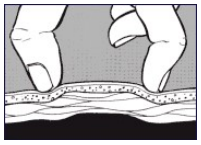


d)Waist (Suprailiac) is located just above the iliac crest, the protrusion of the hip bone, a little towards the front from the side of the waist. The skinfold is taken horizontal.

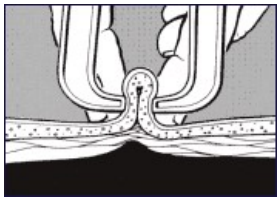


2.1.1.2-Skinfold Testing Technique

Thumb and index finger of left hand were used to pinch an area of skin wide enough to get a good fold.




The fold of skin and underlying layer of fat was pulled out with left hand away from the body. Muscle is firm and does not come into a fold with the skin and fat. While holding the skinfold with the left hand, the jaws of the calipers was placed about 1/4" from the fingers of the left hand. The trigger of the caliper was released so the entire force of the jaws are on the skinfold. Without releasing the skinfold with the left hand, the force of the caliper was let to creep a bit for a few seconds to settle to the correct reading. The measurements were noted down from all the four locations and the body fat percentage was calculated.



2.2 Blood pressure (BP) was recorded with the sphygmomanometer in mmHg under quiet conditions. A 12 lead Schiller's ECG machine was used to record the heart rate

Paired sample statistics of T test was used to calculate the mean and Standard error of mean and the significance stated using SPSS.

Various confounding factors were taken care, by advising the subjects to follow a common daily fasting time. As the subjects belong to same geographical area, the cultural habits and type of diet is more or less the same and may not have shown there influence on the health related effects of fasting.

3. Results

The Table-1 shows the anthropometric values before and towards the end of the fasting. Body weight, BMI, WC, WHR & Body fat percentage decreased significantly at the end of fasting as shown in the chart 1 & 2 also.

Table 1: Anthropometric values before and at the end of Ramadan (mean ± SD)

	Baseline	28th day	*P* value
Weight (Kg)	63.86± 1.977	63.27± 1.968	<0.001
BMI (Kg/m^2)	23.962± .6683	23.750± .6721	0.002
WC (inch)	31.52± .668	30.60± .690	<0.001
HC (inch)	38.15± .498	37.83± .579	0.142
WHR	0.8164±.00895	0.8023±.00932	0.004
Fat %	29.675 ±1.1929	26.520 ±1.2626	<0.001

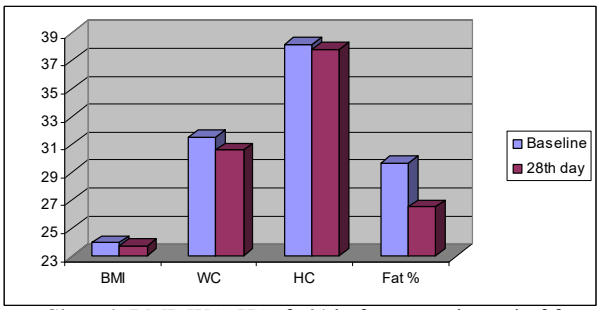


Chart 1: BMI, WC, HC, fat% before & at the end of fast

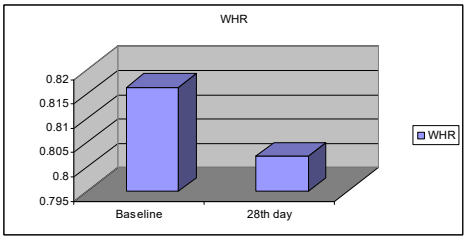


Chart 2: WHR before & at the end of fast

The Table-2 depicts the changes seen in the BP and heart rate before and at the end of the fasting .SBP, DBP, MAP (as in the chart 3 as well) showed a highly significant decrease after the period of fasting. Heart rate was also significantly low at the end of the study as seen in chart 3.

Table 2: BP & HR values before and at the end of Ramadan (mean ± SD)

	Baseline	28th day	*P* value
SBP (mmHg)	116.86±1.848	110.59±1.984	<0.001
DBP (mmHg)	84.41 ±1.076	78.50± 1.225	<0.001
PP (mmHg)	32.45 ±1.413	32.09 ±1.276	0.697
MBP (mmHg)	95.191 ±1.2099	89.230 ±1.3714	<0.001
HR (/min)	82.23 ±2.320	76.80 ±1.960	<0.001

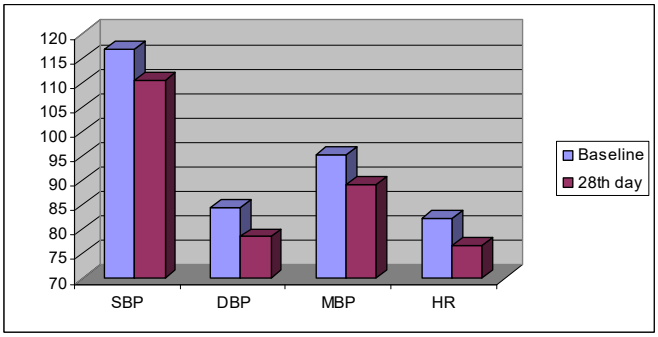


Chart 3: BP & HR before & at the end of fast

4. Discussion

Fasting during Ramadan affects the body composition to a great extent. In this study the body weight, BMI, WC, WHR & body fat percentage decreased after the fast. Similar findings were noted by Al-Hourani etal[4] Amir-Hossein Memari etal [5] Rashed [6],Fakhrzadeh et al[7], Hallak et al[8], Varady et al[9],Heilbronn et al[10],Mustafa et al[11],

Perk et al[12],Salehi et al[13]and Toda M et al[14].Fakhrzadeh found decrease in WC after fast, as is our findings, and confirmed that Waist circumference is a more accurate reflection of visceral obesity, which is more strongly associated with insulin resistance, hypertension and dyslipidaemia and is a better predictor than BMI of vascular events such as stroke. Reduction of visceral adipocytes leads to a decreased concentration of free fatty acids in the portal vein due to a reduction in the rate of lipolysis, which leads to a reduction in hepatic gluconeogenesis and VLDL secretion. Faintuch J [15] found that all compartments diminished during fasting, but body fat was by far the most affected as also was found in this study. Keeping in mind the similarity between Ramadan fasting and ADF/IF several such studies can be referred for the positive effects of fasting. Various studies of Varady et al suggests that intermittent fasting is effective in decreasing body weight and fat mass and for the retention of lean mass as well[16]. ADF produces beneficial modulations in body fat distribution [17].Varady et al also studied the effects of CR and ADF regimens on parameters of adipose physiology, its link to indicators of chronic disease risk [18].They also proved that ADF may be protective even in the presence of High Fat diets [19]. It has been suggested that the decrease in body weight could be attributed to a decrease in fluid intake during the fast as also by decrease in glycogen-bound water stores, extracellular volume contraction secondary to a lower sodium intake, and a moderate degree of hypohydration with little loss of body tissue [20].Ramadan fasting is characterized by changes in meal schedule and frequency. Meals are exclusively nocturnal and less frequent, and consequently, this may affect energy and nutrient intake [21]. The SBP, DBP, MAP showed a highly significant decrease after the period of fasting as also observed by Dewanti etal[22], Varady et al[23], Pietrobelli[24] and Saleh[25]. Decreased systolic and diastolic blood pressure during Ramadan is explained by a reduction in body weight, given the reportedly strong association between BMI and both SBP and DBP[22].They have also shown that weight loss is associated with a decrease in arterial pressure, even when salt intake is not restricted[22]. It can also be attributed to the reduced fluid intake and disturbance in fluid balance observed during the fasting periods of that month [26]. Decrease in HR was similar to the findings of Mager et al [27] and Guy et al [28]. Fasting during Ramadan as per Kubati et al[29] has advantages in lowering BP and HR during the day and disadvantages in the evening and early morning. The effects of fasting on the blood pressure and heart rate can be attributed to an increase in vagal tone[30].Weight loss is associated with significant improvement in autonomic cardiac modulation through enhancement of parasympathetic modulation, which clinically translates into a decrease in heart rate[31]. Dominance of the sympathetic nervous system (SNS) over the parasympathetic nervous system (PNS) has been shown to be a strong risk factor for cardiovascular disease. Obesity and aging are associated with increased SNS activity, and weight loss and/or exercise seem to have positive effects on this balance. Weight loss improves SNS/PNS balance especially when fasting is combined with exercise [32]. Garruti [37] at one time, referred to fasting, as the royal road to health and long life. Fasting is a popular method of detoxification for, rather quickly, the body can begin extricating the noxious materials, allowing the body to commence the healing process. Despite the lack of agreement as to the definition, the term hormesis as per Mager[27] has been used to reflect this phenomenon where by beneficial effects are achieved from exposure to a low intensity stressor. Fasting too is considered to be having the potential of hormesis which equips the body for a greater stress any time later. Fasting has been found to be beneficial by reducing the levels of oxidative stress as indicated by decreased oxidative damage to proteins, lipids, DNA; increased resistance to various types of stress including heat, oxidative, metabolic stress, enhanced immune function may be the physiological effects that may contribute to their abilities to increases health span[34],[35],[36]. Fasting also produces increased levels of brain-derived neurotrophic factor (BDNF)[38].Several studies show that fasting inhibits the production of TNF, IL-1, and IL-6 at the same time it does not affect the ant-inflammatory cytokine IL-10[27]. Goodrick etal found IF regimen to be a repeated mild stress that induces expression of genes that enhance the ability of cells to cope with more severe stress. These effects of fasting on body weight and life span are greatly dependent upon the genotype and age of initiation, may encourage us to start these habits at an early age[34].The beneficial effects of fasting has also been noted by Johnson et al on communicable diseases by improving resistance to infection[38].

5. Conclusions

In conclusion, fasting is a healthy method for improving the cardiovascular health. To explore the issue more extensively, its effect on other systems also can be studied for a generalized overview.

6. Acknowledgement

The authors are grateful to the participants of this study for their full cooperation. They are also thankful to the biostatistician Sri. Balakrishna for his assistance in the statistics. Thanks also to the lab assistant Mr. Arun and the attenders Ms. Devi and Mr. Rajender for their help.

References

1. Trepanowski JF, Bloomer RJ. The impact of religious fasting on human health. Nutrition Journal, 9: 57:1-9,2010.
2. Michalsen A, Hoffmann B et al. Incorporation of fasting therapy in an integrative medicine ward: evaluation of outcome, safety, and effects on lifestyle adherence in a large prospective cohort study. J Altern Complement Med. Aug;11(4):601-7,2005.
3. Fakhrzadeh H, Larijani Bet al: Effect of Ramadan fasting on clinical and biochemical parameters in healthy adults. Ann Saudi Med, 23:223-226,2003.

4. Al-Hourani HM, Atoum MF: Body composition, nutrient intake and physical activity patterns in young women during Ramadan. Singapore Med J, 48:906-910,2007.
5. Amir-Hossein M; Ramin Ket al. Effect of Ramadan Fasting on Body Composition and Physical Performance in Female Athletes.Asian Journal of Sports Medicine.; Vol 2, No 3:161-166,Sep 2011.
6. Awad H Rashed.The fast of Ramadan.BMJ Vol 304;521-522,1992.
7. Fakhrzadeh H, Larijani Bet al. Effect of Ramadan fasting on clinical and biochemical parameters in healthy adults. Ann Saudi Med 23: 223-226,2003.
8. Hallak MH, Nomani MZ: Body weight loss and changes in blood lipid levels in normal men on hypocaloric diets during Ramadan fasting. Am J Clin Nutr, 48:1197-1210,1988.
9. Krista A Varady and Marc K Hellerstein..Alternate-day fasting and chronic disease prevention: a review of human and animal trials. Am J Clin Nutr;86:7–13,2007.
10. Leonie K Heilbronn, Steven R Smithet al. Alternate-day fasting in nonobese subjects: effects on body weight, body composition, and energy metabolism. Am J Clin Nutr;81:69 – 73,2005.
11. Mustafa K. Y, Mahmoud N. A:The effects of fasting in Ramadan.2. Fluid and electrolyte balance.Br. J. Nutr., 40: 583-589,1978.
12. Perk G, Ghanem Jet al: The effect of the fast of Ramadan on ambulatory blood pressure in treated hypertensives. Journal of Human Hypertension15:723–725,2001
13. Salehi M, Neghab M: Effects of fasting on a medium calorie balanced diet during the holy month of Ramadan on weight, BMI and some blood parameters of overweight males. Pak J Biol Sci, 10(6):968-971,2007.
14. Toda M, Morimoto K. Effects of Ramadan fasting on the health of Muslims.Nihon Eiseigaku Zasshi. Jan;54(4):592-6,2000.
15. Faintuch J, Soriano FG et al. Changes in body fluid and energy compartments during prolonged hunger strike. Nutrition Feb;17(2):100-4,2001.
16. Varady KA. Intermittent versus daily calorie restriction: which diet regimen is more effective for weight loss?Obes Rev.;12(7),Jul 2011.
17. Varady KA, Allister CA et al. Improvements in body fat distribution and circulating adiponect in by alternate-day fasting versus calorie restriction. J Nutr Biochem.;21(3):188-95, Mar2010.
18. Varady KA, Hellerstein MK. Do calorie restriction or alternate-day fasting regimens modulate adipose tissue physiology in a way that reduces chronic disease risk? Nutr Rev.;66(6):333-42,Jun2008.
19. Varady KA, Hudak CS et al. Modified alternate-day fasting and cardioprotection: relation to adipose tissue dynamics and dietary fat intake. Metabolism.;58(6):803-11,Jun2009.
20. Gavrankapetanović F. Medical aspects of fasting Med Arh.;51(1-2):25-7,1997.
21. Al-Hourani HM, Atoum MF: Body composition, nutrient intake and physical activity patterns in young women during Ramadan. Singapore Med J, 48:906-910,2007.
22. Dewanti L, Watanabe C et al: Unexpected changes in blood pressure and hematological parameters among fasting and nonfasting workers during Ramadan in Indonesia. Eur J Clin Nutr,60:877-881,2006.
23. Varady KA, Bhutani S et al. Short-term modified alternate-day fasting: a novel dietary strategy for weight loss and cardioprotection in obese adults.Am J Clin Nutr;90: 1138–43,2009.
24. Pietrobelli A, Rothacker D:Electrocardiographic QTC interval: short-term weight loss effects.Int J Obes Relat Metab Disord.; 21(2):110-4,1997 Feb.
25. Saleh SA, El-Kemery TA et al:Ramadan fasting: relation to atherogenic risk among obese Muslims.Egypt Public Health Assoc.;79(5-6):461-83,2004.
26. Nizal Sarraf-Zadegan, Mahmood Atashi, Gholam A. ,Naderi,.BaghaiAM et al. The effect of fasting in Ramadan on the values and interrelations between biochemical, coagulation and hematological factors.Ann Saudi Med;20(5-6):377-381,2000.
27. Mager DE., Wan R, Brown M et al. Caloric restriction and intermittent fasting alter spectral measures of heart rate and blood pressure variability in rats. The FASEB Journal; Vol. 20:631-637, April 2006.
28. Guy E. Alvarez, Brenda M. Davy et al.Weight loss increases cardiovagal baroreflex function in obese young and older men. Am J Physiol Endocrinol Metab 289:E665-E669,2005.
29. M. Al-Kubati, B. Fišer, P. Homolka,:Ramadan Fasting And The Circadian Rhythm Of Blood Pressure, Heart Rate And Robinson Index Physiol. Res. 3PVol. 56,2007..
30. Ismayil A, Ruiqian W, et al. Cardioprotection by Intermittent Fasting in Rats. Circulation, 112:3115-3121,2005.
31. Poirier P, Hernandez TL et al. Impact of Diet-Induced Weight Loss on the Cardiac Autonomic Nervous System in Severe Obesity Obesity Research Vol. 11 No. 9;1040-47, September 2003.
32. Lilian de J, Moreira E.A.M, et al: Impact of 6-month Caloric Restriction on Autonomic Nervous System Activity in Healthy, Overweight, Individuals. Obesity 18, 414–416,2010.
33. Garruti G, De Pergola G et al.34-day total fast in an adult man. Int J Obes Relat Metab Disord;19(1):46-9,1995 Jan.
34. Mattson MP, Wan R:Beneficial effects of intermittent fasting and caloric restriction on the cardiovascular and cerebrovascular systems. J. Nutr Biochem.;16(3):129-37,2005 Mar.
35. Castello L, Froio T, Maina M et al: Alternate-day fasting protects the rat heart against age-induced inflammation and fibrosis by inhibiting oxidative damage and NF-kB activation. Free Radic Biol Med. 1;48(1):47-54,2010 Jan.
36. Chandrasekar B, Nelson JF et al .Calorie restriction attenuates inflammatory responses to myocardial ischemia-reperfusion injury. Am J Physiol Heart Circ Physiol.; 280(5):H2094-102,2001 May.
37. Goodrick CL, Ingram DK et al. Effects of intermittent feeding upon body weight and lifespan in inbred mice: interaction of genotype and age. Mech Ageing Dev.;55(1):69-87, 1990 Jul.
38. Johnson JB, Laub DR et al. The effect on health of alternate day calorie restriction: eating less and more than needed on alternate day calorie restriction: eating less and more than needed on alternate days prolongs life. Med Hypotheses.;67(2):209-11,2006.