

Effect of Ramadan Fasting on Oxidative Stress and Thyroid Functions.

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Abstract

Ramadan fasting might be beneficial for digestive health, if appetite control and balanced diet is achieved. In this study we aimed to evaluate the effect of Ramadan fasting on thyroid glands and some biochemical parameters in Turkish people living in Yozgat region.

A total of 40 healthy subjects (20 men and 20 women) aged between 21-50 years were randomly recruited. Thyroid nodule volumes, thyroid hormones, body weights, glucose, total Cholesterol (TC), and oxidant stress index (OSI) were measured before Ramadan and at the end of Ramadan.

There were beneficial changes in blood parameters and thyroid volumes, after one month of fasting during Ramadan compared with baseline.

The Ramadan fasting might affect the radiological and biochemical parameters in healthy Turkish subjects. To improve the favorable digestive health in Ramadan fasting, diet and lifestyle modifications such as, increased intake of healthy foods and physical exercises might be recommended.

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Introduction

Fasting during Ramadan, the ninth month of the lunar calendar is one of the five pillars of the Muslim faith. This practice involves abstinence from all fluid and food intake during the period from first sunrise to sunset, as well as rituals involved with breaking of the fast and various prayers and feasts throughout the night [1]. The duration of restricted food and beverage intake is approximately 12 h/day for 1 month, which makes Ramadan a model of prolonged intermittent fasting [2]. Ramadan can improve a person's health, but if the correct diet is not followed, one may possibly get some ailments related to the digestive health. Past studies have been conducted to evaluate the impact of fasting in Ramadan on the endocrine system and gastrointestinal (GI) tract. Nonetheless, the findings have been heterogeneous, and therefore, no consensus exists regarding how fasting in Ramadan might affect some serum parameters. Therefore, we aimed to evaluate whether or not fasting during Ramadan has any significant effect on thyroid functions, biochemical parameters and oxidative stress in healthy men and women

Materials and Methods

Study Design

The present study included prospective observational analysis of 40 healthy subjects between August 1 and August 30 in 2011 (during the month of Ramadan). The study protocol was approved by the Ethical Committee of the School of Medicine, University of Yozgat Bozok. Before the study started all participants were required to provide written informed consent after explaining the study group the nature and type of study.

Study Population

The study was conducted in collaboration with the departments of Radiology, Biochemistry and General Surgery of Yozgat Bozok University, Medical Faculty. The subjects were health workers of Bozok University Hospital. The sample size was calculated according to a power of 80% and a confidence level of 95%. Inclusion criteria included healthy subjects. The exclusion criteria were as follows: recent acute infectious illness; any inflammation, infiltrative disorders, or autoimmune diseases; any evidence of liver, kidney, or respiratory

disease; diabetes mellitus; uncontrolled essential hypertension; heart failure; malignancy; or regular alcohol use. Moreover, the women were not pregnant, lactating or receiving contraceptives. A detailed history of disease and demographic information was collected from all patients, and all patients underwent physical examination at baseline. All participants answered a questionnaire which included questions pertaining to: demographic characteristics, smoking status, alcohol intake, exercise, education, family history of medical diseases and drug history during the first day of Ramadan (pre-Ramadan), the last day of Ramadan.

Biochemical Measurement

Body Mass Index (BMI) was calculated as a ratio of weight in kg and height in meters square (kg/m^2). Blood samples were collected after fasting 12 hour and centrifuged at 3,000 rpm for 10 min at 10–18°C. Supernatant serum samples were stored in plastic tubes at –80°C until analysis. Serum glucose, total cholesterol (TC), thyroid-stimulating hormone (TSH), Free T3 (FT3) and FT4 were measured by colorimetric and electrochemiluminescence immunometric assay (ECLIA) methods using commercially available assay kits (Abbott, Abbott Park, IL, USA) with an auto-analyzer (Abbott, Abbott Park, IL, USA).

Measurement of Oxidative Stress Parameters

Serum, total antioxidant capacity (TAS) and total oxidant status (TOS) were determined with commercial kits (Rel Assay Diagnostics kit; Mega Tip, Gaziantep, Turkey) and Oxidative Stress Index (OSI) values were calculated.

Measurement of the TAS

The antioxidative effect of the sample against the potent free radical reactions, which is initiated by the produced hydroxyl radical, is measured. The results are expressed as $\mu\text{mol Trolox Eq/L}$.

Measurement of the TOS

The colour intensity, which can be measured spectrophotometrically, is related to the total amount of oxidant molecules present in the sample. The assay is calibrated with hydrogen peroxide (H_2O_2) and the results are expressed in terms of micromolar hydrogen peroxide equivalent per litre ($\mu\text{mol H}_2\text{O}_2 \text{ Eq/L}$).

Calculation of OSI

The OSI was defined as the ratio of the TOS level to TAS level. Specifically, OSI (arbitrary unit) = $TOS (\mu\text{mol H}_2\text{O}_2 \text{ Eq/L}) / TAS (\mu\text{mol Trolox Eq/L}) \times 100$ [The OSI was defined as the ratio of TOS to TAS level].

Radiological Examinations

Sonographic evaluation was made by a specialized radiologist that used Aloka Alpha 6 ultrasound device with 7-12 Mhz linear transducer. All patients underwent a sonographic procedure in supine position, while neck was in hyperextension. His thyroid lobe was examined in the transverse and longitudinal plane. Transverse, sagittal and anteroposterior lengths of a thyroid lobe were measured according to the ellipsoid formula (volume = (anterior—posterior diameter) x (transverse diameter) x (sagittal diameter) x ($\pi/6$)).

Statistical Analysis

Statistical analyses were performed by SPSS statistical software (23.0 version, SPSS, Cary, NC, USA). All data were tested for normality using the Kolmogorov–Smirnov test. Continuous variables were expressed as the mean ± Standard Deviation (SD). Categorical variables were presented as percentages. According to the normality of the data, the comparisons of the continuous variables between the gender groups were made using student t test and the changes after 1 month of Ramadan was compared with the baseline by paired samples t-test. A p-value of < 0.05 were considered statistically significant.

Results

The demographic and biochemical characteristics of the study subjects are summarized in [Table 1]. There were no statistically significant differences between men and women in means of age.

Characteristics of Study Subjects

Among the 42 volunteers participated, 40 completed (20 men and 20 women) the study. The mean age of the study subjects were 36.86 ± 15.35 and 37.80 ± 15.05 years in men and women, respectively. Weight and BMI were significantly higher in men than in women, whereas, significantly higher levels of TC were observed in women compared with men. There was no significant difference in other parameters. There were

significant decrease in BMI, Glucose and TC levels after Ramadan fasting compared to baseline levels ($p < 0.05$).

The changes in TAS, TOS levels and OSI ratio before and after Ramadan fasting are shown in Table 2. Compared to baseline levels, subjects had significantly lower TOS levels and OSI ratio and higher TAS levels after Ramadan fasting (all $p < 0.05$).

The changes in thyroids before and after Ramadan fasting are shown in Table 3. Compared to baseline levels, subjects had significantly lower TSH levels and thyroid volumes and higher FT3 and FT4 levels after Ramadan fasting (all $p < 0.05$).

Discussion

To the best of our knowledge, this is the first study to investigate the effect of Ramadan fasting on biochemical parameters in healthy Turkish subjects living in central Anatolia. There were significant changes in BMI and body weight after Ramadan fasting in this study. Our results contradicts a previous study in Turkey [3] in which TC, body weight and/or BMI did not change after Ramadan fasting. However, the decrease in these parameters after Ramadan fasting has been observed in several studies in other countries [4-7].

We found alteration in thyroid functions after Ramadan fasting. No knowledge exists in the literature demonstrating, altered thyroid hormone levels during fasting. Hormones regulate the integrated metabolic response that involves mobilization of fat stores and hepatic gluconeogenesis, including a reduction in the plasma insulin concentration and increased circulating concentrations of glucagon, catecholamines, growth hormone, thyroid stimulating hormone and corticosteroids [8]. Alteration in diet pattern during fasting might have led to altered blood fat, protein and carbohydrate levels that might have stimulated or suppressed hormones by negative feedback mechanism. In this study we studied the alterations on thyroid hormones, further studies are needed to reveal the changes in various other hormones during Ramadan fasting.

In general, Ramadan fasting seems to have effect on lipid, carbohydrate and protein metabolism, as well as hormone functions. The increases that are observed to occur in variables are usually attributed to

Table 1. Basic characteristics of the study subjects.

Parameters	Total (n= 40)	Men (n=20)	Women (n=20)	p-value*
Age (years)	37.33±15.14	36.86±15.35	37.80±15.05	>0.05
Weight (kg)	58.33±10.22	67.23±18.66	54.35±11.02	<0.001
Body Mass Index (BMI) (kg/m ²)	21.49±3.55	22.94±4.12	20.79±3.05	<0.05
Fasting Blood Glucose (FBG) (mmol/L)	5.19±0.42	5.24±0.48	5.11±0.25	>0.05
Total Cholesterol (mmol/L)	4.99±0.68	4.76±0.70	5.23±0.85	<0.05

Data are expressed as means ± SD.

Table 2. Oxidant and antioxidant parameters before and after Ramadan fasting

	Before (n = 40)	After (n = 40)	p
TAS (µmol Trolox Eq/L)	1.23 ± 0.16	1.35 ± 0.17	<0.05
TOS (µmol H ₂ O ₂ Eq/L)	7.42 ± 2.52	6.27 ± 2.78	<0.05
OSI (arbitrary unit)	0.60 ± 0.03	0.46 ± 0.02	<0.05

Values are mean ± SEM. TAS, total antioxidant capacity; TOS, total oxidant status; OSI, oxidative stress index.

Table 3. Thyroid volume and hormone levels before and after Ramadan fasting

		Before Ramadan (n = 40)	After Ramadan (n = 40)	P
Thyroid volume	Right	43.67±15.58	39.88±15.01	0.001
	Left	33.60±12.60	32.53±12.09	0.282
	Total	77.41±27.11	72.49±25.38	0.004
Thyroid hormones	TSH (µIU/mL)	1.17±0.62	1.03±0.55	0.016
	FT3 (pg/mL)	2.34±0.39	2.82±0.48	0.000
	FT4 (ng/mL)	1.03±0.16	1.12±0.24	0.028

Reference values for thyroid hormones are as follows: TSH; 0.35-4.94 µIU/mL, FT3; 1.71-3.71 pg/mL, FT4 0.7-1.48 ng/mL.

mild dehydration during fasting. Similar small changes that were attributed to changes in patterns of food consumption during Ramadan, changes in activity patterns and hypo-hydration were also observed in a large population of young football players who fasted during Ramadan [9]. Clearly, however, there will be changes over the course of the day, and these will be influenced by diet and digestion. In addition to changes in the timing of food intake, and possibly also in the amount of intake, there may be changes in the composition of the diet during Ramadan. Changes in the composition of the diet may affect the protein synthetic response to an exercise bout, even when this takes place after an overnight fast [8]. Altering the lipid, carbohydrate and protein content of the diet results in proportional alterations in protein oxidation during fasting that might eventually alter the level of oxidative stress. We found beneficial effect of Ramadan fasting on oxidative stress. The antioxidant capacity increased whereas the oxidative stress levels decreased after a month of fasting period. We were unable to compare a relevant study in literature to compare our results. The decrease in levels of BMI, glucose and TC levels which are primary substrates for carbohydrate and lipid peroxidation might have decreased the rate of oxidation reactions during fasting.

In conclusion, our present study demonstrated that fasting improved serum biochemical parameters as well as thyroid gland volume in healthy subjects. The limitations of the present study are that: The sample size was relatively small, and the study was conducted in a single center. Therefore, there is a need for multicenter, prospective, randomized studies in which a greater number of patients are studied in order to evaluate the effect of Ramadan fasting on various biochemical parameters and digestive function.

References

1. Zerguini Y, Ahmed QA, Dvorak J. The Muslim football player and Ramadan:current challenges. *J Sports Sci.* 2012;30 Suppl 1:S3-7.
2. Aksungar FB, Topkaya AE, Akyildiz M. Interleukin-6, C-reactive protein and biochemical parameters during prolonged intermittent fasting. *Ann Nutr Metab.* 2007;51(1):88-95.
3. Aksungar FB, Eren A, Ure S, Teskin O, Ates G. Effects of intermittent fasting on serum lipid levels, coagulation status and plasma homocysteine levels. *Ann Nutr Metab.* 2005;49:77–82.
4. Sarraf-Zadegan N, Atashi M, Naderi GA, Baghai AM, Asgary S, Fatehifar MR, et al. The effect of fasting in Ramadan on the values and interrelations between biochemical, coagulation and hematological factors. *Ann Saudi Med.* 2000;20:377–81.
5. Ziaee V, Razaee M, Ahmadinejad Z, Shaikh H, Yousefi R, Yarmohammadi L, et al. The changes of metabolic profile and weight during Ramadan fasting. *Singapore Med J.* 2006;47:409–14.
6. Bahijri S, Borai A, Ajabnoor G, Abdul Khaliq A, Al Qassas I, Al-Shehri D, et al. Relative metabolic stability, but disrupted circadian cortisol secretion during the fasting month of Ramadan. *PLoS One.* 2013;8(4):e60917.
7. Radhakishun N, Blokhuis C, Van Vliet M, Von Rosenstiel I, Weijer O, Heymans M, et al. Intermittent fasting during Ramadan causes a transient increase in total, LDL, and HDL cholesterols and hs-CRP in ethnic obese adolescents. *Eur J Pediatr.* 2014;173(8):1103–06.
8. Maughan RJ, Fallah J, Coyle EF. The effects of fasting on metabolism and performance. *Br J Sports Med.* 2010 Jun;44(7):490-4.
9. Maughan RJ, Leiper JB, Bartagi Z, et al. Effect of Ramadan fasting on some biochemical and haematological parameters in Tunisian youth soccer players undertaking their usual training and competition schedule. *J Sports Sci* 2008;26(Suppl 3):S39–46.