

RAMADAN FASTING AND THYROID HORMONE PROFILE

Pages with reference to book, From 213 To 216

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ABSTRACT

A study comprising 41 males, 5 females of the age ranging from 28 to 56 years was conducted during Ramadan of 1989 to compare T₃, T₄ and TSH levels in fasting with the levels of non-fasting conditions. Each individual gave 6 blood samples: One sample was taken 20 days before the onset of Ramadan, 3 samples at different fasting days and last two samples were drawn 23 days and five months after the end of Ramadan, respectively. The results showed a significant gradual rise in TSH throughout the fasting month, although the mean levels remained within normal limits. Pre-Ramadan levels were re-attained well after the end of Ramadan. There was no significant change in T₃ and T₄ levels (JPMA 41: 213, 1991).

INTRODUCTION

Fasting, one of Islamic essentials, is observed by most of the Muslims in the month of Ramadan. They awake in the last quarter of night, take their meals and stop food intake shortly before dawn. They do not eat or drink until after the sun sets. Whereas documentation is available in fasting, starvation and malnourished individuals with known hormone economy, the short term, regular fasting is not thoroughly studied. Khan et al.³ in their study on 33 normal volunteers compared serum T₃ and T₄ levels during 15th hour of fasting with levels reached three hours after breaking the fast. They did not observe any significant difference. The biological and metabolic manipulations of thyroid hormones in the body, especially those related to slow metabolic rate and longer biologic half life of T₄ (about 7 days)² suggests that such studies should also be conducted in conditions where the time gaps between fasting and non-fasting conditions are greater and the influence of number of days of fasting could also be recorded. We, therefore, conducted a study with changed sample schedules. TSFI estimations are also included in the study.

MATERIALS AND METHODS

Normal subjects comprising 41 males and 5 females of ages ranging from 28 to 56 years, who fasted throughout the month of Ramadan (April-May '89) were included in the study. Males were mostly hospital staff whereas females were domestic women. The individuals fasted from 3:30 hours to 19:00 hours and had nothing by mouth during this period. Temperature in these days reached a maximum of 41°C. None of the subjects gave any history of thyroid illness or other disease. Each individual gave 6 blood samples. First sample was taken 20 days before the onset of Ramadan, 3 samples on 10th, 17th and 26th fasting days, and last two samples were drawn 23 days and five months (151 days) after the end of Ramadan, respectively. Ramadan samples were collected 15 minutes before breaking the fast. Pre and post Ramadan samples were taken at 13:00 hours. Meals during, before and after Ramadan were of average Pakistani composition. Proteins: 12% (58g), Fat: 6% (29g), Carbohydrate: 82% (405g) and average caloric content was 2100 calories³. Activities of the individuals were restricted. Bed rest was also availed by 11 members.

Radioimmunoassay technique (double antibody) was applied to measure T₃ and T₄ levels, analyzing all samples in duplicate in single lots. TSH samples were measured by immunoradiometric assay.

Intra-assay coefficients of variability were less than 6% within normal range of the hormones. Intra-assay drift calculated using IAEA data reduction programme was less than 8% in all assays. The sensitivities of the assays were as follows: T3 RIA= 0.06 nmol/l, T4-RIA= 2.8 nmol/l, TSH-TRMA= 0.22 mU/i.

Students t-test of paired samples was used to compare variables. Results were expressed as $X \pm SEM$, where X=Mean and SEM= standard error of mean.

RESULTS

Non-fasting (pre-Ramadan & post-Ramadan) and DT₄ fasting serum levels of T₃, T₄ and

TABLE . Mean (\pm SEM) Serum T₃, T₄ and TSH values in non-fasting and fasting conditions.

	T ₃ (nmol/l)	T ₄ (nmol/l)	TSH (mU/l)
Non-Fasting			
i) Before Ramadan (Sample:1)	1.32 \pm 0.069	104.26 \pm 4.52	3.34 \pm 0.337
ii) After Ramadan (Sample:5)	1.42 \pm 0.063 ^a	94.23 \pm 3.87 ^a	4.15 \pm 0.372 ^b
iii) After Ramadan (Sample:6)	1.46 \pm 0.054 ^a	89.90 \pm 4.30 ^a	3.48 \pm 0.179 ^a
Fasting			
i) 10th Fast (Sample:2)	1.34 \pm 0.072 ^a	99.78 \pm 4.52 ^a	3.93 \pm 0.367 ^b
ii) 17th Fast (Sample:3)	1.36 \pm 0.061 ^a	95.23 \pm 3.22 ^a	4.31 \pm 0.341 ^c
iii) 26th Fast (Sample:4)	1.40 \pm 0.070 ^a	102.55 \pm 4.95 ^a	4.61 \pm 0.375 ^c
Normal Ranges	0.8---2.7	62---167	1---7

a---Vs Non-fasting --- NS

(Sample-1)

b---(Sample-1) --- p < 0.05 Significant

c---(Sample-1) --- p < 0.001 Highly Significant.

* Determined at A.E.M.C., Multan.

TSH are shown in Table and displayed quantitatively in figures 1 and 2.

Non-fasting (pre-Ramadan & post-Ramadan) and

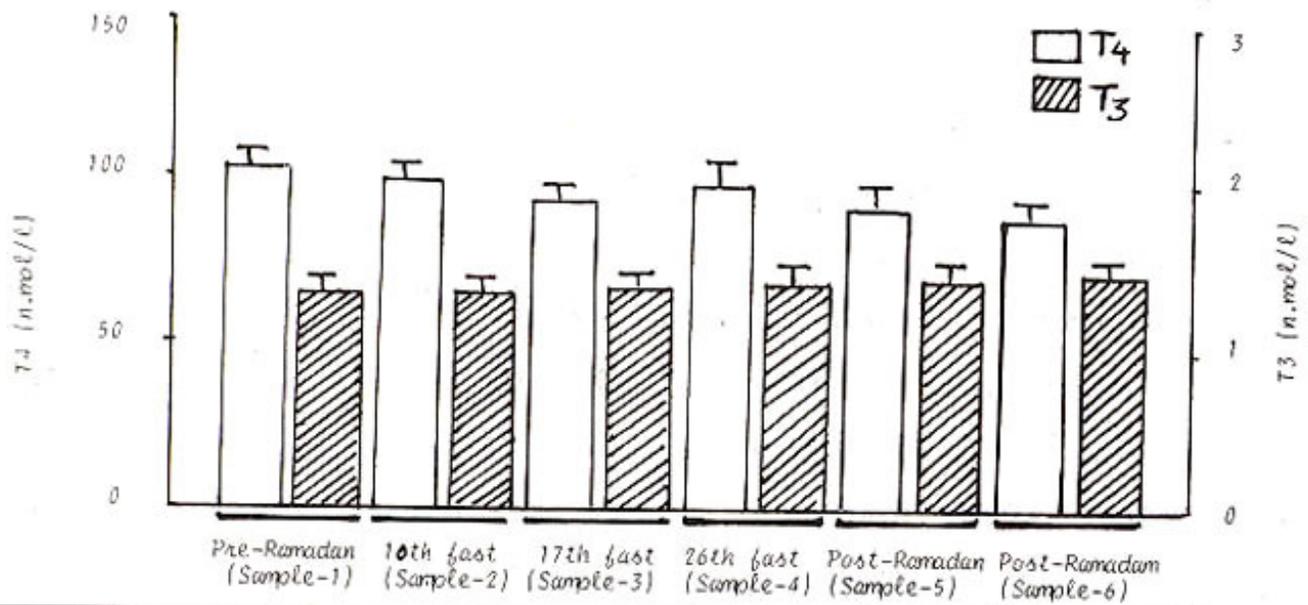
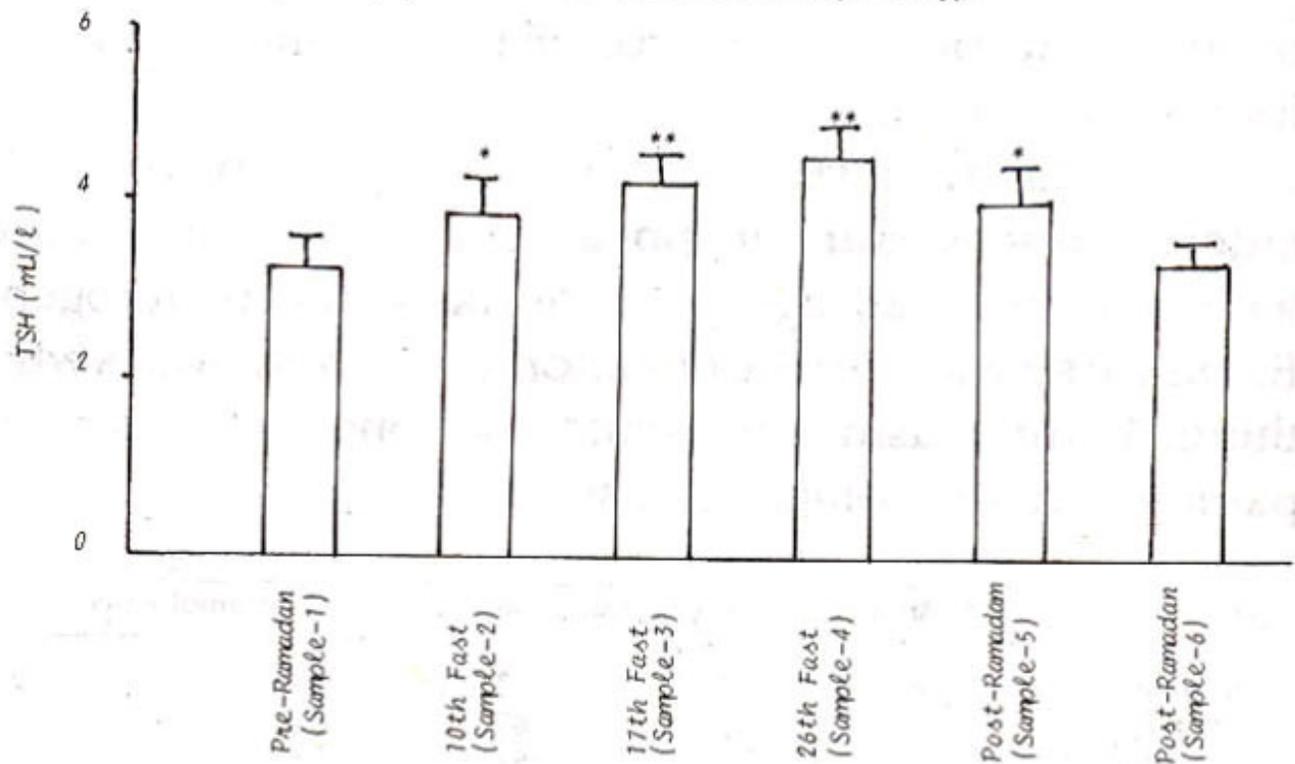


Figure 1. Serum T3 and T4 levels in non-fasting and fasting conditions (Note: Sample-1 was taken 20 days before the onset of Ramadan. Samples 5 & 6 were taken 23 days and 5 months (151 days) after the end of Ramadan respectively).



* Significant
 ** Highly significant

Figure 2. Serum TSH levels in fasting and non-fasting conditions.

T₃ and T₄ values remained within normal limits and did not show significant changes throughout the study. The levels of TSH also remained within normal limits. However, significant gradual increase in TSH levels was seen, which reached a maximum on 26th fasting day. The levels dropped after Ramadan but were still significantly higher than pre-Ramadan levels on 23rd day after the end of the month. The levels observed 5 months after the end of Ramadan were not significantly different from pre-Ramadan levels. Pre-Ramadan levels were probably re-attained at around two months after the end of Ramadan. The increased levels of TSH seem linearly related to the number of days of fasting.

DISCUSSION

Thyroid function is affected by age, non-specific illness, stress, some adrenal and gonadal hormones and many other miscellaneous states. Various nutritional states like diminished food intake, gross and total starvation also affect thyroid function in man. A number of studies have been published in this regard. Alexander reported in 1964 that total caloric deprivation results in decreased thyroid function⁴. Malnutrition or starvation in normal or obese subjects reduces plasma T₃. During total starvation of 9 obese subjects for four weeks, mean plasma T₃ was reduced in one study to about 50% of control values with some subjects reaching 'hypothyroid level'⁵. In another study comparable experimental conditions produced much smaller decrease in plasma T₃⁶. A study of chronic malnutrition in Indian adults shows reduction in plasma T₃ to extremely low values (20% of normal: with refeeding T₃ returns to or towards normal⁷). Study of Merimee on seven women and seven men who fasted for 60 hours, demonstrates that a decrease of circulating T₃ is a constant feature of both men and women and that energy requirements are decreased by means of an alteration of circulating T₃ concentration. This appears due to decrease in conversion of circulating T₄ to T₃⁸. Conversion of T₄ to T₃ is in liver and kidney (80% of daily T₃ production arises from peripheral deiodination of T₄⁹ is catalyzed by enzyme 5'-deiodinase. During fasting (or starvation), 5-deiodinase activity is reduced which results in decreased T₃ production¹⁰. Work of Wartofsky and Burman¹¹ (1982) shows that there is a 20% decrease in plasma T₃ by the end of first day of fasting (24 hours) and a 50% decrease at the end of 3 days. With a prolonged fasting of more than 3 weeks T₃ remains low. With refeeding original levels are restored. This happens due to decreased metabolic rates (and hence energy requirements)¹². Decreased production of T₃ is accompanied by adaptive changes in the pattern of enzymes induced in the liver, so that T₃ induction of α-glycerolphosphate dehydrogenase is maintained but T₃ induction of malic enzyme is not¹³. Reported results on plasma T₄ are variable: T₄ is unaffected or decreased during caloric deprivation^{5,6}. TSH results in short term and long term fasting are also variable. In normal adults basal levels of TSH decreased by 50% after 36 hours of fasting⁷ but levels were unaffected in chronic malnutrition in adults^{7,14,15} and children¹⁶. During total starvation of obese subjects for several weeks, basal TSH concentrations were unchanged or slightly decreased^{5,6}. It is also shown by others¹⁷ that serum TSH levels may be normal or slightly elevated under some conditions of non-thyroidal illness including hepatic cirrhosis, starvation etc. but without apparent correlation with either T₃ or T₄ concentrations. Recently a 5 years old boy who was under malnutrition due to dietary maladvice for 3 years developed iodine deficiency hypothyroidism with low T₃ and high TSH levels¹⁸. Decrease in T₃ levels during fasting could also be attributed to greater metabolic clearance and biologic activity of T₃ relative to T₄. The values of T₄ in our subjects seem decreasing (as shown in Figure. 1)

with number of days of fasting, although this decrease is not significant on statistical analysis. Ramadan fasting which is expanded over a fraction of day is observed daily for one month. The literature is almost silent as regards this type of fasting. The findings related to malnutrition and starvation in literature show a constant feature of human population over a period of months or years. Fasting is confined to nutrient lack. Ramadan fasting (or short term regular starvation type fasting) is a single incidence for a duration extending over days or weeks. Such fasting is therefore different. The periodic daily fasting requires the thyroid to adjust its function gradually to the new menu. The thyroid profile will behave in a different mode. In the reported situations T_3 levels are reduced but the extent of decrease is different in different situations. T_4 and TSFI levels may change or remain unchanged. In Ramadan there is no food deprivation (except for a limited interval daily), T_3 levels are, therefore, not lowered as may be expected (peripheral conversion of T_4 to T_3 compensates small variations in T_3 levels). Ramadan fasting reflects a gradual decrease in T_4 levels which is not significant in a month interval (Figure 1). This decrease is visible only if pre-Ramadan sample is taken as control. However, TSH estimates in our study showed a significant gradual rise (within normal limits) which reached a maximum at the end of the month (Figure.2). Is this rise related to the reduction in T_4 levels or has it to do with dietary changes? This requires further thorough investigation.

Synthesis and secretion of thyroid hormones depend upon the individual rates of several enzymatic conversions from tyrosine to T_4 . Deficiency of one or more of these enzymes could block the synthesis of T_4 (e.g., in hypothyroidism)¹⁹. Increased thyroid stimulation could improve the synthesis. The possibility is not yet explored. Perhaps the enzymatic activities are affected by fasting. Wider trial experiments are, therefore, required for worth exploration.

Our study is interesting in the sense that the samples were repeated at fixed intervals of time and comparisons were made with pre-Ramadan samples of same individuals.

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