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The Effect of Ramadan Fasting on Thyroid Hormone Profile: A Cohort Study

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Abstract: Ramadan is the holiest month in the Islamic calendar and Muslims fast during this month. We designed this study to evaluate the effect of Ramadan fasting on thyroid hormone profile. This cohort study was performed during Ramadan of 1423 (Dec. 2002). Subjects were 81 students of Tehran University of Medical Sciences. We evaluated weight, Body Mass Index (BMI), Thyroxin (T4), triiodothyronine (T3) and Thyrotropin-stimulating Hormone (TSH) before and after Ramadan. Eighty one healthy volunteers were included in the study. T4 decreased significantly during fasting in Ramadan in both genders, TSH increased significantly in male subjects, although TSH and T4 levels were within the normal range. There was a positive correlation between T4 changes and number of days of fasting in women. There were no significant changes in T3 after Ramadan fasting. Short fasting is not probably accompanied by significant changes in thyroid hormone, but the repetitiveness of this in Ramadan fasting decrease T4 and increase TSH. The reason of this finding is not well understood.

Key words: Thyroid hormone, fasting, Ramadan, Muslims, thyroxin, triiodothyronine

INTRODUCTION

Ramadan is the holiest month in the Islamic calendar and fasting during this month is a religious duty for all healthy adult Muslims (The Holy Quran). As one of the five pillars of Islam, fasting is observed by millions of Muslims all over the world. Believers are commanded to abstain from food, drink and sexual relationships from sunrise to sunset as a sign of restraint and introspection. Food and fluid intake is mainly nocturnal and usually, intake frequency and food quantity, sleep duration at night and daily physical activity are reduced. From the physiological standpoint, Islamic fasting provides a unique model of fasting and an appropriate opportunity to investigate the metabolic effects of changing the time of eating in humans.

The period in which the person fasts may vary depending on the geographical location of the country and the season of the year and can be as long as 18 h day in summers of tropical regions.

Daytime fasting accompanied by a delay and shortening of night-time sleep and changes in behavioral and social habits have been shown to affect many

biochemical and hormonal parameters (Bensouda *et al.*, 1991; Haouari-Ourerro *et al.*, 1999). Some studies have shown Food restriction and starvation decrease plasma TSH and T3 in all vertebrates (Reyns *et al.*, 2002; Van der Geyten *et al.*, 1999), but the effect of Ramadan fasting is not understood on thyroid hormone.

On the other hand some hypo- or hyperthyroid patients would like to fast during this month. It is therefore of interest to compare pre- and post-Ramadan Thyroid hormone profile. So we designed this study to evaluate the effects of Ramadan fasting on Thyroid hormone profile.

MATERIALS AND METHODS

This cohort study was performed during Ramadan of 1423 (Dec. 2002). Subjects were students of Tehran University of Medical Sciences.

Inclusion criteria included TUMS students of dormitory (for easy accessibility) aged 20-35 years who were going to fast during the Ramadan. We excluded students with any acute or chronic disease, those on medications during the study, those fasting less than 15

days and those with any addictions except cigarette smoking. Furthermore, none of the female subjects were pregnant or using contraceptives.

All subjects had the same dietary regimen before and during Ramadan and were encouraged to continue their usual lifestyle and activities during the study.

This study was approved by the ethical committee from the research office of Tehran University of Medical Sciences and volunteers were given an informative consent for participation in the study.

We visited all subjects twice; 3 days before Ramadan and on 26th of Ramadan. Data gathering was performed by a questionnaire (by the same observer and same equipment on all occasions). Variables included general condition and review of different systems, past medical history, changes in habits during Ramadan such as smoking, illnesses, changes in food intake and body weight. Blood samples were taken from all subjects for evaluation of T4, T3 and TSH; once before Ramadan at 10:00 am after an overnight fast and then at 26th of Ramadan (5:00 pm) 12 h after last meal.

We analyzed our findings in the female group according to the number of fasting days during Ramadan (not fasting during menstruation period).

Statistical analysis was performed with software statistical package for the social sciences (SPSS version 10). Results were expressed as means and standard deviations (mean \pm SD). ANOVA and Student's paired t-test were used for data analysis; p-value less than 0.05 was considered statistically significant.

RESULTS

Eighty-one healthy volunteers (Male/female: 41/39) were included in the study (unknown sex in one subject). The mean age of subjects was 22.7 year (Range: 18-29 years, SD = 2.3). The respective means of BMI and weight were 21.2 (\pm 4.5) and 62.4 (\pm 11.6) kg before Ramadan fasting respectively. Weight decreased significantly in both genders (61.2 \pm 10.8) and BMI decreased in female subjects after Ramadan (20.9 \pm 2.0) ($p < 0.05$).

T4 decreased significantly during fasting in Ramadan in both genders, TSH increased significantly in male subjects, although these changes were within the normal range.

There was a positive correlation between T4 changes and number of days of fasting in women [Pearson Correlation = -0.374, Sig. (2-tailed) = 0.027, N = 35].

T3 decreased after Ramadan but this change was not significant. T4, T3 and TSH changes during Ramadan fasting didn't have any association with BMI or weight.

Table1: Changes of thyroid hormone profiles during Ramadan Fasting

	Mean before Ramadan	Mean after Ramadan	Mean diff	Std. error mean	T	df	p-value
T4: Male	8.4 \pm 1.6	7.2 \pm 1.5	1.2 \pm 1.8	0.3	4.0	38	0.000
Female	8.6 \pm 1.6	7.2 \pm 1.7	1.2 \pm 1.7	0.3	4.3	34	0.000
Total	8.5 \pm 1.6	7.2 \pm 1.6	1.2 \pm 1.9	0.2	5.9	73	0.000
T3: Male	151.7 \pm 28.0	145.6 \pm 29.1	3.4 \pm 34.7	5.8	0.4	36	0.7
Female	151.3 \pm 22.0	149.5 \pm 31.9	4.6 \pm 34.7	5.9	0.8	33	0.4
Total	151.0 \pm 25.1	147.6 \pm 29.2	2.2 \pm 35.2	4.1	0.8	70	0.4
TSH: Male	0.9 \pm 0.7	1.2 \pm 0.6	-0.2 \pm 0.7	0.1	-2.1	38	0.039
Female	0.8 \pm 0.9	1.2 \pm 1.2	-0.3 \pm 1.2	0.1	-1.6	34	0.1
Total	0.9 \pm 0.4	1.2 \pm 0.9	-0.3 \pm 0.9	0.2	-2.5	73	0.014

T3 decreased in subjects with reduction in weight and increased in subject with rising in weight during Ramadan fasting, but these changes were not significant. Table 1 shows changes of thyroid hormone profiles in both genders.

DISCUSSION

During Ramadan, Muslims refrain from eating, drinking, smoking and sexual relations from sunrise (Sahur) until sunset (Iftar) and people can eat during the remaining hours. This life style during Ramadan can have hormonal effects (Bogdan *et al.*, 2001; Iraki *et al.*, 1997), but its effects on thyroid hormone profiles is not well understood. The purpose of present study was to consider the effects of Ramadan on thyroid hormone profiles.

Present findings are compared with other studies in Table 2. Bogdan *et al.* (2001) reported a reduction of TSH values at midnight and a rising in the afternoon. Fasting is associated with a blunted TSH response to TRH, although basal TSH and thyroid hormone levels are within normal ranges (Coiro *et al.*, 1999). Azizi and Amir-Rasouli (1986) showed that no significant alterations in serum concentrations of T4, T3, TSH and TSH response to intravenous injection of TRH occurs in males during Ramadan fasting.

Sajid *et al.* (1991) reported a significant gradual rise in TSH throughout Ramadan fasting, but Bogdan *et al.* (2001) showed a flattened circadian rhythm of serum TSH during this month. Acute fasting result in a marked suppression of TSH secretion and that leptin regulates the starvation-induced alterations in TSH levels (Chan *et al.*, 2003). Also, a complex sequence of alterations in serum TSH and thyroid hormone levels have been observed in previous studies in subjects undergoing short-term fasting (LoPresti *et al.*, 1991; Spencer *et al.*, 1983). These include a decrease in TSH pulse amplitude, a decrease in serum T3 levels and increase in reverse T3 (the less biologically potent hormone) (Romijn *et al.*, 1990).

Table 2: Comparison our study findings and similar studies

Study parameters	Our study	Bogdan study (2001)	Sajid study (1991)	Chan study (2003)
No. of subjects	81	10	46	8
Age	20-35	32-40	28-56	22-25
Time of fasting	Ramadan fasting (12 h/day in 26 days)	Ramadan fasting (17 h/day in 23 days)	Ramadan fasting (12 h/day in 23 days)	Non-Ramadan fasting (72 h fasting)
TSH	↓	Decrease midnight Increase afternoon	↓	↓
T3	No change	No change	No change	↓
T4	↓	No change	No change	No change

We found a decrease in T3 and T4 levels after Ramadan fasting with reduction of the former not being significant. The fall of T3 and T4 is mainly due to TBG alterations and free thyroid indices remain unchanged (Azizi *et al.*, 1994; Suleiman, 1988). Chan *et al.* (2003) observed that fasting induced a decrease in T3 levels by approximately 30% and that this is due to a reduction of leptin levels. Leptin regulates the acute fasting-induced changes in the hypothalamic-pituitary-gonadal axis and in part, changes in the hypothalamic-pituitary-thyroid (Chan *et al.*, 2003). Spaulding *et al.* (1976) reported a reduction in T3 level after fasting in subjects receiving the no-carbohydrate hypocaloric diets for two weeks but the same subjects receiving isocaloric diets containing carbohydrate showed no significant changes in T3 concentration. Furthermore, it has been shown that refeeding with carbohydrates but not protein or fat causes an increase in serum T3 (Azizi, 1978). High carbohydrate diet in Ramadan, can explain non significant T3 change in our subjects.

A small but significant increase in serum T4 in the last days of Ramadan has been reported by some authors. Fedail *et al.* (1982) reported an increase in serum T4 in a sample taken before the main evening meal on the first and last days of Ramadan, but some studies have shown no change in T3 and T4 during Ramadan fasting (Bogdan *et al.*, 2001; Sajid *et al.*, 1991) or of T4 between fed and fasting conditions (Bogdan *et al.*, 2001). Chan *et al.* (2003) believed T4 levels remain unchanged in short fasting (once for 12-24 h) due to its longer half life.

Experimental case-control study on rats showed T4 and T3 were lower in the fasting group and this decrease was lower in older than younger rats (Kmiec *et al.*, 1998).

Difference in the effects of fasting on thyroid hormone profiles in some published articles may be due to a change in the dietary regimen in Ramadan, the difference in the number of Ramadan fasting days prior to the study or effect of circadian rhythm.

Limitations: This study had some limitations. This study represents healthy population and it is not representative for hyper or hypo thyroid patients. Although volunteers had their blood investigations done after 12 h fasting, the timing were different (10:00 vs. 17:00 h). We didn't

evaluate the effect of counter regulatory hormones and circadian rhythm on thyroid hormone profiles.

CONCLUSIONS

We found T4 decreased significantly after Ramadan fasting in both genders and TSH increased significantly in male subjects. There was a positive correlation between T4 changes and number of days of fasting in women in this study. Short fasting is not probably accompanied by significant changes in thyroid hormone, but the repetitiveness of this in Ramadan fasting decrease T4 and increase TSH. The reason of this finding is not well understood.

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