



# Ramadan Fasting and Thyroid Hormone Levels in Women with Hypothyroidism

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## ABSTRACT

**Introduction:** According to some studies, Ramadan fasting causes minimal changes in the levels of thyroid hormones. The present study aimed to evaluate the impact of Ramadan fasting on the levels of thyroid hormones in fasting women with hypothyroidism and levothyroxine intake.

**Methods:** Serum levels of free thyroxine (T4) and thyroid-stimulating hormone (TSH) were measured in 36 women with hypothyroidism aged 12-56 years, who fasted during Ramadan. Three blood samples were collected three days before Ramadan, on day 27 of Ramadan, and two months after Ramadan. In addition, the levels of hemoglobin and hematocrit (HCT) were measured during and after Ramadan.

**Results:** The serum level of free T4 significantly decreased during Ramadan compared to before Ramadan ( $P < 0.05$ ). However, no significant difference was observed in the serum free T4 level before and after Ramadan. On the other hand, the TSH was higher during Ramadan compared to before Ramadan although the difference was not considered significant (normal range). TSH level reduced after Ramadan compared to during Ramadan, while no significant difference was denoted in the TSH level at the three measurement times. In addition, hemoglobin and HCT decreased significantly after Ramadan compared to during Ramadan.

**Conclusion:** According to the results, Ramadan fasting could reduce the serum levels of free T4 in the women with hypothyroidism. However, only a slight increase was observed in the TSH levels, which was not considered significant. Further investigation is required regarding the changes caused by Ramadan fasting in the levels of hemoglobin and HCT.

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## Introduction

The population of Muslims is more than 1.8 billion across the world, with higher propensity in Asia and Africa (1). The Islamic law commands Muslims to fast for one month per year. Every Muslim must fast during the holy month of Ramadan, which is the ninth month of the lunar calendar; however, children, patients, passengers, and menstruating women are exempt from fasting. Fasting individuals refrain from eating, drinking, and sexual intercourse from dawn until sunset during the holy month of Ramadan (2). Ramadan fasting differs from regular or experimental fasting due to the subsequent changes in the sleep and eating pattern. As a result, Ramadan fasting differently affects the hormonal system and metabolism of

the body (3-6). Some studies have indicated that Ramadan fasting causes minimal changes in the levels of thyroid hormones (7, 8).

Hypothyroidism is an endocrine disorder, which is characterized by the reduced production of thyroid hormones. In addition, disorders such as Hashimoto's thyroiditis, iodine deficiency, and congenital defects could cause hypothyroidism (9). Hypothyroidism may be overt or subclinical; in overt hypothyroidism, the symptoms are obvious and prominent, while in subclinical hypothyroidism, the symptoms may not be as evident (10). The prevalence of hypothyroidism has been reported to be 4.8% in the general population, while it is considered to be more common in women and the elderly. According to

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the literature, the prevalence of hypothyroidism is 10 times higher in women compared to men. In addition to primary and secondary hypothyroidism, women may also experience a transient form of hypothyroidism after childbirth (9).

Ramadan fasting affects the hormonal system and metabolism, including the levels of thyroid hormones. Many Muslim women with hypothyroidism fast during Ramadan and experience changes in several parameters (sleep-wake cycle, food intake, and spiritual atmosphere of life), which may interfere with levothyroxine absorption and cause metabolic and hormonal changes.

The present study aimed to assess the impact of Ramadan fasting on the levels of thyroid hormones in women with hypothyroidism receiving levothyroxine.

### Materials and Methods

This study was conducted on 36 Iranian women in Mashhad, Iran during June-July 2016. The inclusion criteria were the presence of hypothyroidism, levothyroxine administration, and use of no other drugs. Participation was voluntary, and the participants were allowed to withdraw from the study at any given time. The subjects were aged 12-56 years. During the study period, the duration of daily fasting in Ramadan was more than 16 hours.

Three blood samples were obtained from each participant at Nejat Shokoohi Laboratory. The first sample was collected three days before

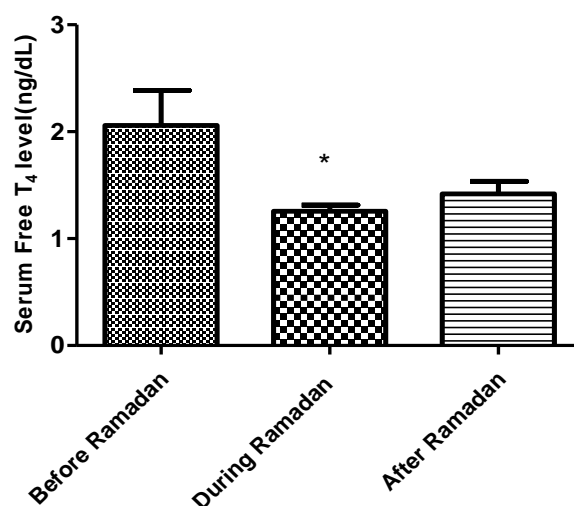
Ramadan, the second sample was obtained on day 27 of Ramadan, and the last sample was collected two months after Ramadan. The serum levels of free thyroxine (T<sub>4</sub>) and thyroid-stimulating hormone (TSH) were measured using the radioimmunoassay kit in all the collected blood samples, and blood cell count was carried out on the last two samples.

All the patients were clinically examined, and data were collected using two questionnaires, which were completed by the participants. The first questionnaire was provided at the beginning of the study, and the other questionnaire was provided to the subjects during Ramadan.

Data analysis was performed in SPSS version 20.0, and the obtained results were expressed as mean and standard error of the mean (SEM). One-way analysis of variance (ANOVA) and paired-t test were applied to determine the sequential differences between the means at the significance level of  $P < 0.05$ . In addition, Tukey's contrast analysis was used if needed.

### Results

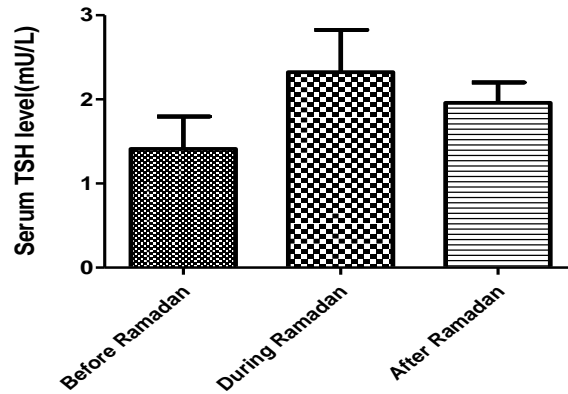
Figure 1 shows the results of free T<sub>4</sub> serum levels. Accordingly, free T<sub>4</sub> serum levels significantly decreased in the patients during Ramadan compared to before Ramadan ( $P < 0.05$ ). However, the difference between the serum levels of free T<sub>4</sub> before and after Ramadan was not considered significant although the serum levels of free T<sub>4</sub> after Ramadan were higher compared to before Ramadan.



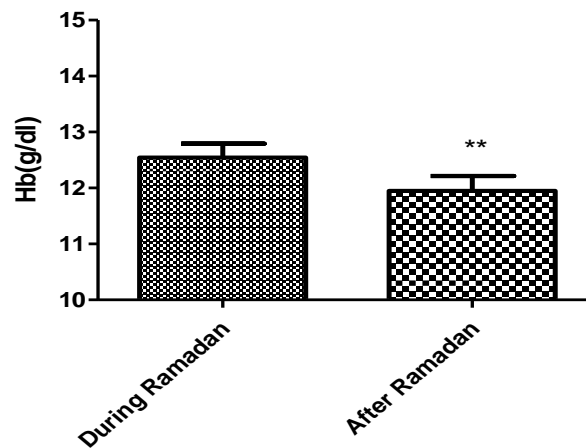
**Figure 1.** Serum Free T<sub>4</sub> Levels in Women with Hypothyroidism before, during, and after Ramadan (Data expressed as Mean±SEM; \* $P < 0.05$  vs. before Ramadan; SEM: standard error of mean)

Figure 2 depicts results of the serum TSH levels, which indicated that the serum levels of TSH were higher during Ramadan compared to before Ramadan. However, the difference in this regard was not considered significant. Figures 3

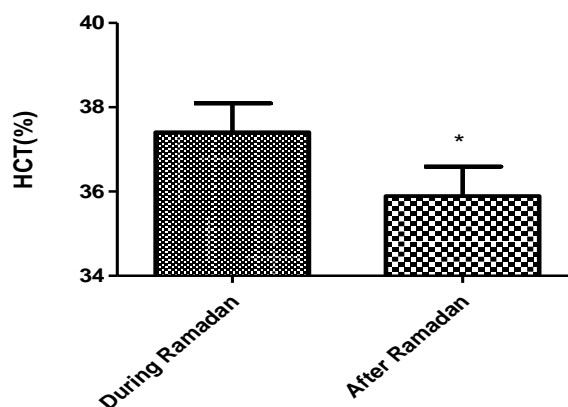
and 4 show the results of hemoglobin and hematocrit (HCT) levels; accordingly, the levels of hemoglobin ( $P < 0.05$ ) and HCT ( $P < 0.01$ ) significantly decreased after Ramadan compared to during Ramadan.



**Figure 2.** Serum Free T4 Levels in Women with Hypothyroidism before, during, and after Ramadan (Data expressed as Mean±SEM; SEM: standard error of mean)



**Figure 3.** Hemoglobin Levels in Women with Hypothyroidism during and after Ramadan (Data expressed as Mean±SEM; SEM: standard error of mean; \*\* $P < 0.01$  vs. during Ramadan; Hb: hemoglobin)



**Figure 4.** Hematocrit Levels in Women with Hypothyroidism during and after Ramadan (Data expressed as Mean $\pm$ SEM; SEM: standard error of mean; \*P<0.05 vs. during Ramadan; HCT: hematocrit)

## Discussion

According to the results of the present study, Ramadan fasting could reduce the serum levels of free T4 in the female patients with hypothyroidism, while causing a slight increment in the serum levels of TSH. In addition, the levels of hemoglobin and HCT were higher during Ramadan compared to after Ramadan although they were considered to be within the normal range for women.

Ramadan fasting is associated with energy restriction and altered sleep/wake cycles occur, which may affect the clinical features and health of the fasting individuals with hypothyroidism. Several studies have been conducted on animal models so as to investigate the effects of fasting on the levels of thyroid hormones (11), and there has recently been ongoing human research regarding the correlation of Ramadan fasting and thyroid function (7, 8, 12). Nevertheless, few studies have been focused on the impact of Ramadan fasting on patients with hypothyroidism.

In a study in this regard, Sulimani et al. reported that the total serum levels of T4, T3, free T4, and TSH had no significant differences in the male subjects aged 25-50 years from the first until the last day of Ramadan (13). Similarly, Sajid et al. claimed that Ramadan fasting caused no changes in the levels of T4 and T3 in normal adults, while a significant, gradual increase was denoted in the TSH level during Ramadan (7). On the other hand, Bahrayni et al. reported that in the pre-menarcheal girls aged 9-13 years, Ramadan fasting decreased the body mass index, body weight, and serum T3 although the values remained within the normal range later.

Furthermore, the researchers reported a slight reduction in T4 and a slight increase in TSH (12), concluding that despite the T3 reduction, changes in the thyroid hormones were within the normal range, and Ramadan fasting had no adverse effects on the pre-menarcheal girls. Based on the aforementioned studies, which have been performed on healthy men and women, Ramadan fasting has no adverse effects on thyroid function.

In a study in this regard, Ahmadinejad et al. reported that Ramadan fasting decreased T4 in the men and women aged 20-35, and only TSH increased in men. Therefore, it was concluded that Ramadan fasting was not associated with severe changes in the levels of thyroid hormones. In the mentioned research, T4 reduction and TSH elevation were attributed to the number of the fasting days (14), which is in line with the results of the present study. In the current research, most of the participants with hypothyroidism fasted for more than 21 days. In a similar study, Hameed et al. also reported that T4 levels reduced in fasting women, and the T4 level was correlated with the number of the fasting days; as such, changes in T4 shifted to the levels in the stage before fasting immediately after the cessation of fasting (15). This is consistent with the results of the present study as two months after Ramadan, the levels of both free T4 and TSH returned to the levels before Ramadan. According to the findings of Bogdan et al., free T4 and free T3 had no significant difference before Ramadan and on day 23 of Ramadan, which is inconsistent with the current research in terms of the levels of free T4.

Ramadan fasting is associated with changes in the sleep-wake cycle, especially for the individuals who say prayers at night and take their meal at Sahur (sunrise meal). However, it seems that Ramadan fasting causes no changes in the circadian rhythm of the neuroendocrine glands (3). In a review study, Boroumand et al. stated that Ramadan fasting is not accompanied by significant changes in the levels of T3, T4, and TSH although other studies with various number of fasting days have denoted changes in the T4 and T3 levels (16).

One of the main findings of the present study was the reduction of free T4 during Ramadan, which could be due to the interval between levothyroxine and food intake. Maximum levothyroxine absorption occurs within a minimum of 1-2 hours before breakfast with an empty stomach (17). In the current research, the patients with hypothyroidism were asked to take levothyroxine preferentially 1-2 hour before Sahur or two hours after Iftar (sunset meal) (15), which proved to be challenging for most of the female participants. On the other hand, some other factors may also interfere with levothyroxine absorption, such as the consumption of fatty/solid foods and variable portions of dietary carbohydrates, proteins, and fats, which could eventually alter the levels of TSH (17) and become involved in the reduction of free T4 and elevation of TSH in the present study.

Several studies have evaluated hemoglobin and HCT change during Ramadan fasting. For instance, Trabelsi et al. reported that hemoglobin, HCT, and plasma osmolality increased after Ramadan compared to before Ramadan, while the total body water had no difference with before Ramadan (18). Another study in this regard also indicated that hemoglobin, HCT, and plasma osmolality increased after Ramadan fasting (19). These findings are in congruence with the results of the present study. On the other hand, Furuncuoglu reported that hemoglobin and HCT decreased after Ramadan fasting (20). Similarly, Farshidfar et al. denoted a significant reduction in hemoglobin on days three and 15 of Ramadan (21). These findings are inconsistent with the results of the present study. The increased levels of hemoglobin and HCT in the current research could be attributed to prolonged fasting of the patients and the subsequent dehydration.

## Conclusion

According to the results, Ramadan fasting decreased the levels of free T4 in the women with hypothyroidism; this may highlight the need for the increased dose of levothyroxine in these patients. It seems that in the women with hypothyroidism whose symptoms intensify during Ramadan fasting, increased levothyroxine dosage could be beneficial within a short period. Furthermore, our findings indicated that hemoglobin and HCT increased during Ramadan although they returned to the levels of before Ramadan.

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## Conflicts of interest

None declared.

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