

Dietary intake and nutritional status of Turkish pregnant women during Ramadan

Gul Kiziltan, PhD, Efsun Karabudak, PhD, Gorkem Tuncay, MD, PhD, Filiz Avsar, MD, PhD, Pirl Tuncay, BSc, Onur Mungan, BSc, Pinar Meral, BSc.

ABSTRACT

Objectives: To determine the effects of Ramadan fasting on dietary intakes, nutritional status and biochemical parameters of Turkish pregnant women.

Methods: We carried out this study at Dr. Zekai Tahir Burak Women's Health Care and Research Hospital, Ankara, Turkey from October 15th to November 13th 2004. Forty-nine fasting group and 49 non-fasting group (control group) voluntarily enrolled for the study. We analyzed the blood biochemical parameters of pregnant women and obtained the dietary intakes from the groups.

Results: Compared to the control group, weight gain and energy intake ($p < 0.05$ for second and third trimesters) was less in the fasting group. The percentage of protein ($p < 0.05$ for first and second trimesters) and carbohydrates ($p < 0.05$ for all trimesters) from total energy was higher in the fasting group than in the control

group. We noticed a slight increase in the fasting blood glucose, serum total cholesterol high-density lipoprotein-cholesterol and triglycerides ($p < 0.05$ for first trimester) concentrations in the fasting group during Ramadan. However, we found decreased levels in the plasma urea, total cholesterol, triglycerides, low-density lipoprotein-cholesterol and total protein and albumin levels of the fasting group in comparison with the control group. Dietary mineral and vitamin intakes were lower than the recommended daily allowance, except vitamin A and vitamin C in both groups.

Conclusion: Based on the results of the present study, Ramadan fasting had no significant adverse effect on the health of pregnant women.

Saudi Med J 2005; Vol. 26 (11): 1782-1787

Ramadan is the ninth month on the Islamic calendar and the month when Muslims must refrain from eating and drinking from dawn (sahur) to sunset (ifthar).¹ The month of Ramadan contains 29-30 days and varies by geographical location and season. Depending upon these factors, the length of the fast may vary from 12-19 hours a day. During the one-month of fasting, Muslims consume 2 meals in a day. A large meal at ifthar and a light meal at sahur is more common. Many physiological and psychological changes are observed during Ramadan probably due to the changes in eating pattern and frequency and also sleep pattern. Studies

pertaining to Ramadan fasting have been carried out mostly in males.^{2,3} However, few studies have been reported on pregnant and lactating women.^{4,5} Ramadan has reported a reduction in food intake, a decrease or increase in body weight and fat percentage, a decrease in resting metabolism and an increase in creatine, plasma albumin, hematocrit and urea levels.^{1,6} Pregnancy, breast-feeding, traveling, menstruating are some conditions in which fasting is not obligatory in Islam. However, a pregnant woman who is in good health, capable of fasting and does not feel any worry about herself or to her fetus is required to fast like any ordinary women.

From the Department of Nutrition and Dietetics (Kiziltan, Karabudak, Tuncay P, Mungan, Meral) Baskent University and the Department of Obstetrics and Gynecology (Tuncay G, Avsar), Dr. Zekai Tahir Burak Women's Health Care and Research Hospital, Ankara, Turkey.

Received 22nd May 2005. Accepted for publication in final form 23rd August 2005.

Address correspondence and reprint request to: Dr. Gul Kiziltan, Department of Nutrition and Dietetics, Baskent University, Baglica Kampusu, Eskişehir Yolu 20 km, 06530, Ankara, Turkey. Tel. +90 (312) 2341010/16051603. Fax. +90 (312) 2341157. E-mail: gkizilta@baskent.edu.tr

We conducted this study to determine the dietary intakes, nutritional status and blood biochemical parameters of Turkish pregnant women during Ramadan.

Methods. We conducted this study in Dr. Zekai Tahir Burak Women's Health Care and Research Hospital, Ankara, Turkey. The population consisted of 49 pregnant women (12 in the first trimester, 29 in the second trimester, 8 in the third trimester [fasting group]) who fasted during Ramadan (one month) and 49 pregnant women (12 in the first trimester, 30 in the second trimester, 7 in the third trimester [control group]) who did not fast. By antenatal care, they were all free from any chronic or acute somatic or psychiatric problems. We explained the study to the subjects, and we obtained a written consent. After the approval of the protocol by the Local Ethics Committee, we conducted the physical examination, weight measurement and collected a blood sample for biochemical parameters. We measured the height and weight (using a digital or balance beam scale) on the first and 30th days of Ramadan. Prepregnancy weight was self-reported. Prepregnancy and current body mass index (BMI) was calculated by weight (kg)/height (m²). The groups were similar in term of age and prepregnancy BMI. The study was conducted from October 15th to November 13th, 2004. Average duration of the fast was approximately 12 hours and maximum ambient temperature ranged from 18-20°C. Fasting venous blood samples were taken on day one and 30 of Ramadan in the fasting group and only on day 30 of Ramadan in the control group. We collected the venous blood samples 8 hours after sahur into ethylene-diaminetetraacetic acid-containing tubes and stored at -18°C until subsequent analysis in Dr. Zekai Tahir Burak Women's Health Care and Research Hospital Laboratory, which meets the criteria of the central standard laboratory of the Ministry of Health in Turkey. We analyzed the blood sample for urea⁷ and glucose⁸ by a Hitachi Moduler P800 automated clinical chemistry analyzers (Roche reactivities were used). Pregnant women who were under 20 years old and who had twin pregnancies or fetal anomalies were excluded from the study.

Total cholesterol (TC) and high-density-lipoprotein cholesterol (HDL-C) were measured by an enzymatic colorimetric method by using cholesterol esterase, cholesterol oxidase, peroxidase and a chromogenic reaction with 4-aminophenazone (CHOD-PAP) on a spectrophotometer.⁹ Plasma triglyceride (TG) concentrations were determined by an enzymatic colorimetric method by using lipoprotein lipase glycerokinase, glycerophosphate oxidase and the 4-aminophenazone, 4-chlorophenol.¹⁰ Very-low-density lipoprotein cholesterol

(VLDL-C) was calculated by dividing triglycerides by 5 (TG/5). Low-density-lipoprotein cholesterol (LDL-C) was calculated by using the Friedewald equation:¹¹ $LDL-C = (TC - HDL-C) - TG/5$. We obtained the food intake by 24-hour records from fasting and the control group on day one, 2, 29 and 30 of Ramadan. The energy and nutrient intakes during Ramadan were the mean values of these 4 days. We estimated the volumes and portion sizes with 2-dimensional food models and with a portion size picture booklet of 120 photographs of foods, each with 3-5 different portion sizes. Three experienced dietitians assisted with the dietary recall and reviewed all questionnaires with the subjects probing for inaccurate and omitted responses. The average energy, total fat, protein, carbohydrates, thiamin, vitamin B12, folates, vitamin A, vitamin C, niacin, riboflavin, calcium, iron, zinc and phosphorus content for each individual's diet were analyzed using food composition tables.¹² We compared the energy and nutrient intakes of these participants to the recommendation dietary allowances (RDAs).¹³

We analyzed the data using the Statistical Packages for Social Sciences (SPSS) for Windows version 11.0. The results have been expressed as mean and standard deviation ($\bar{x} \pm SD$). Independent samples t- test was used to ascertain the significance of differences between mean values of 2 groups (fasting and control) and confirmed using the Mann-Whitney U test for non-parametric distribution. Also, Wilcoxon test was used to ascertain differences between blood parameter mean values between day one and day 30 of fasting group. Values were considered to be significantly different if $p < 0.05$.

Results. There were no significant differences between the 2 groups in terms of age, education and parity. The current (first day of Ramadan) mean BMI of fasting and control group was similar in all trimesters. The mean body weight changes during Ramadan were lower in the fasting group than control group as shown in **Table 1**.

Table 2 shows that total energy intake of fasting pregnant women was less than the control group. Especially pregnant women in the second and third trimester had high-energy restriction ($p < 0.05$). The percentage of protein and carbohydrate from total energy (TE) was higher in the fasting group than control group. However, saturated, polyunsaturated fatty acids and fiber intake was significantly lower than the control group.

The mean dietary mineral and vitamin intake was less than the RDA in both groups. But, in fasting group deficiency was more than the control group. Only vitamin A and vitamin C intake was higher than the RDA (**Table 3**). Analyses of blood biochemical parameters of the pregnant women

Table 1 - Demographic characteristics of pregnant women.

Characteristics	Fasting group (n=49)			Control group (n=49)		
	1st trimester (n=12)	2nd trimester (n=29)	3rd trimester (n=8)	1st trimester (n=12)	2nd trimester (n=30)	3rd trimester (n=7)
Age (years)	25.2 ± 4.76	25.1 ± 4.95	22.6 ± 4.20	26.1 ± 2.71	24.9 ± 2.80	23.8 ± 2.79
Education (years)	5.2 ± 3.32	6.5 ± 2.14	6.8 ± 2.19	5.6 ± 4.01	6.4 ± 2.11	6.4 ± 2.19
Parity	1.9 ± 0.60	1.5 ± 0.61	1.3 ± 0.57	1.8 ± 0.58	1.6 ± 0.52	1.5 ± 0.32
BMI (kg/m ²)	25.9 ± 6.45 (19.5 - 39.8)*	26.5 ± 2.81 (21.7 - 32.9)*	29.1 ± 4.27 (25.6 - 35.4)*	26.3 ± 3.38 (21.4 - 32.1)*	27.7 ± 2.78 (23.1 - 32.4)*	29.2 ± 3.41 (24.1 - 32.4)*
Weight changes (kg) during Ramadan	1.5 ± 1.38 (0 - 3.0)*	2.2 ± 1.89 (-2.0 - 5.0)*	2.5 ± 0.71 (2.0 - 3.0)*	3.2 ± 1.98 (1.0 - 6.0)*	4.1 ± 2.53 (0.9-12.2)*	4.8 ± 2.39 (1.1 - 7.0)*
*minimum - maximum values, BMI - body mass index						

Table 2 - The energy and nutrient intakes of pregnant women (means ± SD).

Nutrients	Fasting group (n=49)			Control group (n=49)		
	1st trimester (n=12)	2nd trimester (n=29)	3rd trimester (n=8)	1st trimester (n=12)	2nd trimester (n=30)	3rd trimester (n=7)
Energy (kcal)	1414 ± 555	1207 ± 664 ^g	749 ± 505 ^k	1609 ± 538	1788 ± 593 ^g	1955 ± 677 ^k
Protein (% TE)	22.7 ± 9.60 ^a	21.2 ± 10.54 ^h	15.5 ± 8.34	11.5 ± 1.68 ^a	13.2 ± 2.73 ^h	12.4 ± 2.99
Fat (% TE)	26.6 ± 6.33 ^b	30.5 ± 4.82 ⁱ	25.7 ± 7.88 ^l	37.2 ± 5.32 ^b	36.9 ± 6.84 ⁱ	37.6 ± 7.18 ^l
Saturated (% TE)	8.3 ± 3.86 ^c	10.9 ± 9.26	7.8 ± 5.56	12.1 ± 3.43 ^c	12.2 ± 3.26	12.5 ± 4.46
Polyunsaturated (% TE)	6.1 ± 5.43 ^d	7.3 ± 4.85	10.4 ± 5.84	11.2 ± 3.98 ^d	9.6 ± 4.58	9.1 ± 2.76
Monounsaturated (% TE)	10.1 ± 5.59	16.6 ± 14.07	17.1 ± 17.4	11.9 ± 2.97	12.5 ± 3.43	13.7 ± 4.40
Carbohydrates (% TE)	60.5 ± 7.79 ^e	56.4 ± 5.81 ⁱ	62.6 ± 9.29 ^m	51.6 ± 4.98 ^e	49.9 ± 7.29 ⁱ	50.3 ± 9.19 ^m
Fiber (g)	4.3 ± 2.12 ^f	4.1 ± 2.58 ^j	2.4 ± 1.28 ⁿ	17.3 ± 7.27 ^f	18.9 ± 6.17 ^j	17.7 ± 5.27 ⁿ
% TE - percentage of total energy Values shown with same letters in the same horizontal column are significantly different (p<0.05)						

Table 3 - Percentage of Recommended Daily Allowance met by mean nutrient intakes of pregnant women.

Nutrients	Fasting group (n=49)			Control group (n=49)		
	1st trimester (n=12)	2nd trimester (n=29)	3rd trimester (n=8)	1st trimester (n=12)	2nd trimester (n=30)	3rd trimester (n=7)
Calcium (mg)	47.5	39.5	26	56.8	56.6	49.9
Iron (mg)	36.6	37.4	28.5	46.3	43.7	39.2
Zinc (mg)	53.6	42.7	41.8	65.5	55.5	62.7
Phosphorus (mg)	96	91.7	87	143.7	119.6	147.7
Vitamin A (mcg RE)	191.6	238.1	174.9	235.1	230.5	132.6
Thiamin (mg)	57.1	50	50	85.7	71.4	78.6
Riboflavin (mg)	64.3	57.1	42.8	71.4	71.4	64.3
Niacin (mg)	54.4	48.3	36.6	52.2	50.1	51.1
Vitamin C (mg)	118.8	135.2	60	111.8	134.1	114.1
Folic Acid (mcg)	17.7	17.2	17.2	28.8	23.8	24.2
Vitamin B12 (mcg)	57.7	65.4	34.6	53.8	53.8	69.2

Table 4 - Blood biochemical parameters of pregnant women (means \pm SD).

Parameters	Fasting group (n=49)						Control group (n=49)		
	1st trimester (n=12)		2nd trimester (n=29)		3rd trimester (n=8)		1st trimester (n=12)	2nd trimester (n=30)	3rd trimester (n=7)
	1st day Ramadan	30th day Ramadan	1st day Ramadan	30th day Ramadan	1st day Ramadan	30th day Ramadan			
Urea, mg/dl	15.6 \pm 6.48	16.5 \pm 4.78	16.7 \pm 5.06	19.2 \pm 3.21 ^f	18 \pm 4.59	16.8 \pm 3.92 ^l	13.3 \pm 4.69	13.6 \pm 4.31 ^f	12.2 \pm 2.85 ^l
Glucose, mg/dl	86 \pm 9.06	87 \pm 9.89	83 \pm 9.16	84 \pm 7.28	83 \pm 17.9	85 \pm 11.04	85 \pm 5.65	85 \pm 6.93	86 \pm 4.06
TC, mg/dl	187 \pm 26.5	193 \pm 36.5	199 \pm 40.31	207 \pm 42.7 ^g	184 \pm 20.98	181 \pm 22.19	183 \pm 24.16	162 \pm 12.75 ^g	171 \pm 15.78
Triglycerides, mg/dl	117 \pm 29.86 ^a	132 \pm 38.35 ^{ac}	173 \pm 56.18	174 \pm 57.45 ^h	172 \pm 51.03	188 \pm 71.13	161 \pm 22.42 ^c	144 \pm 17.92 ^h	133 \pm 15.3
LDL-C, mg/dl	122 \pm 24.06	129 \pm 28.17	139 \pm 42.48	138 \pm 49.36 ⁱ	184 \pm 20.98	147 \pm 20.42 ^m	127 \pm 22.42	100 \pm 42.06 ⁱ	85 \pm 38.84 ^m
HDL-C, mg/dl	61 \pm 12.17	64 \pm 13	60 \pm 14.84	62 \pm 13.57	59 \pm 9.08	61 \pm 5.96	58 \pm 12	59 \pm 8.58	60 \pm 9.21
Protein, g/dl	7.4 \pm 0.40 ^b	7.3 \pm 0.30 ^{bd}	7.2 \pm 0.39	7.1 \pm 0.36 ^j	7.4 \pm 0.59	7.1 \pm 0.51	7.6 \pm 0.34 ^d	7.6 \pm 0.32 ^j	7.5 \pm 0.39
Albumin, g/dl	4.1 \pm 0.24	4 \pm 0.20 ^e	3.9 \pm 0.19	3.9 \pm 0.16 ^k	4 \pm 0.28	3.9 \pm 0.34	3.2 \pm 1.33 ^e	3.7 \pm 0.32 ^k	3.7 \pm 0.33
Values shown with same letters in the same horizontal column are significantly different ($p < 0.05$). TC - total cholesterol, LDL-C - low density lipoprotein cholesterol, HDL-C - high density lipoprotein cholesterol									

were presented in **Table 4**. Compared to the first day of Ramadan plasma TG levels increased, plasma protein levels decreased in fasting group (in first trimester, $p < 0.05$). Alternatively, plasma urea, total cholesterol, TG, LDL-cholesterol and total protein and albumin levels of fasting group were less than the control group.

Discussion. Globally, approximately 800 million Muslims strictly observe Ramadan fasting without food and water from dawn to sunset during the entire month.¹⁴ Despite various studies concerning the metabolic changes in the human body caused by fasting during Ramadan, most of the researches are conducted on a small number of healthy young individuals. Although pregnant women are exempted from fasting, most women chose to fast during pregnancy with a prevalence of 80% in Singapore¹⁵ and 75% in Birmingham.¹⁶ Despite this high prevalence, few studies have been carried out on pregnant women. In Turkey, we have no indication of how many women in the study adhered to Ramadan during pregnancy, but it seems that most Turkish mothers do observe the fast. Apart from religious and spiritual considerations, it is often a subject of discussion whether Ramadan fasting confers any harmful effects on the body. Changes in eating pattern and infrequent meals lead to reduced food intake, which may alter important enzymatic and metabolic responses. Nutritional studies have shown that with a reduction in the frequency of meals, food intake is generally lower, with a reduction in body weight, more significant in women. Similar metabolic changes have been described in pregnant women who observe the Ramadan fast in Gambia¹⁷ and Birmingham.⁵ In this

study, all pregnant women had a weight gain during Ramadan. The control group experienced greater increase than the fasting group. These results were in agreement with the findings by Keller et al.¹⁸ Adlouni et al¹⁹ reported a decrease in daily energy intake, a significant increase in the energy provided from carbohydrates and no change in the percentage received from fats during Ramadan. Alternatively, Sweileh et al²⁰ stated that there is a reasonable increase between the intake of energy, fat and protein; and no change for carbohydrate intake.

In this study, the mean energy intake (kcal/day) of fasting group in the second and third trimesters was significantly lower than the control group. The percentage of protein and carbohydrate of TE was significantly higher in the fasting group. However, the control group was on a high-fat diet. It is stated that the nutrition of the Turkish society during Ramadan is based on grains, sugars and deserts;²¹ milk and its derivatives were the most inadequate group in Ramadan.²² Generally, there is evidence that there is a reduction in feeding frequency during Ramadan, but that each meal is nutritionally denser than meals taken outside of Ramadan. The mean dietary vitamin and mineral intakes of all pregnant women were generally below the RDA. The insufficiency of these nutrients was higher in the fasting group. Only vitamin A and vitamin C intakes were above the RDA, with consumption of a high quantity of citrus fruits and carrots. Various metabolic changes occur in healthy adults taking part in such a fast. Mustafa et al,¹² found increases in serum uric acid and lipid concentrations as well as changes in overall fluid balance. In pregnancy, starvation of a long duration is associated with the development of hypoglycemia, raised plasma levels of free fatty acids and increased plasma and urinary

ketones.²³ Azizi and Siankolah²⁴ observed a slight decrease in serum glucose in the first day of Ramadan followed by normalization on the 20th day and a slightly rise on the 29th day of Ramadan. In our study, there was no significant rise in blood glucose levels at the end of the fasting and similar to the control group's values. Different studies conducted on the effect of fasting on blood urea revealed conflicting results, mainly due to the difference in experimental methodology. We observed a non-significant increase in blood urea towards the end of this study. We attribute this elevation to the dehydration effect. We observed a decreased on serum total proteins and albumin levels at the end of the study in the fasting group. However, this decrease was found statistically non-significant, but still significantly higher than control group (first and the second trimesters $p < 0.05$). These findings showed that Ramadan fasting did not lead to a state of malnutrition. There are some reports concerning the effects of Ramadan fasting on lipid levels, but the results are often based on small numbers and may be contradictory. However, according to Fedail et al,²⁵ TC levels increased during Ramadan whilst TG levels were unaffected. In another study, El-Hazmi et al²⁶ demonstrated that TG and TC levels decreased after the first week of Ramadan and subsequently increased towards the end of the month. In our study, we observed non-significant increases on TC and TG levels in the fasting group at the end of Ramadan. But, when compared to the control group, TC and TG levels were significantly higher in the first and second trimesters. These findings were in line with the study by Nagra et al²⁷ who observed an increase in serum TG level at the end of fasting. Elevated serum TG may be attributed to the lipolytic effect of prolonged fasting. It has been shown that nibbling diet reduced both serum TC and LDL cholesterol concentrations. Many investigators^{28,29} reported the beneficial effect of increased meal frequency on plasma lipid. They suggested that a decrease in eating frequency might elevate plasma cholesterol levels. However, in this study, we showed in contrast a decrease in serum cholesterol levels despite the infrequent eating. When compared to the control group total cholesterol and triglyceride levels were higher in fasting group. Also, LDL cholesterol levels showed a non-significant decrease at the end of Ramadan. Another important result of Ramadan fasting was a rise in concentrations of HDL-cholesterol. According to our results, HDL-cholesterol levels increased at the end of Ramadan in fasting group, but were statistically not significant. This result was similar to the study reported by Weisweiler and Schwarndt.³⁰

In conclusion, the present study on healthy young adults and pregnant women showed that Ramadan fasting had no significant adverse effect on health.

Also, some other studies showed Ramadan has no effect on breast milk quality and composition, moreover, any effect on the prevalence of low birth weight in babies born at full term. But, further studies in larger pregnant women groups are needed to determine the effects of malnutrition, dehydration and prolonged fasting on women's and fetus health. However, there may be undesirable biochemical consequences in pregnant individuals, as the nutrient intakes do not meet the requirements for pregnant women.

References

- Hallak MH, Nomani MZA. Body weight loss and changes in blood lipid levels in normal men on hypocaloric diets during Ramadan fasting. *Am J Clin Nutr* 1988; 48:1197-1210.
- Mustafa KY, Mahmoud NA, Gumaa KA, Gader AMA. The effects of fasting in Ramadan: 1. Serum uric acid and lipid concentration. *Br J Nutr* 1978; 40: 573-581.
- Suleman S, Fedail MD, Murphy D, Salih SY, Bolton CH, Harvey RF. Changes in certain blood constituents during Ramadan. *Am J Clin Nutr* 1982; 36: 350-353.
- Prentice AM, Lamb WH, Prentice A, Coward WA. The effect of water abstention on milk synthesis in lactating women. *Clin Sci* 1984; 66: 291-298.
- Malhotra A, Scott PH, Scott J, Gee H, Wharton BA. Metabolic changes in Asian Muslim pregnant mothers observing the Ramadan Fast in Britain. *Br J Nutr* 1989; 61: 663-672.
- Husain R, Duncan MT, Cheah SH, Ch'ng SL. Effects of fasting in Ramadan on tropical Asiatic moslems. *Br J Nutr* 1987; 58: 41-48.
- Marsh WH, Fingernut B, Miller H. Automated and manual methods for the determination of blood urea. *Clin Chem* 1965; 11: 624-627.
- Bittner DL, Manning J. Automated neocuproine glucose method. Automation in analytical chemistry. Technicon symposia. Vol 1. White Plains (NY): Mediad Inc; 1967. p. 33-36.
- Lopes-Virella MF, Stone P, Ellis S, Colwell JA. Cholesterol determination in high-density lipoproteins separated by three different methods. *Clin Chem* 1977; 23: 882-884.
- Bergmeyer HU. Methods of enzymatic analysis. 2nd English ed. New York: Academic Press; 1974.
- Friedwald WT, Levy RI, Fredericson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem* 1972; 18: 499-502.
- Baysal A, Keçecioglu S, Güneşli U, Yücecan S, Pekcan G. Food Composition Table. 2nd ed. Ankara: Publication of Turkish Dietetic Association; 1988.
- Institute of Medicine. Food and Nutrition Board Recommended Dietary Allowances. Washington (DC): National Academy Press; 2001.
- Sakr AH. Fasting in Islam. *J Am Diet Assoc* 1975; 67: 17-21.
- Joosop J, Abu J, Yu SL. A survey of fasting during pregnancy. *Singapore Med J* 2004; 45: 583-587.
- Cross JH, Eminson J, Wharton BA. Ramadan and birth weight at full term in Asian Moslem pregnant women in Birmingham. *Arch Dis Child* 1990; 65:1053-1056.
- Prentice AM, Prentice A, Lamb WH, Lunn PG, Austin S. Metabolic consequences of fasting during Ramadan in pregnant and lactating women. *Hum Nutr Clin Nutr* 1983; 37: 283.

18. Keller C, Chintapalli K, Lancaster J. Correlation of anthropometry with CT in Mexican-American women. *Res Nurs Health* 1999; 22: 145-153.
19. Adlouni A, Ghalim N, Benslimane A, Lecerf JM, Saile R. Fasting during Ramadan induces a marked increase in high-density lipoprotein cholesterol and decrease in low-density lipoprotein cholesterol. *Ann Nutr Metab* 1997; 41: 242-249.
20. Sweileh N, Schnitzler A, Hunter GR, Davis B. Body composition and energy metabolism in resting and exercising Muslims during Ramadan fast. *J Sports Med Phys Fitness* 1992; 32: 156-163.
21. Baykan S. The Effect of Ramadan on Nutritional Habits. *J Nutr Diet-Turkish* 1981; 10: 119-137.
22. Karaagaoglu N, Yucecan S. Some behavioral changes observed among fasting subjects, their nutritional habits and energy expenditure in Ramadan. *Int J Food Sci Nutr* 2000; 51: 125-134.
23. Metzger BE, Vileisis RA, Ravnikar V, Freinkel N. Accelerated starvation and the skipped breakfast in late normal pregnancy. *Lancet* 1982; 13: 588-592.
24. Azizi F, Siaholah B. Health in Islam: Ramadan Fasting and Diabetes Mellitus. *Int J Ramadan Fasting Res* 1998; 2: 8-17.
25. Fedail SS, Murphy D, Salih SY, Bolton CH, Harvey RF. Changes in certain blood constituents during Ramadan. *Am J Clin Nutr* 1982; 36: 350-353.
26. El-Hazmi MAF, Al-Faleh FZ, Al-Mofleh IB. Effect of Ramadan fasting on the values of hematological and biochemical parameters. *Saudi Med J* 1987; 8: 171-176.
27. Nagra SA, Rahman Z, Mehmood J. Study of some biochemical parameters in young women as affected by Ramadan fasting. *Int J Ramadan Fasting Res* 1998; 2: 1-5.
28. Jones PJH, Leitch CA, Pederson RA. Meal frequency effects on plasma hormone concentrations and cholesterol synthesis in humans. *Am J Clin Nutr* 1993; 57: 868-874.
29. Mc Grath SA, Gibney MJ. The effect of altered meal frequency on plasma lipids in healthy males on normal self selected diets. *Eur J Clin Nutr* 1994; 48: 402-407.
30. Weisweiler P, Schwarndt P. Lipoprotein and apolipoprotein changes in obesity after a short-term fast. *Int J Obesity* 1981; 5: 11-14.