

# The Effect of Ramadan Fasting on Biochemical Substances Relating to the Renal and Bone Function of Fasting Pregnant Women, 2011-2012

Abolfazl Khoshdel<sup>1</sup>, Soleiman Kheiri<sup>2</sup>, Jafar Nasiri<sup>3\*</sup>, Mahmoud Mobasheri<sup>4</sup>

<sup>1</sup> Department of Pediatrics, Faculty of Medicine, Shahrekord University of Medical Sciences, Shahrekord, Iran

<sup>2</sup> Department of Epidemiology and Biostatistics, Faculty of Health, Shahrekord University of Medical Sciences, Shahrekord, Iran

<sup>3</sup> Department of Internal Medicine, Faculty of Medicine, Shahrekord University of Medical Sciences, Shahrekord, Iran

<sup>4</sup> Department of Epidemiology and Biostatistics, Faculty of Public Health, Shahrekord University of Medical Sciences, Shahrekord, Iran

ARTICLE INFO	ABSTRACT
<p><i>Article type:</i> Original article</p> <hr/> <p><i>Article History:</i> Received: 03 Sep 2013 Revised: 27 Sep 2013 Accepted: 07 Oct 2013 Published: 25 Dec 2013</p> <hr/> <p><i>Keywords:</i> Biochemical substances Pregnant woman Ramadan fasting</p>	<p><b>Introduction:</b> The effect of fluid and food restrictions on biochemical substances relating to the renal and bone function of pregnant women is not well defined. The purpose of this study is to evaluate the effects of fluid and food restriction on the following substances in pregnant fasting women during Ramadan: blood urea nitrogen (BUN), creatinine (Cr), calcium (Ca), phosphorus (P), and alkaline phosphates (ALP).</p> <p><b>Material and Methods:</b> Thirty fasting pregnant women voluntarily participated in this prospective descriptive study. The serum levels of BUN, Cr, P, and ALP were measured at the baseline, and on the 7th, 14th, and 28th days of Ramadan; the measurements were also performed 2 weeks after this month. The statistical significance was defined as <math>P &lt; 0.05</math> and the analyses were performed using SPSS version 11.5.</p> <p><b>Results:</b> As to the results of the present study, the weight and body mass index (BMI) of women didn't change during the experiment. BUN and Cr increased significantly by the 2nd week of Ramadan; however, no differences were observed between BUN and Cr values at the end of Ramadan and two weeks after it (<math>P &gt; 0.05</math>); also, Cr didn't change during Ramadan and 2 weeks after it (<math>P &gt; 0.05</math>). Moreover, no differences in P and ALP levels were noticed between the end of Ramadan and two weeks after it (<math>P &gt; 0.05</math>).</p> <p><b>Conclusion:</b> According to this study, there is no sufficient evidence regarding the adverse effects of Ramadan fasting on biochemical substances relating to the renal and bone function of pregnant fasting women.</p>

► Please cite this paper as:

Khoshdel A, Kheiri S, Nasiri J, Mobasheri M. The Effect of Ramadan Fasting on Biochemical Substances Relating to the Renal and Bone Function of Fasting Pregnant Women, 2011-2012. J Fasting Health. 2013; 1(2): 79-84.

## Introduction

Annually during the month of Ramadan, fasting is practiced by many Muslims around the world. Not only does the eating pattern greatly alter during this month, but also the amount and type of food consumed at night may be significantly different from the usual. Healthy adults are expected to abstain from eating and drinking during daylight hours, throughout the

month of Ramadan. Based on Islamic principles, abstinence from eating and drinking can lead to physical and psychological improvement of an individual.

However, the impact of Islamic Ramadan fasting on blood urea nitrogen (BUN), creatinine (Cr), calcium (Ca), phosphorus (P), and alkaline phosphatase (ALP) of pregnant women has not

\* Corresponding author: Jafar Nasiri, Department of Internal Medicine, Faculty of Medicine, Shahrekord University of Medical Sciences, Shahrekord, Iran. Tel: +98381-3332907; Fax: +98381-3335776; Email: [jhnasiri@yahoo.com](mailto:jhnasiri@yahoo.com)

© 2013 [mums.ac.ir](http://mums.ac.ir) All rights reserved.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

been evaluated. There have been various studies regarding the metabolic changes and different aspects of human health during and after Ramadan (2-5).

Pregnancy which is the process of carrying one or more fetuses by female mammals induces physiological and biochemical changes in the body. During this period, the need for calcium intake increases, and in case pregnant women receive insufficient calcium supplements during their pregnancy, they may suffer from bone loss (6).

Fasting during pregnancy has always been a controversial issue. Some Muslim women refrain from fasting for the sake of their neonates' health; however, they feel guilty due to their religious beliefs. On the other hand, some pregnant mothers prefer to cherish their religious principles despite their uncertainty about the impact of fasting on their neonates' health (1).

Calcium and inorganic phosphate are macronutrients which are quite essential for the bone formation of the fetus (7). Khastgir in his study has noted that there is an increasing demand for these macronutrients during fetal development (10). During pregnancy, the improvements in cardiac output and renal blood flow lead to the increase of glomerular filtration rate (GFR), with a resultant decrease in the concentration of serum BUN and Cr levels (9). With advancing pregnancy, maternal plasma urea and creatinine concentrations decrease as a result of altered renal hemodynamics, as well as decreased protein catabolism (10, 11).

In a normal pregnancy, maternal calcium concentration decreased after about 20 weeks of gestation; although before this period, the concentration had not altered.

The plasma phosphorus concentration in both maternal and fetal plasma had a progressive though non-parallel decrease; however, regarding alkaline phosphatase in maternal plasma, no obvious pattern was observed (12). In a normal pregnancy, the fall in plasma concentrations of calcium and phosphate is probably due to the expansion of plasma volume (13).

Our aim was to study the changes in renal function, serum calcium, phosphorus and alkaline phosphatase in pregnant women during Ramadan fasting.

## Materials and Method

This self-controlled cohort study was carried out in Ramadan of 2012 (from 21<sup>st</sup> July to 18<sup>th</sup> August), in Shahrekord University of Medical Sciences, Iran. The study was conducted on 39 healthy pregnant volunteers who were fasting during this period (age range: 18-45 years old).

The subjects' gestational age was 7 to 39 weeks, with a mean of  $22.4 \pm 7.9$  weeks. All the subjects signed the written informed consent, in which the experimental procedures were described in detail. Subjects were excluded from the study due to hypertension, diabetes mellitus, chronic renal failure and smoking. The present study was approved by the scientific advisory and the Ethics Committee of Shahrekord University of Medical Sciences.

All participants in the study abstained from eating and drinking throughout the day, from dawn (Sahar) to sunset (Iftar), and consumed food only during the night. Using a standard calibrated balance, the subjects were weighed bare-footed (wearing light clothes). To determine BMI, the weight was reported to the nearest 1 kg, and height to the nearest 1cm.

At the end of Ramadan, fasting venous samples were taken for the measurement of serum levels of blood urea nitrogen, creatinine, calcium, phosphorous and alkaline phosphatase. Prior to the analysis, the collected sera samples were kept at  $-20^{\circ}\text{C}$ . During the 1<sup>st</sup>, 2<sup>nd</sup>, and 4<sup>th</sup> week of Ramadan, and 2 weeks after it, the sampling was performed at 1:00-2:00 pm.

The analytical methods used for the determination of substances were as follows: diacetyl monoxime method for urea, alkaline picrate (Jaffe's) method for creatinine, cresolphthalein complexone method for calcium, ammonium molybdate (at 340 nm) method for phosphate, and p-Nitrophenylphosphate AMP  $37^{\circ}\text{C}$  method for determining alkaline phosphatase.

The mean  $\pm$  standard deviation was used for the descriptive statistical analysis of the data. The parametric repeated measure analysis of variance was applied to determine whether the variables of interest changed during the study. The multivariate F-tests of Greenhouse-Geisser were used for subject analysis due to the

**Table 1.** Variables measured during Ramadan and two weeks after this month

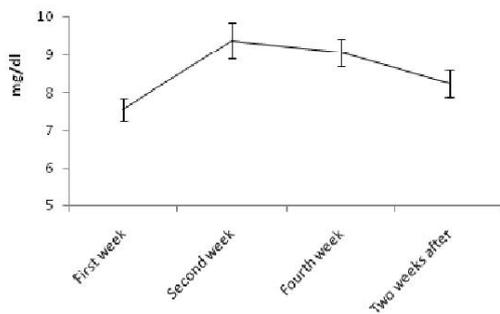
	First week	Second week	Fourth week	Two weeks after Ramadan	P-value
Weight (kg)	62.31 ± 10.91	62.02 ± 10.69	62.17 ± 10.71	62.53 ± 10.67	0.721
BMI (kg/m <sup>2</sup> )	25.05 ± 4.24	25.04 ± 4.25	25.11 ± 4.26	25.25 ± 4.26	0.713
BUN(mg/dl)	7.6±1.81	9.37±2.78	9.06±2.02	8.24±2.14	0.01
Cr(mg/dl)	0.54±0.12	0.67±0.17	0.6±0.1	0.54±0.09	0.001
Ca(mg/dl)	8.54±0.51	8.52±0.43	8.41±0.45	8.41±0.41	0.316
P (mg/dl)	4.53±0.65	3.47±0.57	3.74± 0.66	3.86±0.58	0.001
ALP (U/L)	132.9 ± 81.4	174.4 ± 65.6	208 ± 77.6	184.1 ± 75.2	0.002

violation of sphericity assumption.

For the comparison of the means, the tests of within-subject contrast were used, and in order to evaluate the correlation among variables, Pearson correlation coefficient was utilized. The statistical significance was defined as  $P < 0.05$  and the analysis was performed using SPSS (version 11.5).

## Results

The present prospective descriptive study was conducted on 30 healthy pregnant volunteers who were fasting during the month of Ramadan. The subjects were within the age range of 17-42 years old, and the mean was  $26.9 \pm 6.4$  years. The participants' gestational age was 7-35 weeks, with the mean of  $21.9 \pm 7.5$  weeks. The BMI of women at the beginning of the study ranged from 18.3 to 35.9, with the mean of  $25 \pm 4.2$ . The study variables including BUN, Cr, Ca, P and ALP are demonstrated in Table 1, and the changes are shown in Figures 1 to 5.

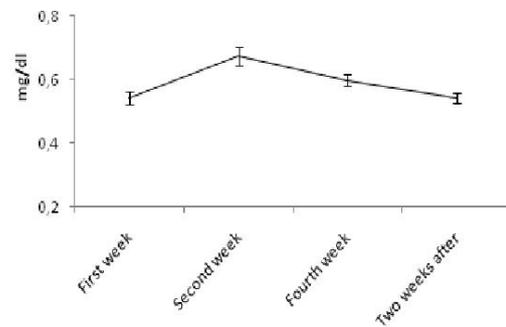


**Figure 1.** Mean ± SD of BUN in fasting pregnant women during Ramadan and two weeks after it.

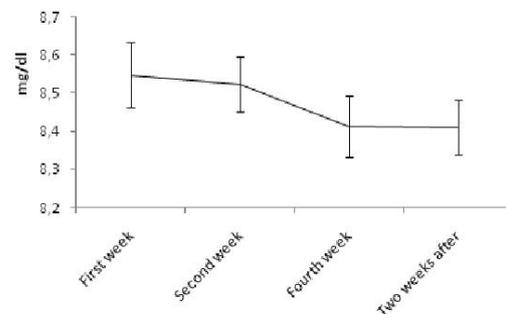
The weight and BMI of the subjects didn't alter during the present study; however, all substances except Ca changed significantly. BUN increased significantly by the 2<sup>nd</sup> week of

Ramadan, and decreased substantially afterwards ( $P < 0.05$ ); the highest value of BUN was observed during the 2<sup>nd</sup> week of Ramadan. However, no difference was revealed between BUN at the end of Ramadan and two weeks after this month ( $P > 0.05$ ) (Figure 1).

Cr similar to BUN increased significantly until the 2<sup>nd</sup> week of Ramadan, and decreased afterwards ( $P < 0.05$ ); the highest value of Cr was measured during the 2<sup>nd</sup> week of Ramadan. Same as BUN, no differences were observed between the value of Cr at the end of Ramadan and 2 weeks after it ( $P > 0.05$ ) (Figure 2). Ca didn't change during Ramadan or after this month ( $P > 0.05$ ) (Figure 3).

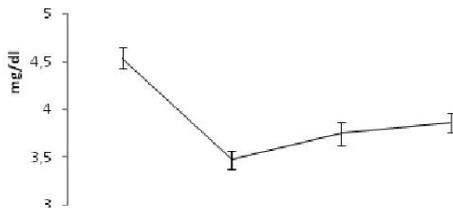


**Figure 2.** Mean ± SE of Cr in fasting pregnant women during Ramadan and two weeks after it.



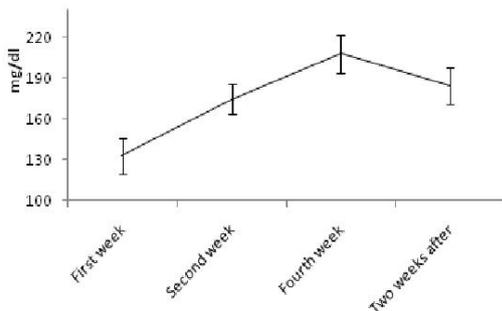
**Figure 3.** Mean ± SE of Ca in fasting pregnant women during Ramadan and two weeks after it.

Phosphorous (P) decreased significantly prior to the 2<sup>nd</sup> week of Ramadan, and increased slightly after this month ( $P<0.05$ ); the lowest value of phosphorous was observed during the 2<sup>nd</sup> week of Ramadan. However, no difference was noticed between the phosphorous values at the end of Ramadan and two weeks after it ( $P>0.05$ ) (Figure 4).



**Figure 4.** Mean ± SE of P in fasting pregnant women during Ramadan and two weeks after it.

ALP increased significantly during Ramadan and then followed a decrease; ALP at the end of Ramadan had the highest value among the four measurements ( $P<0.05$ ). However, no differences were seen between ALP values at the end of Ramadan and two weeks after it ( $P>0.05$ ) (Figure 5).



**Figure 5.** Mean ± SE of ALP in fasting pregnant women during Ramadan and two weeks after it.

A significant positive correlation was observed between BUN and Cr in all the measurements. The same was observed between Ca and ALP during the 4<sup>th</sup> week of Ramadan ( $r= 0.602$ ,  $P<0.001$ ); also a significant positive correlation was observed between Cr and ALP in the 4<sup>th</sup> week of Ramadan ( $r= 0.394$ ,  $P=0.028$ ).

## Discussion

During Ramadan, some pregnant women follow their religious beliefs and fast, although it

is not obligatory for them (2). During pregnancy, cardiac output and renal blood flow increase, and this leads to increased GFR (Glomerular Filtration Rate) with a resultant decrease in the concentration of serum urea and creatinine (9). In the present study, no difference was observed between BUN and Cr at the end of Ramadan and after this month ( $P> 0.05$ ).

The blood samples were collected at 1:00-2:00 pm, and the participants were relatively dehydrated; also, their dietary intake of protein reduced during Ramadan.

Many previous studies regarding the effects of fasting on renal function, blood urea, and creatinine in healthy individuals reported small changes which were not statistically significant (14-16); however, the blood urea level in our study significantly increased by the 2<sup>nd</sup> week of Ramadan.

Protein increase in the daily diet, body dehydration, and inadequate liquid consumption are some of the other factors which can increase blood urea level during fasting periods (17); sometimes, long-term fasting, thirst, and dehydration gradually exacerbate the increased BUN.

Serum creatinine decreases if dehydration is treated (17).

In our study, calcium didn't change during and after Ramadan ( $P>0.05$ ); also no differences were observed between serum phosphorus at the end of Ramadan and two weeks after this month ( $P>0.05$ ).

In a normal pregnancy, due to the expansion of plasma volume, we expect a decrease in levels of calcium and phosphorus in maternal plasma; although ionized calcium values remain normal (13, 18).

In a cross-sectional study in Iran, no significant alteration was observed in the mean serum calcium/phosphorus ratio during different trimesters of pregnancy (19).

In our study, the alkaline phosphatase in maternal plasma increased significantly during Ramadan, but no difference was observed between alkaline phosphatase at the end of Ramadan and 2 weeks after it ( $P>0.05$ ). During pregnancy, maternal alkaline phosphatase progressively increased due to alkaline phosphatase of placental origin (9), which resulted in a sharp increase in the rate of bone metabolism.

Fetus' skeleton formation and bone miner-

alization during pregnancy highly demand maternal mineral supplies. Bone is the greatest reservoir of calcium, and significant changes may occur in maternal bone mass during pregnancy which may result in osteoporosis and osteomalacia. It is demonstrated that the regulation of calcium metabolism in pregnancy occurs without any increase in alkaline phosphatase level (20). Power et al. showed that the serum phosphorus level is the same in the pregnant and non-pregnant women (21).

## Conclusion

According to the findings of the present study on healthy pregnant women, Ramadan fasting has no adverse effects on biochemical substances relating to the renal and bone function in maternal plasma throughout pregnancy; however, it is necessary to perform further related studies to confirm the findings of this study.

## Financial support

This study was funded by the Islamic Medical Committee of Shahrekord University of Medical Sciences.

## Acknowledgments

We would like to thank The Research and Technology chancellor of Shahrekord University of Medical Sciences for offering us a grant (No. 963). We also express our deepest gratitude to the pregnant women who assisted us in carrying out this study.

## References

1. Joosop J, Abu J, Yu SL. A Survey of fasting during pregnancy Singapore Med J 2004; 45 (12): 583-6.
2. Ziaee V, Razaei 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(5): 405-14.
3. Rahman M, Rashid M, Basher S, Sultana S, Nomani MZ. Improved Serum HDL, Cholesterol Profile among Bangladeshi male student during Ramadan fasting. East Mediterr Health J. 2004; 10(1-2): 131-7.
4. Khoshdel A, Najafi M, kheiri S, Taheri E, Nasiri J, Yousofi H. Impact of maternal Ramadan fasting on growth parameters in exclusively breast - fed infants. Iran J Pediatr. 2007; 17(4): 345- 72.
5. Salleh H. Ramadan fasting among pregnant woman in Mur distric , Malaysia and its association to health out comes. Malays J Repod Health. 1989; 7(1):69- 83.
6. Mittenclorof R, Williams MA, Berkey CS, Celter PF. The length of uncomplicated human gestation. Obstet Gynecol. 1990; 75: 929-32.
7. Raman L, Rajalakshmik, Krishnamachari KA, Sastry JG. Effect of calcium supplementation on under nourished mothers during pregnancy on the bone density of the neonates. Am J Clin Nut. 1978; 31: 466-9.
8. Mayne P. Calcium phosphate and magnesium metabolism in: Clinical chemistry in Diagnosis and treatment ELSB, 6th ed. Bath press CO: UK, Great Britain; 1996. P. 179- 188.
9. Sturgiss SN, Dunlop W, Davison JM. Renal haemodynamics and tubular function in human pregnancy. Baillière's clinical obstetrics and gynaecology. 1994; 8(2): 209-34.
10. Khastgir G. Pregnancy associated osteoporosis. Br J obstet Gynaecol. 1994; 101: 836-8.
11. Robertson EG, Cheyne GA. Plasma biochemistry in relation to oedema of pregnancy. Br J Obstet Gynaecol. 1972; 79:769-73.
12. Kuhlback B, Widholm O. plasma creatinine in normal pregnancy. scand lab invest. 1966; 18: 654-6 .
13. Reitz RE, Doane TA, Woods JR, Weinstein RC. Calcium, mangnesium, phosphorus and parathyroid Hormone interrelationship in pregnancy and newborn infants, obstet Gynecol. 1977; 50: 701-4.
14. Pitkin RM. Calcium metabolism in pregnancy: A review. Am J obstet Gyneool. 1975; 121: 724-37.
15. Gharbi M, Akrot M, Zouari B. Food intake during and outside Ramadan. East Mediterr Health. 2003; 9(12): 131-40.
16. Boobes Y, Bernieh B, Al Hakim MR. Fasting Ramadan in kidney transplant patients is

- safe. Saudi J Kidney Dis Transpl. 2009; 20(2): 198- 200.
17. Degoutte F, Jouanel P, Begue RJ, Colombier M, Lac G, Pequignot JM, et al. Food restriction, performance, biochemical, psychological and endocrine changes in judo athletes. Int J sport Med. 2006; 27(1): 9- 18.
  18. Kovacs CS, El -Hajj Fulihan G. Calcium and bone disorders during pregnancy and lactation. Endocrinol Metab Clin N Am. 2006; 35: 21- 51.
  19. Gharedaghi M, Ghomian N, Rahimi H, Bahari M, Ariamanesh Ash. Serum calcium, phosphorous and alkaline phosphatase level in different trimester of pregnancy. J Mashhad Uni med sci. 2007; 101-6.
  20. Hosking DJ. Calcium homeostasis in pregnancy. Clin Endocrinol. 1996; 45(1): 1- 6.
  21. Power MI, Heamey RP, Kalkwarf HY, Power ML, Heaney RP, Kalwarf HJ, et al. the role of calcium in healthand disease. Am J obstet Gnecol. 1999; 181(6): 1560.