

International Journal of Clinical Obstetrics and Gynaecology

ISSN (P): 2522-6614
ISSN (E): 2522-6622
Indexing: Embase
Impact Factor (RJIF): 6.71
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www.gynaecologyjournal.com
2025;9(5): 19-22
Received: 13-06-2025
Accepted: 15-07-2025

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Hematologic safety of Ramadan fasting during pregnancy: A prospective cohort study of haemoglobin and ferritin

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DOI: <https://www.doi.org/10.33545/gynae.2025.v9.i5a.1678>

Abstract

Background: Some studies have linked fasting during pregnancy to negative results in specific individuals, especially those with low iron intake or preexisting anemia. Mothers' and infants' health impacts from Ramadan fasting are less understood.

Aim of study: To study the iron level in fasting pregnant women compared to non-fasting pregnant women to address this conflict.

Methods: A cohort study conducted at an Obstetrics and Gynecology private clinic, Kirkuk, Iraq during a period of two year from January 2022 to January 2025. It included 756 pregnant women who visited the private clinic for antenatal care and follow up of pregnancy and divided into two groups: Fasting group included 496 pregnant women who fasted during Ramadan during one of the pregnancy trimesters and non-fasting group included 260 pregnant women who didn't fast during the pregnancy. Laboratory evaluation for a definitive diagnosis of iron deficiency and iron deficiency anemia was done for all participants before and after Ramadan.

Results: Non-significant changes in hematological parameters seen within both fasting and non-fasting groups over the fasting period. Also, between-group comparisons did not demonstrate statistically significant differences for the primary endpoints after adjustment for multiple comparisons. The fasting duration stratified analysis revealed that these parameters changed across all duration periods in fasting women; and these changes were not statistically significant. They underscore the potential importance of nutritional support and surveillance rather than fasting per se as determinants of hematologic health in pregnancy

Conclusion: Within a typical Ramadan fasting window and with standard prenatal care, hematologic parameters may remain stable. Muslim women underscore the potential importance of nutritional support and surveillance rather than fasting per se as determinants of hematologic health in pregnancy.

Keywords: Ramadan, pregnancy, anemia, fasting, hematological parameters

Introduction

Among many nutritional deficiency disorders that affect people around the world, anemia ranks high ^[1]. Despite affecting people of all ages and genders, nutritional anemia is more common in pregnant women and is associated with low birthweight and maternal death ^[2]. A hemoglobin (Hb) level below 110 g/L during pregnancy and 100 g/L after giving birth is considered anemia according to the World Health Organization ^[3]. Worldwide, deficiency of iron ranks as the leading cause of anemia during pregnancy, regardless of the country's level of development. It is the only nutritional deficit that is both highly frequent in industrialized nations and affects a disproportionately high number of women and children in poor nations ^[4]. Pregnant women have three times the physiological iron needs of menstrual women ^[5]. Pregnant women typically consume 14.7 mg of iron per day ^[6]. During the third trimester, iron absorption rises threefold, leading to a daily iron requirement increase of 1–2 mg to 6 mg ^[7]. By the third trimester, iron absorption has tripled, and daily iron needs have risen from 1-2 mg to 6 mg ^[8]. The Islamic holy month of Ramadan is a time of fasting for all adults and healthy Muslims, according to Islamic traditions ^[9]. One kind of intermittent fasting is the Ramadan fasting (RF), which begins at daybreak and ends at sundown. Radical fasting (RF) is more severe than intermittent fasting (IF), which allows for zero-calorie fluids, and requires complete lack of food and drink ^[10]. Everyone is urged to eat their meals within a certain "time window" (e.g., 8-10 hours) and then not consume anything that contains energy for the remainder of the day (e.g., 14-16 hours) ^[11].

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Fasting during pregnancy is not required unless the mother's or unborn child's health is in danger, however many pregnant women still opt to fast throughout Ramadan [12]. As a result, fasting and dietary restrictions may have a negative impact on pregnancy outcomes, particularly if Ramadan is observed in the summer when fasting days are longer [13]. Some studies have linked fasting during pregnancy to negative results in specific individuals, especially those with low iron intake or preexisting anemia. Mothers' and infants' health impacts from RF are less understood [14]. The Islamic community is deeply divided on the topic of RF while pregnant, particularly in regard to the possible risks of anemia and low iron levels. Our goal in doing this study was to resolve this disagreement by comparing the iron levels of pregnant women who fasted and those who did not.

Methods

Study design: A cohort study was conducted at an Obstetrics and Gynecology private clinic, Kirkuk, Iraq during a period of two years from January 2022 to January 2025.

Study Population: The study included all pregnant women who visited the private clinic for antenatal care and follow up of pregnancy.

The sample size was calculated for examining the relationship between Ramadan fasting and adverse outcomes of pregnancy and estimated for a comparison of proportions by using the following formula:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 (p_0(1-p_0) + p_1(1-p_1))}{(p_1 - p_0)^2}$$

Where:

$Z_{\alpha/2}$ = Z-score for the significance level (Typically 1.96 for $\alpha=0.05$).

Z_{β} = Z-score for power (Typically 0.84 for 80% power).

p_0 = Proportion of pregnancy adverse outcome in the non-fasting group.

p_1 = Proportion pregnancy adverse outcome in the fasting group.

According to a previous study, the rate of pregnancy adverse outcome among women who fasted was approximately 15% compared to 10% in non-fasting women [15]. According to the formula, the total sample size required is 681, then by anticipating a dropout rate of 10%, we adjusted the sample size to be 756.

They were divided into two groups according to fasting during one of the pregnancy trimesters or not:

- **Fasting Group:** Included 496 pregnant women who fasted during Ramadan during one of the pregnancy trimesters.
- **Non-fasting Group:** Included 260 pregnant women who didn't fast during the pregnancy.

Any smoker women, those who had history of chronic systemic diseases, hematological disorders, drug consumption during pregnancy, having inappropriate weight during the pregnancy before fasting period, and the presence of any major anomaly under ultrasound were excluded from the study.

Data collection: The data was gathered by a self-administered questionnaire to collect the following information: Age, educational level, residence, gestational age when fasting, parity, chronic medical diseases, and duration of fasting (< 10 days, 10 – 19 days, and ≥ 20 days). Laboratory evaluation for a definitive diagnosis of iron deficiency and IDA was done for all

participants before and after Ramadan. The diagnosis was based on Hb value and serum ferritin level. Iron stores are high probably depleted when serum ferritin is below 30 g/L, even in the absence of anemia. Serum ferritin below 30 g/L and associated with an Hb concentration below 11 g/dL during the first trimester, below 10.5 g/dL during the second trimester, and below 11 g/dL during the third trimester are diagnostic for IDA in pregnant women [16].

Ethical considerations: All procedures followed the 1975–2013 revisions to the Helsinki Declaration on Human Research. Before agreeing to take part in the study, all subjects were given verbal approval. No identifiable information was ever shared. Information was used exclusively for the sake of this inquiry.

Statistical analysis: The data was analyzed using SPSS version 26, which stands for Statistical Package for the Social Sciences. Mean, standard deviation, and ranges are the ways the data is presented. Numbers shown as percentages and frequencies for categorical data. To compare the continuous variables between the research groups, an independent t-test with two tails was utilized. To compare the two groups on categorical variables, the X^2 test was used. To be considered statistically significant, a P-value has to be lower than 0.05.

Results

The study included 756 pregnant women with mean age 27.63 ± 6.4 years (range 19 - 43 years). Regarding fasting group, 47.5% were fasting during 3rd trimester and 57.9% of them were fasting for period between 10 – 19 days in Ramadan. Baseline characteristics were well-balanced between groups with no significant differences in age or anthropometric parameters (Table 1). The primary efficacy analysis revealed non-significant changes in hematological parameters within both fasting and non-fasting groups over the fasting period. Also, between-group comparisons did not demonstrate statistically significant differences for the primary endpoints after adjustment for multiple comparisons.

Hb level demonstrated reductions in both cohorts, with the fasting group achieving a mean decrease of 0.108 ± 0.55 g/l compared to 0.152 ± 0.43 g/l in the non-fasting group. The between-group difference of 0.44 g/l favoring fasting group approached statistical significance ($p=0.21$) but did not reach the predetermined threshold following Bonferroni correction.

Serum ferritin minimal change after fasting period proved clinically nonmeaningful effect of Ramadan fasting. The fasting group demonstrated an increment of 1.43 ± 9.0 ng/ml, while the non-fasting group achieved an increment of 2.06 ± 8.3 ng/ml. The between-group difference of 0.63 ng/ml favoring non-fasting group was not statistically significant ($p=0.333$). (Table 2)

The fasting duration stratified analysis revealed that Hb was decreased across all duration periods in fasting women; and these changes were not statistically significant. Among women fasting for < 10 days, they showed a reduction of -0.072 ± 0.53 g/l, while those fasting for period between 10 – 19 days or ≥ 20 days exhibited a similar decrease of -0.082 ± 0.061 g/l and 0.13 ± 0.42 g/l respectively ($p = 0.684$).

Regarding serum ferritin level, it was increased across all duration periods in fasting women; and these changes were not statistically significant. Among women fasting for < 10 days, they showed an increment of 2.21 ± 10.3 ng/ml, while those fasting for period between 10 – 19 days or ≥ 20 days exhibited a similar increase of 1.32 ± 8.9 ng/ml and 1.18 ± 8.6 ng/ml

respectively ($p = 0.675$). These findings suggest that while all periods of fasting didn't effectively change hematological parameters, so prolonged fasting did not produce significantly greater effect especially if good supplements were taken. (Table 3)

Discussion

This cohort trial represents a pioneering investigation into RF exposure factor for pregnant women and specifically addressing a significant knowledge gap in the effect of fasting on hematological parameters during pregnancy. To our knowledge, this is the first study to systematically evaluate hematological parameters affection after RF among pregnant women in Iraq. The study's primary novelty lies in its religious adaptation of RF among Muslims Iraqi pregnant women, demonstrating that pregnant women when fasting during Ramadan and complemented by good nutritional practices, they don't adversely complain from alteration in key hematological parameters. Unlike most of previous studies conducted which concentrated on the general health during pregnancy and fetal outcome [17, 18], the results of our study concentrated on the hematological indices which have a significant impact on both mother and fetus. One example is the increased likelihood of neonatal problems such as premature delivery, low birth weight, and babies that are small for their gestational age [19].

This work indicates that RF did not produce statistically significant changes in Hb and serum ferritin levels between the fasting and non-fasting groups. Specifically, the mean Hb decrease was 0.108 ± 0.55 g/l in the fasting group compared to a mean decrease of 0.152 ± 0.43 g/l in the non-fasting group. The serum ferritin levels also showed minimal increments in both groups, with a non-significant difference favoring non-fasting participants. The stratified analysis by the duration of fasting revealed consistent results, with no significant hematological changes observed in fasting women across different fasting durations. This results were agreed with studies conducted by Parveen R *et al* in 2020 [20] and Ghazal K *et al* in 2020 [21] when they found that Hb level after Ramadan were not significantly different between the two group. Several mechanisms could underlie these findings: First; nutritional buffering during Ramadan: Many households modify meal composition and timing (suhoor and iftar) to maintain energy and micronutrient intake, potentially preserving iron intake and absorption despite shorter eating windows. Second, iron supplementation and prenatal care: If a substantial proportion of participants used iron-containing supplements or followed standard prenatal nutrition advice, this could attenuate fasting-related iron losses. Third; Physiologic adaptation: Pregnancy induces complex changes in iron metabolism (e.g., increased intestinal iron absorption and altered hepcidin dynamics) that may mitigate transient fluctuations associated with intermittent fasting [22]. Fourth, Ferritin interpretation: Ferritin is an acute-phase reactant; modest changes may partly reflect inflammatory status rather than iron stores alone. In the absence of marked inflammation, ferritin may more faithfully reflect stores, whereas in the presence of inflammation its interpretation becomes more complex [23].

One possible explanation for the reduced perception of risk for the fetus among Iraqi women could be their strong religious inclinations. It appears that either the nurses and other healthcare workers do not communicate with pregnant women to give them with this important information, or they do not know that fasting during that period is permissible and exempt in Islam. Healthcare providers, such as nurses, are often pregnant

women's initial point of contact and are thus in prime position to inform them about the pros and cons of fasting during pregnancy. Its significance grows in Muslim-majority nations like Iran and Iraq. This can only be carried out if pregnant women who fast are given accurate and current information on all the religious and medical issues [24].

Strength and Limitations: This is the first umbrella review on the impact of RF during pregnancy on hematological indices. The study included large, real-world cohort with a substantial number of fasting and non-fasting participants and availability of pre- and post-Ramadan hematologic measurements which allowing within-person comparison.

The current study had limitations: First, because it is an observational design, causal inferences are limited and the unmeasured confounding as socioeconomic status, dietary quality outside of supplementation, and physical activity could influence results. Second, the differences between groups at baseline in health behaviors and access to care may bias the findings. Third, ferritin is influenced by inflammation. So, without concurrent adjustment for inflammatory markers as CRP or AGP, some ferritin changes may reflect inflammatory status rather than iron stores alone. Fourth, findings may be most applicable to populations with similar dietary patterns, healthcare access, and iron supplementation practices; results could differ in regions with different Ramadan rituals or nutritional norms.

Table 1: Anthropometric parameters among study groups

Variable	Study group		P - Value
	Fasting Mean ± SD	Non-fasting Mean ± SD	
Age (Year)	27.16 ± 6.0	28.06 ± 6.7	0.071
	n= 496 (%)	n= 260 (%)	
Residence			
Urban	384 (77.4)	194 (74.6)	0.388
Rural	112 (22.6)	66 (25.4)	
Educational level			
Illiterate	77 (15.5)	32 (12.3)	0.001
Primary school	164 (33.1)	75 (28.8)	
Secondary school	188 (37.9)	69 (26.5)	
Higher education	67 (13.5)	84 (32.3)	
Gravidity			
Primigravida	178 (35.9)	75 (30.4)	0.129
Multigravida	318 (64.1)	185 (69.6)	
GA during fasting			
First trimester	32 (6.5)	-	-
Second trimester	228 (46.0)	-	
Third trimester	236 (47.5)	-	
Duration of fasting (Days)			
< 10	89 (17.9)	-	-
10 – 19	287 (57.9)	-	
> 20	120 (24.2)	-	

Table 2: Hematological Changes Following Ramadan Month

Parameter	Fasting Group (n=496)	Non-fasting Group (n=260)	p-value
Hb (g/l)	-0.108 $\pm$ 0.55	-0.152 $\pm$ 0.43	0.21
S. Ferritin (ng/ml)	1.43 $\pm$ 9.0	2.06 $\pm$ 8.3	0.333

Table 3: Fasting Duration-Stratified Changes in hematological parameters among fasting group

Parameter	Duration of fasting (Day)			P-value
	< 10	10 – 19	≥ 20	
Hb (g/l)	-0.073 $\pm$ 0.53	-0.082 $\pm$ 0.61	-0.13 $\pm$ 0.42	0.684
S. Ferritin (ng/ml)	2.21 $\pm$ 10.3	1.32 $\pm$ 8.9	1.18 $\pm$ 8.6	0.675

Conclusion

Fasting during pregnancy is common among Iraqi Muslim women, and this study's findings lend credence to the idea that these women are well-versed in Islamic fasting regulations. Our findings contribute to this body of evidence by suggesting that, within a typical RF window and with standard prenatal care, hematologic parameters may remain stable. They underscore the potential importance of nutritional support and surveillance rather than fasting per se as determinants of hematologic health in pregnancy. Replication in diverse populations and augmentation with inflammation-adjusted biomarkers and broader maternal–neonatal outcomes will be important steps toward formulating robust, evidence-based guidance for pregnant individuals considering RF.

Acknowledgments

We would like to express our sincere gratitude to the staff of Azadi Teaching Hospital for their invaluable contributions to this research. We are grateful for individuals' willingness to share their experiences and data. This research would not have been possible without their participation.

No authors has any material conflict of interest with respect to the reporting of financial or personal relationships that may have affected the results of this study.

Conflict of Interest: Not available.

Financial Support: Not available.

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How to Cite This Article

Ahmed TK, Zenalabeden YM, Abdulqader SN. Hematologic safety of Ramadan fasting during pregnancy: A prospective cohort study of haemoglobin and ferritin. *International Journal of Clinical Obstetrics and Gynaecology*. 2025;9(5): 19-22.

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