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# Assosiation Maternal Serum Iron Profile with Preeclampsia in a Tertiary Care Hospital

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**Abstract:**

**Background:** *Preeclampsia is a hypertensive disorder of pregnancy mediated by systemic endothelial dysfunction and dysregulated iron metabolism is considered a contributing factor. However, the role of maternal serum iron profiles in preeclampsia remains poorly understood. The aims of this study was to evaluate the association between maternal serum iron profile and preeclampsia in pregnant women.*

**Methods:** *This retrospective case control study conducted at the Department of Obstetrics and Gynecology, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, from June 2014 to July 2015. A total of 25 preeclamptic (case group) and 25 nonpreclamptic women (control group) aged 18–40 years were included in this study. Serum iron, ferritin (by assay), total iron binding capacity (TIBC), and transferrin saturation values were collected from the medical records. SPSS software was used for statistical analysis and $p < 0.05$ was considered significant.*

**Results:** *Serum iron levels (64.5±12.5 µg/dl vs 86.4±11.2 µg/dl) and transferrin saturation (24.5±5.7% vs 31.2±6.3%) were significantly less in preeclamptic women compared with controls (,%; p<0.001). Case group had higher serum ferritin (85.3±22.5 ng/dl, 63.4±19.7 ng/dl) and TIBC (225.5±35.6 µg/dl, 282.7±35.5 µg/dl; p<0.001) than controls.*

**Conclusion:** *This study shows a substantial association between altered iron metabolism and preeclampsia. Serum ferritin and low transferrin saturation may be potential biomarkers of disease severity and progression.*

**Keywords:** *Maternal serum iron, Serum ferritin, pregnancy, preeclampsia, adverse outcomes.*

## INTRODUCTION

Preeclampsia is a unique hypertensive disorder affecting 2–8% of pregnancies globally and is a major cause of maternal and fetal morbidity and mortality [1]. First described with new-onset hypertension and proteinuria after 20 weeks of gestation, it is frequently associated with systemic endothelial dysfunction complicating its diagnosis and management [2]. The etiology of preeclampsia is not understood although there have been successes in obstetric care. There is current evidence in support of a multifactorial disease process that includes a genetic predisposition, immunologic factors, and environmental factors [3,4].

Interest has been focused on the pathophysiology of preeclampsia in relation to maternal iron metabolism. Iron is required for many physiological processes including oxygen transport, cellular respiration and oxidative stress regulation. Oxidative stress and endothelial injury play central roles in the etiology of preeclampsia, a disorder of iron homeostasis can compound these injuries and exacerbate oxidative stress [5,6]. We observed that women with preeclampsia have also had altered levels of key iron related parameters such as serum iron, ferritin, TIBC and transferrin saturation, indicating a role of iron in progression of disease [7].

Among these are ferritin a marker of iron storage that is often increased in preeclampsia perhaps as an indicator of an inflammatory response or oxidative stress [8]. On the other hand, in affected pregnancies, TIBC, a reflection of iron binding capacity, usually decreases, indicating impaired regulation of iron [9]. Therefore, these findings underscore the complexity of the relationship between iron metabolism and the proclivities that induce preeclampsia, and encourage more comprehensive examination. Understanding these alterations may lead to early detection and improved risk stratification [10] diagnostic or prognostic markers.

In this study, maternal serum profile iron association with preeclampsia is also investigated. Both evaluate serum iron, ferritin, TIBC, and transferrin saturation, to identify possible biomarkers and to determine how the condition's pathogenesis is influenced by these. Knowing something about these associations can help us understand the underlying mechanisms of preeclampsia and indicate approaches to mitigate adverse outcomes.

Additionally, the findings seek to add to a wider understanding of how micronutrient imbalances such as those of irons affect pregnancy complications [11]. This research bridges the gap in the current literature by exploring evidence based solutions to optimize maternal and neonatal outcomes by focusing on modifiable risk factors for preeclampsia [12].

The findings in this study stress the importance of a multidisciplinary approach to identifying the multivariate forces that contribute to the development and progression of preeclampsia and the consequent potential for prevention of adverse maternal health outcomes worldwide.

## OBJECTIVE

The objective of this study were to evaluate the association between maternal serum iron profiles with preeclampsia.

## METHODOLOGY & MATERIALS

This retrospective cross sectional study conducted at Department of Obstetrics and Gynaecology, Bangabondhu Sheikh Mujib Medical University, Bangladesh from June 2014 to July 2015. A total of 50 patients were included, with 25 patients diagnosed with preeclampsia forming the case group and the remaining 25 patients serving as the control group.

### Inclusion Criteria

- Women who were pregnant and were diagnosed with preeclampsia (case group).
- Normal blood pressure pregnant women with no prior history of preeclampsia (control group).
- Women aged 18–40 years.
- No major fetal anomalies, but singleton pregnancy.
- Complete medical records available to analyze.

### Exclusion Criteria

- Multiple pregnancies.
- Other comorbidities such as chronic hypertension, diabetes, or cardiovascular diseases are present.
- History of iron supplementation or treatment for anemia during pregnancy.
- Patients with incomplete or unavailable medical records.

**Data Collection:** Medical records of patients were reviewed, including demographic data, clinical presentation, and maternal serum iron levels. Routine antenatal visits were made to obtain blood tests for iron parameters, including serum ferritin and total iron binding capacity. The diagnosis of preeclampsia was confirmed with documented clinical criteria and associated laboratory results for both groups.

**Statistical Analysis of data:** SPSS software was used for statistical analysis. Continuous variables were presented as means and standard deviations and categorical data as percentages. Independent t-tests for the continuous variables were used to compare serum iron levels between the case and control groups.

We used the chi square test for categorical variables to check for group differences. Statistically significant means $p < 0.05$.

## RESULTS

**Table 1.** *Baseline characteristics (n=50)*

| Variables | | Case (25) | | Control (25) | | p-value |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| Age (Year) | <20 | 5 | 20 | 3 | 11 | 0.638 |
| | 20-30 | 16 | 64 | 16 | 63 | |
| | >30 | 4 | 16 | 6 | 26 | |
| Mean±SD | | 8.34±3.84 | | 8.34±3.92 | | |
| Parity | Nulipara | 16 | 64 | 15 | 60 | 0.489 |
| | Primipara | 3 | 12 | 6 | 24 | |
| | Multipara | 6 | 24 | 4 | 16 | |
| Gravida | Primigravida | 15 | 60 | 17 | 68 | 0.768 |
| | Multigravida | 10 | 40 | 8 | 32 | |
| Gestational Age (weeks) | <37 | 11 | 44 | 7 | 28 | 0.377 |
| | ≥37 | 14 | 56 | 18 | 72 | |
| Mean±SD | | 12.5±1.5 | | 12.5±5.5 | | |

The majority of the patients fell between the ages of 20-30 years, and there was no significant difference in between two group ($p = 0.638$). The majority (64% cases, 60% controls) were nulliparous ($p = 0.489$). The mean gestational age was 12.5 weeks in both groups, though controls showed a wider variability (SD: 1.In cases (5 in cases vs. 5.5 in controls). Gravidity and gestational age were not significantly different ($p > 0.05$).

**Table 2.** *Association between hematological parameters and preeclampsia (n=50)*

| Parameter | Case group (n=25) | Control group (n=25) | p-value |
|---|---|---|---|
| Serum Iron (µg/dl) | 64.5±12.5 | 86.4±11.2 | <0.001 |
| Serum Ferrintin (ng/dl) | 85.3±22.5 | 63.4±19.7 | <0.001 |
| Total Iron binding capacity (µg/dl) | 225.5±35.6 | 282.7±35.5 | <0.001 |
| Transferrin saturation (%) | 24.5±5.7 | 31.2±6.3 | <0.001 |

Serum iron was significantly lower in preeclamptic women (64.5 ± 12.5 µg/dl) compared to controls (86.4 ± 11.2 µg/dl, $p<0.0001$). Serum ferritin levels were significantly higher in case group (85.3±22.5 ng/dl) than controls (63.4±19.7 ng/dl, $p<0.001$). Total iron-binding capacity (TIBC) was elevated in cases (225.5±35.6 µg/dl) versus controls (282.7±35.5 µg/dl, $p<0.001$), and transferrin saturation was lower in cases (24.5±5.7%) compared to controls (31.2±6.3%, $p<0.001$).

**Table 3.** *Association between severity of preeclampsia and hematological parameters (n=25)*

| Parameter | Mild cases (n=15) | Severe cases (n=10) | p-value |
|---|---|---|---|
| Serum Iron (µg/dl) | 71.5±10.3 | 56.5±8.7 | 0.001 |
| Serum Ferrintin (ng/dl) | 76.4±17.6 | 95.2±23.5 | 0.03 |
| Total Iron binding capacity (µg/dl) | 232.4±28.8 | 212.5±33.2 | 0.12 |
| Transferrin saturation (%) | 25.6±5.7 | 21.4±5.2 | 0.07 |

The relationship between hematological parameters and preeclampsia severity is explored in this table. Serum iron level was lower in severe than mild cases (56.5±8.7 µg/dl vs. 71.5±10.3 µg/dl, $p=0.001$). While serum ferritin was significantly higher in the severe cases (95.2±23.5 ng/dl) compared to those with a mild disease (76.4±17.6 ng/dl, $p=0.03$). In TIBC we found no significant difference (212.5±33.2 µg/d l in severe vs. 232.4±28.8 µg/d l in mild, $p = 0.12$), and transferrin saturation was dropped in severe cases (21.4±5.2%) compared to mild cases (25.6±5.7%, $p = 0.07$).

**Table 4.** *Association of preeclampsia and perinatal outcome (n=50)*

| Adverse outcome | Case group (n=25) | Control group (n=25) | p-value |
|---|---|---|---|
| Premature Delivery | 14(56%) | 4(16%) | 0.003 |
| Low Birth Weight | 11(44%) | 4(16%) | 0.03 |
| NICU Admission | 7(28%) | 3(12%) | 0.16 |

Association of preeclampsia and perinatal outcomes shows in table 4. Premature delivery was significantly higher in case group (56%) than that of controls (16%, $p= 0.003$). A low birth weight was

seen in 44 versus 16% of controls (p=0.03). Case group had a more frequent NICU admission (28% compared to 12% in controls; p=0.16). These results demonstrate a greater risk of adverse outcomes in preeclampsia.

## DISCUSSION

Preeclampsia is a hypertensive disorder of pregnancy, a leading cause of maternal and fetal morbidity and mortality. This study demonstrates the link between maternal serum iron profiles and preeclampsia, and expands the growing body of evidence that implicates dysregulated iron metabolism as a fundamental component in preeclampsia pathogenesis.

The findings were consistent with previous studies, showing lower serum iron and transferrin saturation levels, and higher serum ferritin and TIBC, in preeclamptic women than controls. Consistent with Rayman et al., high ferritinemia and hyperferritinemia are markers of oxidative stress and inflammation in preeclampsia [13]. Shahabi et al. corroborate that ferritin is an acute phase reactant reflecting the systemic inflammatory state of preeclampsia[14].

Hypoxic placental environments and endothelial dysfunction may result in altered iron metabolism in preeclampsia. Free iron release due to increased oxidative stress catalyzes reactive oxygen species (ROS) formation that damages vascular endothelium [8]. Similarly, Vitoratos et al. [10] showed similar oxidative dysregulation in preeclampsia, with higher TIBC and ferritin levels. These findings are supported by our own study, which demonstrates that elevated ferritin levels are associated with disease severity.

In mild and severe preeclampsia, hematological parameters differ which suggests a progressive alteration of iron dynamics. In severe cases, serum iron levels and transferrin saturation were lower, implying that iron sequestration in the tissues was occurring at increasing rates as preeclampsia became worse. Tasneem Zafar et al. postulate that this phenomenon may be a protective response to alleviate free iron induced oxidative damage [15].

The preeclamptic group was significantly more adverse, with significantly increased prevalence of premature delivery; very low birth weight; and NICU admission compared with the non-preeclamptic group. These findings also match those reported by Conde-Agudelo and Belizan [16], who found preeclampsia linked to poor neonatal outcomes. Consistent with recent reports of placental insufficiency as a principal mediator of adverse outcomes, our cohort has a heightened risk of preterm delivery.

Preeclampsia has multiple pathophysiological mechanisms, which are driven by placental ischemia, systemic inflammation and oxidative stress. Elevated ferritin levels may be biomarkers for oxidative stress, and can predict disease severity, as suggested by Solomon and Seely [17]. Our findings are consistent with this, as higher ferritin levels were associated with preeclampsia of worse severity.

TIBC did not differ between the mild and severe preeclampsia groups to a statistically significant extent, although there is overall increased elevation of TIBC in the preeclampsia groups, indicating a compensatory response to systemic inflammation and iron sequestrations. The observed patterns turned out to be explained by the work of Crichton et al. [8] on the modulatory roles of transferrin, TIBC and free iron availability in inflammatory states.

Robust profiles of hematologic parameters were compared, and focus on disease severity is emphasized as the study's strengths. However, the small sample size and single center prohibited generalizability and may limit the usefulness of this study. Longitudinal changes in iron metabolism should be investigated, and approaches to oxidative stress and inflammation evaluated in future research as therapeutic strategies.

Overall, the results of this study reinforce the relationship between iron metabolism perturbations and preeclampsia for both maternal and neonatal outcome. As potential biomarkers for disease severity, elevated ferritin levels, decreased serum iron, and transferrin saturation are seen. Early detection and targeted interventions to address these metabolic disturbances might improve pregnancy outcomes and preeclampsia burden.

## CONCLUSION

Maternal iron metabolism is essentially disturbed in the preeclamptic women with the significantly decreased serum iron and tranferrin saturation level and significantly increased ferritin and TIBC levels.

Our findings suggest that dysregulated iron homeostasis may be involved in preeclampsia pathogenesis and disease severity. These alterations could be readily identified early and then used to predict disease severity and guide management strategies toward improved maternal and perinatal outcomes.

## LIMITATIONS AND RECOMMENDATIONS

Data was availed from a single center, thus, presented data on a small sample. The causal relationships between urinary PGE2 and other measures should be explored in future studies using larger, multicenter cohorts adopting prospective designs. The impact of dietary and supplemental iron intake to serum iron parameters in preeclampsia can be investigated. Also, consideration for such integration of serum iron profiles into clinical practice as potential biomarkers of preeclampsia early detection and early surveillance should be developed.

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