

# Estimation of Serum Creatinine Level of Preeclamptic Patients in Bangladesh

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## ABSTRACT

**Background:** Preeclampsia remains a major contributor to maternal and fetal morbidity and mortality. While its exact cause is not fully understood, changes in serum creatinine levels have been implicated in its development. This study aimed to assess serum creatinine levels in women with preeclampsia to support early diagnosis and prevent complications using accessible biochemical markers.

**Materials and methods:** A cross-sectional study was conducted in the Department of Biochemistry at Mymensingh Medical College, in collaboration with the Department of Obstetrics and Gynecology at Mymensingh Medical College and Hospital. A total of 120 pregnant women were enrolled through purposive (Non-random) sampling based on defined inclusion and exclusion criteria. Among them, 60 women diagnosed with preeclampsia were designated as the case group and 60 normotensive pregnant women served as controls. Serum creatinine levels were measured and reported as mean  $\pm$  Standard Deviation (SD). The Serum Uric Acid-to-Creatinine (SUA/Scr) ratio was analyzed using logistic regression. Data were analyzed with SPSS version 21 and group comparisons were performed using Student's unpaired t-test.

**Results:** Serum creatinine levels were significantly higher in preeclamptic patients compared to controls ( $p < 0.001$ ).

**Conclusion:** Elevated serum creatinine levels in preeclamptic women highlight its potential role as a simple, cost-effective biomarker for early detection and management of preeclampsia.

## KEY WORDS

Preeclampsia; Serum creatinine; Pregnancy.

## INTRODUCTION

Pregnancy represents a complex physiological state marked by the implantation and development of the embryo or fetus, typically within the uterus, though ectopic implantation can occasionally occur. This period concludes with childbirth or, in some cases, spontaneous or elective abortion. Throughout gestation,

the maternal body underwent significant physiological transformations across virtually every organ system to accommodate and support fetal growth. A thorough understanding of these systemic adaptations is crucial for healthcare professionals to provide effective care for both mother and fetus.<sup>1</sup>

Preeclampsia (PE) is a pregnancy-specific hypertensive disorder that generally arises after the 20th week of gestation.<sup>2</sup> It is characterized by elevated blood pressure in conjunction with proteinuria and/or signs of organ dysfunction such as persistent headaches, visual disturbances, and hepatic or renal impairment. PE lies within a continuum of hypertensive disorders in pregnancy-ranging from gestational hypertension to severe complications like eclampsia and HELLP syndrome (Hemolysis, Elevated Liver enzymes, Low Platelet count).<sup>3</sup> Clinically, it presents with hypertension, proteinuria, edema and rapid weight gain. Laboratory indicators often include thrombocytopenia, hyperuricemia, elevated liver enzymes and hemoconcentration.<sup>4</sup>

Globally, preeclampsia remains a significant contributor to maternal and perinatal morbidity and mortality. It can evolve rapidly and result in life-threatening complications if not identified and managed in a timely manner.<sup>5</sup> The World Health Organization (WHO)

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estimates that preeclampsia affects approximately 2% to 10% of pregnancies worldwide. Its incidence is disproportionately higher in developing nations-ranging from 1.8% to 16.7%-in contrast to roughly 0.4% in more developed countries.<sup>6</sup> Although the precise etiology of PE is not fully understood, it is widely believed to stem from abnormal placental development and insufficient trophoblastic invasion during early gestation. The molecular mechanisms underlying this disorder remain under investigation. Notably, elevated serum creatinine levels have been linked to increased disease severity and poor perinatal outcomes.<sup>7</sup>

Creatinine, a byproduct of muscle metabolism, is primarily filtered by the kidneys and is widely recognized as a reliable indicator of renal function. Pregnancy induces substantial changes in renal physiology, including increased glomerular filtration rate and renal plasma flow. However, in preeclampsia, these parameters are often reduced due to impaired renal perfusion and glomerular injury, leading to elevated serum creatinine concentrations.<sup>8</sup> Given these associations, this study aims to explore the relationship between serum creatinine levels and the occurrence of preeclampsia, with a particular focus on its potential role in predicting maternal complications.<sup>9</sup>

#### MATERIALS AND METHODS

This cross sectional study was carried out at the Department of Biochemistry, Mymensingh Medical College and the subjects were collected from Department of Obstetrics & Gynecology, Mymensingh Medical College Hospital, Mymensingh, during the period from July 2018 to June 2019. A total of 120 subjects included in this studied. Out of them 60 were case (Group-II) and 60 were control (Group-I).

##### *Inclusion criteria*

Group-I (Control): 60 apparently normal healthy pregnant women aged between 20-40 years and gestational age more than 20 weeks selected as control in this study.

Group-II (Case): 60 diagnosed preeclamptic patients aged between 20-40 years and gestational age more than 20 weeks selected as case in this study.

##### *Exclusion criteria*

- Pre-existing hypertension before pregnancy- from history.
- Liver disease- from history and other clinical findings.
- Renal disease- from history and other clinical findings.
- Subjects taking any drugs that containing calcium, magnesium, phosphorus, zinc or iron for last 5 months- from history.

A survey questionnaire was designed. Data were collected through a preformed data collection sheet (Questionnaire). Measurements of height, weight were done with light clothes and without shoes. Blood pressure was taken after 10 minutes rest with standard cuffs for adults fitted with a mercury sphygmomanometer.

Data was collected after direct interview from patients or attendants. Informed consent was obtained from all participants. Blood was collected and analyzed for investigation. Structured case record forms were included.

For the purpose of the study, subjects both normal pregnant and preeclamptic patients were collected from the antenatal Obstetric ward of Mymensingh Medical College Hospital, Mymensingh. The study subjects were selected on the basis of inclusion and exclusion criteria. Their informed written consent was taken. Age, gestational age, occupation, socio-economic status, residential address, family history of diabetes, hypertension, drug history, height, weight and other relevant data were collected and recorded in a preformed data collection sheet. For laboratory investigations, required amount of blood was collected, processed and preserved for estimation of different biochemical parameters. Data were then processed, analyzed to draw a conclusion.

Anthropometric measurements including height in meter (m), body weight in kilogram (Kg) were measured using standardized techniques. Body Mass Indexes (BMI) of the subjects were calculated using standard formula,  $BMI = \text{Weight (kg)} / [\text{Height (m)}]^2$ .

Following study parameters was analyzed in the study subjects: Serum creatinine

Laboratory investigations:

The following laboratory investigations were done for each of the subjects:

Serum Uric acid: Serum uric acid was determined by colorimetric method by using the test kit  
Serum Creatinine: Serum creatinine was estimated by colorimetric method by using the test kit

All biochemical values were expressed as mean  $\pm$ SD (Standard Deviation). Statistical significance of difference between two groups were evaluated by using Student's unpaired 't' test. All statistical analysis were done by using SPSS (Statistical Package for Social Science) version 21 windows package.

The study was approved by the ethics committee of the Mymensingh Medical College.

**RESULTS**

In this study, a total number of 120 subjects were participated. Out of them 60 normal healthy pregnant women were as control group (Group-I) and another 60 preeclamptic patients were selected as case group (Group-II). Different variables of the subjects were being analyzed and compared between Group-I and Group-II. Serum uric acid, creatinine levels were estimated from blood samples collected from 120 subjects. Some physical aspects such as maternal age, BMI, Systolic (SBP) and Diastolic Blood Pressure (DBP) of the subjects were also analyzed.

Serum creatinine levels was expressed in mg/dl. Maternal age expressed in years, gestational age in weeks, BMI in Kg/m<sup>2</sup>, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) in mm of Hg. All the values were expressed as mean  $\pm$ SD and statistical significance of difference between two groups were evaluated by Student's unpaired 't' test.

$p < 0.001$  considered as highly significant result.

$p < 0.05$  considered as significant result.

$p \geq 0.05$  considered as Not Significant (NS) result.

This study showed that serum creatinine levels were higher in case (Group-II) when compared with control (Group-I) group. It was observed that mean serum uric acid, and creatinine levels were  $6.91 \pm 0.58$  mg/dl and  $2.46 \pm 0.51$  mg/dl in Group-II (case) and  $4.60 \pm 0.47$  mg/dl,  $0.86 \pm 0.10$  mg/dl and in Group-I (Control) respectively. Statistical analysis of these parameter showed that the difference of mean values between case and control were significant ( $< 0.05$ ) and highly significant ( $p < 0.001$ ).

In this study mean maternal age of the Group-II (case) and Group-I (control) were  $29.70 \pm 4.02$  and  $27.23 \pm 4.40$  years. The difference of mean values was not significant ( $p > 0.05$ ). Mean BMI, SBP and DBP of the subjects were higher in case than control. Mean BMI, SBP and DBP were  $28.41 \pm 1.25$  kg/m<sup>2</sup>,  $148.50 \pm 6.44$  mm of Hg and  $95.97 \pm 4.80$  mm of Hg in Group-II (Case) and  $26.27 \pm 1.11$  kg/m<sup>2</sup>,  $112.3 \pm 6.93$  mm of Hg and  $72.73 \pm 5.32$  mm of Hg in Group-I (Control) respectively. When case and control were compared the difference of mean values was highly significant ( $p < 0.001$ ).

**Analysis of Clinical Parameters in the Study Population**

In this study, maternal age range was from 20 to 40 years for both case and control group. It was observed that the mean age of the Group-II (Case) and Group-I (Control) group were  $29.70 \pm 4.02$  and  $27.23 \pm 4.40$  years respectively and the level of significance was 0.002

( $p < 0.05$ ). Thus, the difference in mean age was significant between preeclamptic patients (Case) and normal healthy pregnant women. In our study, it was observed that mean BMI of the Group-II (Case) and Group-I (Control) were  $28.41 \pm 1.25$  and  $26.27 \pm 1.11$  Kg/m<sup>2</sup> respectively. A highly significant ( $p < 0.001$ ) increase in BMI was observed in preeclamptic patients (Case) compared to that of the healthy pregnant women. The study was revealed that the systolic blood pressure was higher in preeclamptic (Case) group than in normal healthy pregnant control group. The mean systolic blood pressure of the Group-II and Group-I were  $148.50 \pm 6.44$  and  $112.30 \pm 6.93$  mm of Hg respectively. A highly significant ( $p < 0.001$ ) increase in systolic blood pressure was observed in preeclamptic patients (Case) compared to that of the healthy pregnant women. On the other hand, the diastolic blood pressure was higher in preeclamptic (Case) group than in normal healthy pregnant control group. The mean diastolic blood pressure of the Group-II and Group-I were  $95.97 \pm 4.80$  and  $72.73 \pm 5.32$  mm of Hg respectively. A highly significant ( $p < 0.001$ ) increase in diastolic blood pressure was observed in preeclamptic patients (Case) compared to that of the healthy pregnant women.

The values of all the clinical and biochemical parameters of the study subjects (Case and Control) were presented in Table I

**Table I** Mean  $\pm$ SD of clinical parameters of the study population

| Variables                          | Group-I (Control) | Group-II (Case)   | p value             |
|------------------------------------|-------------------|-------------------|---------------------|
|                                    | Mean $\pm$ SD     | Mean $\pm$ SD     |                     |
| Maternal age (Years)               | $27.23 \pm 4.40$  | $29.70 \pm 4.02$  | 0.002 <sup>NS</sup> |
| BMI (Kg/m <sup>2</sup> )           | $26.27 \pm 1.11$  | $28.41 \pm 1.25$  | $p < 0.001^{**}$    |
| Systolic Blood Pressure (mm of Hg) | $112.3 \pm 6.93$  | $148.50 \pm 6.44$ | $p < 0.001^{**}$    |

$p$  less than 0.05 taken as the level of significance.

$p < 0.001$  considered as highly significant result.

$p < 0.05$  considered as significant result.

$p \geq 0.05$  considered as Not Significant (NS) result.

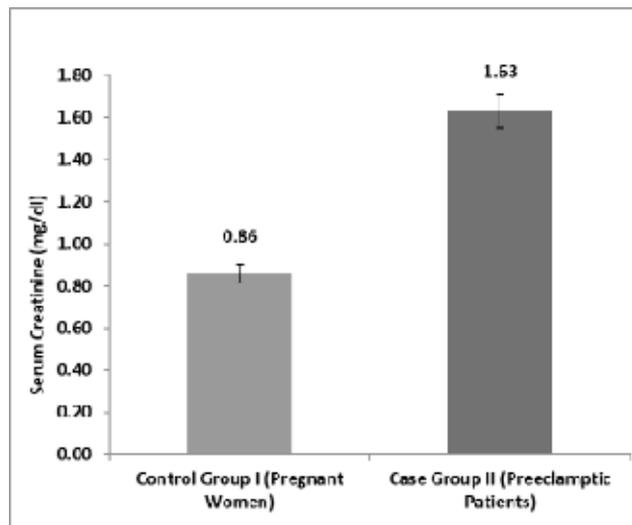
SD= Standard Deviation.

**Creatinine**

In this study, it was observed that the mean values of serum creatinine levels were  $1.63 \pm 0.17$  and  $0.86 \pm 0.10$  mg/dl in Group-II (Case) and Group-I (Control) respectively. A highly significant ( $p < 0.001$ ) increase in serum creatinine levels were observed in preeclamptic

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patients (Case) when compared to that of the normal healthy pregnant women. Analysis of mean serum creatinine levels of study population were presented in Fig 1.



**Figure 1** Comparison of mean serum creatinine levels in the study population

## DISCUSSION

Preeclampsia remains a leading contributor to maternal and fetal morbidity and mortality, affecting approximately 5–7% of pregnancies globally. Despite extensive research, the precise etiology of preeclampsia is still not fully understood. However, nutritional deficiencies and metabolic disturbances have been frequently implicated, especially in low-resource settings where the prevalence of the condition is higher. Among the many biochemical parameters investigated, serum creatinine has emerged as potential markers associated with the onset and severity of preeclampsia.<sup>10</sup>

To the best of our knowledge, recent retrospective case-control studies have explored the clinical relevance of the serum uric creatinine in pregnancy. In our study, it was observed that the mean values of serum creatinine levels were  $1.63 \pm 0.17$  and  $0.86 \pm 0.10$  mg/dl in Group-II (Case) and Group-I (Control) respectively. A highly significant ( $p < 0.001$ ) increase in serum creatinine levels were observed in preeclamptic patients (Case) when compared to that of the normal healthy pregnant women.

In one such study involving women diagnosed with preeclampsia and healthy controls ( $n = 84$  and  $n = 86$ , respectively) significantly higher serum creatinine values was reported in the preeclampsia group.<sup>11</sup> Another recent study also confirmed elevated serum creatinine among preeclamptic patients compared to normotensive pregnant women.<sup>12</sup>

Every mother hopes for a healthy child who will reach their fullest potential in both physical and psychological growth.<sup>16</sup> In developing countries, around 40,000 women, die each year due to preeclampsia or eclampsia. Preeclampsia itself is estimated to account for about 40% to 60% of maternal deaths in developing countries.<sup>17</sup> Given this, serum creatinine levels may serve as an indirect and early marker of increased risk for developing preeclampsia.<sup>13,14</sup>

In light of our findings and consistent with the current body of literature, it is evident that serum creatinine readily accessible and cost-effective biochemical markers. Our study supports that the specifically through the serum creatinine may enhance the accuracy of existing risk prediction models for preeclampsia.

## CONCLUSION

The findings of this study demonstrate that serum creatinine levels are significantly elevated in women with preeclampsia compared to normotensive pregnant women. These alterations reflect underlying renal and metabolic disturbances associated with the condition. Therefore, incorporating routine screening of serum creatinine into antenatal care protocols may aid in the early detection of preeclampsia-potentially before the onset of clinical symptoms. Early identification and intervention could significantly improve maternal and fetal outcomes, thereby reducing the burden of preeclampsia-related complications.

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## DISCLOSURE

All of the authors declared no competing interests.

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