OPEN ACCESS

Saudi Journal of Medicine
Abbreviated Key Title: Saudi J Med
ISSN 2518-3389 (Print) | ISSN 2518-3397 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Demographic and Obstetric Variables of Healthy Pregnant Women vs Pre-eclamptic and Eclamptic Pregnant Women

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DOI: https://doi.org/10.36348/sjm.2025.v10i11.006 | **Received:** 27.09.2025 | **Accepted:** 19.11.2025 | **Published:** 24.11.2025

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Abstract

Background: Pre-eclampsia and eclampsia remain significant causes of maternal and perinatal morbidity and mortality, particularly in developing countries. Emerging evidence suggests that micronutrient deficiencies, such as Vitamin D deficiency, may play an important role in their pathogenesis. Understanding the demographic, obstetric, and biochemical differences among healthy, pre-eclamptic, and eclamptic women can help identify risk factors and improve preventive strategies. ***Objective:*** To evaluate demographic and obstetric variables, blood pressure profiles, and serum Vitamin D levels among healthy, pre-eclamptic, and eclamptic pregnant women. ***Methods:*** This cross-sectional comparative study was conducted among 90 pregnant women attending the Department of Obstetrics and Gynaecology of a tertiary care hospital in Bangladesh. The study population was divided into three groups: healthy pregnant women (n = 30), pre-eclamptic women (n = 30), and eclamptic women (n = 30). Data were collected on demographic and obstetric characteristics, systolic and diastolic blood pressure. Statistical analysis was performed using appropriate tests, and $p < 0.05$ was considered significant. ***Results:*** Pre-eclamptic and eclamptic patients were younger, more likely to be primigravida, and had a lower socioeconomic and educational status compared to healthy controls ($p < 0.05$). Mean systolic and diastolic blood pressures were significantly higher in pre-eclamptic and eclamptic groups ($p < 0.001$). Serum Vitamin D levels were markedly lower among pre-eclamptic and eclamptic patients compared to healthy pregnant women, and the difference was statistically significant ($p < 0.001$). ***Conclusion:*** Pre-eclampsia and eclampsia are associated with younger maternal age, primigravidity, and low socioeconomic background. Significantly lower Vitamin D levels among affected women suggest that Vitamin D deficiency may contribute to the development or severity of these hypertensive disorders in pregnancy. Screening and supplementation strategies could therefore play a role in prevention and improved maternal outcomes.

Keywords: Pre-eclampsia, Eclampsia, Vitamin D deficiency, Blood pressure, Pregnant women.

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INTRODUCTION

Pre-eclampsia, characterized by hypertension and proteinuria after 20 weeks of gestation, remains a major cause of maternal and perinatal morbidity and mortality worldwide.[1,2,3] Its prevalence ranges from 2–10% of all pregnancies and may be higher in low-resource settings, contributing to about 20% of maternal deaths in Bangladesh.[4] Despite extensive research, the etiology of pre-eclampsia is still unclear, though factors such as obesity, diabetes, calcium deficiency, advanced maternal age, and occupational stress have been implicated. The pathophysiology involves defective trophoblastic invasion of spiral arteries, leading to placental hypoperfusion and release of anti-angiogenic factors and cytokines, resulting in endothelial dysfunction. [5,6] This dysfunction causes vasoconstriction and elevated blood pressure through imbalance of vasoactive substances such as nitric oxide and prostacyclin.[8]

Low calcium intake has been linked to increased blood pressure by stimulating parathyroid hormone and renin release. [9] During pregnancy,

inadequate calcium intake may deplete maternal bone calcium and affect fetal bone development. [10] Epidemiological studies have also emphasized the role of vitamin D deficiency in pre-eclampsia development. Vitamin D deficiency alters endothelial function, increases cytokine levels, and enhances renin secretion, thereby raising blood pressure. Vitamin D also improves vascular tone and endothelial function by reducing smooth muscle proliferation and insulin resistance. Moreover, it modulates immune responses and cytokine release, which influence placental development.[11]

Placental 1-α hydroxylase converts vitamin D to its active form, and the presence of vitamin D receptors in the placenta suggests an autocrine role in placental regulation. [12,13] Vitamin D deficiency is common among pregnant women, particularly in developing countries. The World Health Organization recommends calcium supplementation for pregnant women with low dietary intake to prevent pre-eclampsia. Studies have shown that maternal vitamin D and calcium deficiencies are independent risk factors for pre-eclampsia. [14,15] Combined supplementation has been associated with improved metabolic health and pregnancy outcomes through antioxidant activation and parathyroid hormone suppression.

While some studies have found a positive association between vitamin D deficiency and pre-eclampsia, others have reported no correlation. Most prior studies evaluated 25(OH)D levels without concurrent calcium assessment. Therefore, the present study aimed to compare serum vitamin D and calcium levels among healthy, pre-eclamptic, and eclamptic pregnant women to explore their potential roles in the pathophysiology of these conditions.

OBJECTIVES

To evaluate and compare the serum vitamin D and calcium levels among pre-eclamptic, eclamptic, and healthy pregnant women to determine their association with the occurrence of pre-eclampsia and eclampsia.

METHODOLOGY

Type of study: Cross sectional study.

Place of study: Department of Department of Obstetrics & Gynaecology, Dhaka Medical College and Hospital, Dhaka.

Period of study: January 2017 to December 2017.

Study population: Normal pregnant women and pregnant women with pre-eclampsia and eclampsia after 20 weeks of gestation was taken for the study, who attended in the Department of Obstetrics and Gynaecology in DMCH.

Sample size:

Comparison of two means (Sample size of each group)

- $\mu_1 - \mu_2$= difference between the means
- σ_1, σ_2= standard deviations
- z_α and z_β= as below

$$\text{Sample size(n)} = \frac{(Z_\alpha + Z_\beta)^2 \times (\sigma_1^2 + \sigma_2^2)}{(\mu_1 - \mu_2)^2}$$

z_α = z value (two tail) of standard normal distribution at 95% confidence level or 5%
level of significance z_α =1 .96
z_β = Z value (one tail) of standard normal distribution at or Z distribution at a definite
power e. g. z_β value is 1.28 at 90% power
μ_1 = 19.3 (mean vitamin D value in preeclampsia)
μ_2= 23.7 (mean vitamin D value in healthy pregnant woman)
σ_1 = 4.31
σ_1=5.93
n = ((1.96 + 1.28)² × {(4.31)² + (5.93)²}) / (19.3 − 23.7)² = 29.1

Sample size = 30 (each group): All values were taken from Bakacak *et al.*, (2015). Therefore, total sample size was 90 (30×3).

Sampling technique: Purposive sampling technique was used as per inclusion and exclusion criteria.

Selection Criteria
Inclusion Criteria
Group A:

1. Diagnosed preeclamptic patients in third trimester of pregnancy.
2. Pre-eclampsia was diagnosed by the presence of:

1. Hypertension (Systolic BP ≥ 140 mm Hg, and/or Diastolic BP ≥ 90 mm Hg).
1. Proteinuria (≥300 mg protein/24 h) (Dipstick positive).

Group B:

1. Diagnosed eclamptic patients in third trimester of pregnancy.
2. Eclampsia was diagnosed by the presence of tonic-clonic seizures in patients that were followed up with the diagnosis of preeclampsia with no systemic disease that may cause seizures.

Group C:

- Normal healthy pregnant women in third trimester of pregnancy having no hypertension and proteinuria.

Exclusion criteria:

For all groups (Group A, Group B & Group C):

1. No history of hypertension and proteinurea before 20 weeks of gestation or before pregnancy.
2. Presence of the following systemic diseases:
   - Diabetes mellitus
   - Chronic hypertension
   - Chronic renal diseases
3. Patient with history of recent blood transfusion.
4. Patient with hepatic dysfunction.
5. Any acute infective disease (UTI, RTI etc.)

STUDY PROCEDURE:

Between January 2017 and December 2017, 90 third-trimester pregnant women were enrolled into three equal groups: eclampsia (Group A), preeclampsia (Group B), and healthy controls (Group C). All participants were admitted to the inpatient department of Obstetrics and Gynaecology at DMCH. Subjects were selected based on predefined inclusion and exclusion criteria, and informed consent was obtained after explaining study procedures and associated risks. Comprehensive clinical evaluations—including general, systemic, obstetrical, and abdominal examinations—were conducted. Fasting blood samples (6 ml) were collected for serum vitamin D, calcium, and creatinine estimation, while urine samples were obtained for protein analysis. Biochemical tests were performed at Popular Diagnostic Center using a multi-automatic analyzer, and all data were systematically recorded in a pre-tested collection sheet.

Sample collection:

After overnight fasting and aseptic precautions, 6 ml of venous blood was drawn from the median cubital vein using a disposable syringe. The blood was gently transferred into a clean, plain test tube to prevent haemolysis, allowed to clot at room temperature, and centrifuged at 3000 rpm for 20 minutes. Separated serum was collected in labeled eppendorf tubes and stored at –20°C for analysis within six months. Biochemical assays were performed at Popular Diagnostic Center, Dhanmondi. Additionally, 5 ml of clean-catch fresh urine was collected in sterile containers and refrigerated for protein estimation.

Statistical analysis

Statistical analyses were carried out by using the Statistical Package for Social Sciences version 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean±standard deviation, and categorical variables as frequencies and percentages (%). Chi-square test used to analyze the categorical variables and shown in cross tabulation. The mean difference between groups was analyzed by ANOVA test for continuous variables. P values <0.05 considered as statistically significant.

RESULTS

Table I: Comparison of Demographic and Obstetric Variables Among Three Groups (n=90)

Parameter	Group A (n=30)		Group B(n=30)		Group C(n=30)		p value
	Mean ± SD		Mean ± SD		Mean ± SD		
Age (years)	28.32 ± 4.74		25.77 ± 4.88		26.14 ± 5.36		*0.106*^{ns}
Gestational age (weeks)	32.68 ± 2.5		33.05 ± 2.16		37.73 ± 4.00		*0.001*^{s}
	n	%	n	%	n	%	
ANC							
Regular	18	59.10%	7	22.70%	25	81.80%	^{b}0.001^{s}
Irregular	12	40.90%	24	77.30%	5	18.20%	
Socio economic status							
Low-income	5	18.20%	13	43.30%	7	23.30%	^{a}0.073^{ns}
Lower-middle-income	10	36.40%	15	50.00%	14	46.70%	
Upper-middle-income	10	31.80%	6	20.00%	4	13.30%	
High-income	0	0.00%	1	3.30%	5	16.70%	

Friday, 07/01/2016

s = significant

ns = not significant

a value reached from ANOVA test

b value reached from chi square test

Group A = Preeclamptic pregnant women

Group B = Eclamptic pregnant women

Group C = Healthy pregnant women

The mean age was 28.32±4.74 years in group A, 25.77±4.88 years in group B and 26.14±5.28 years in group C. The mean gestational age was found to be 28.2±5.5 weeks in group A, 32.05±1.69 weeks in group B and 37.73±0.98 weeks in group C. The difference in gestational age was statistically significant (p0.05) among the three groups. The Gestational age (in weeks) and ANC were statistically significant (p<0.05) among the three groups.

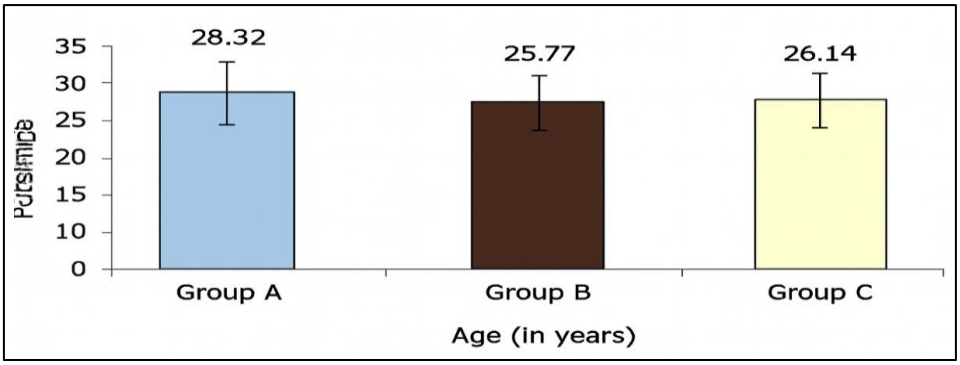

Figure 1: Bar diagram shows mean age of the study patients

Group A = Preeclamptic pregnant women
Group B = Eclamptic pregnant women
Group C = Healthy pregnant women

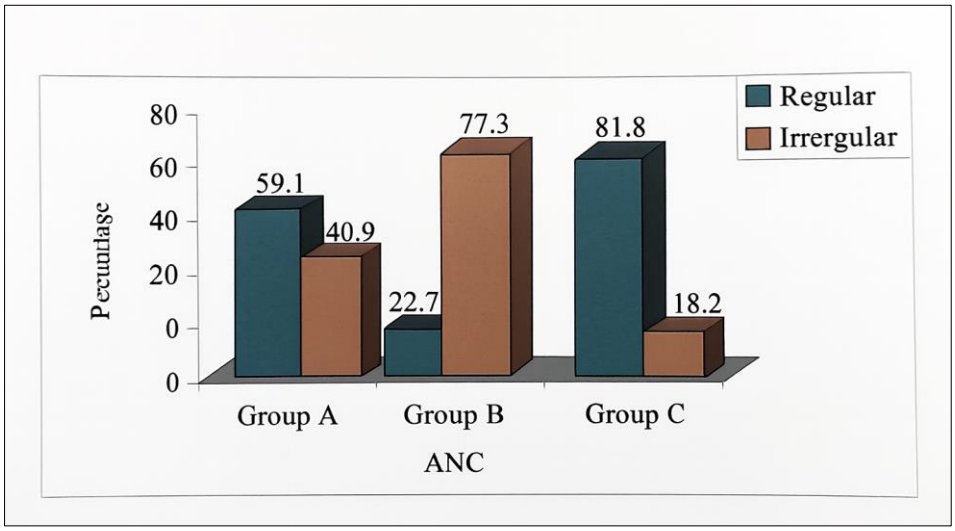

Figure 2: Bar diagram shows mean gestational age of the study patients

Group A = Preeclamptic pregnant women
Group B = Eclamptic pregnant women
Group C = Healthy pregnant women

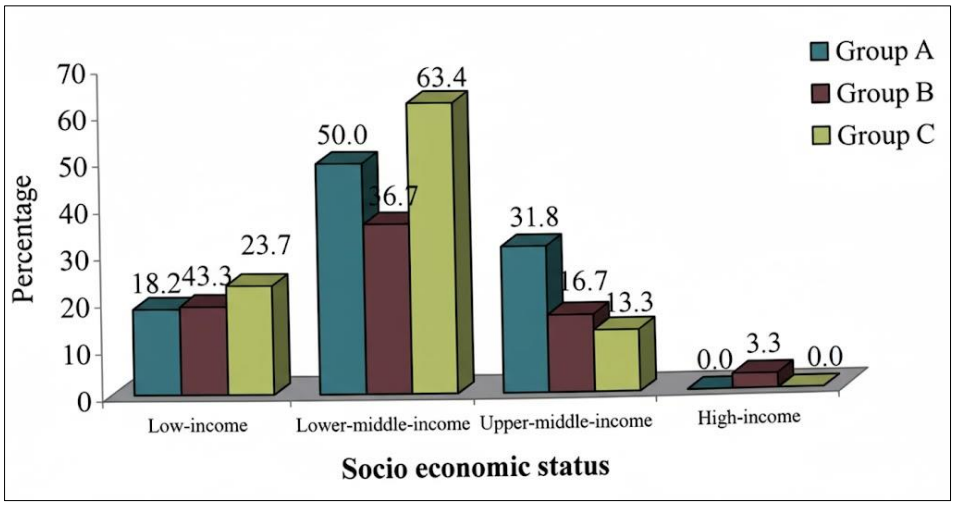

Figure 3: Bar diagram shows socio economic status of the study patients

Group A = Preeclamptic pregnant women
Group B = Eclamptic pregnant women
Group C = Healthy pregnant women

Table II: Distribution of the Study Patients According to Systolic and Diastolic Blood Pressure (n = 90)

	Group A (n=30)		Group B (n=30)		Group C (n=30)		p value
	n	%	n	%	n	%	
Systolic BP (mm Hg)							
Mean ± SD	171.8 ± 24.2	—	159.5 ± 21.49	—	111.82 ± 10.53	—	0.001[s]
Range (min–max)	140–230	—	120–220	—	90–130	—	
Diastolic BP (mm Hg)							
Mean ± SD	115.68 ± 13.3	—	122.55 ± 16.18	—	69.45 ± 16.24	—	0.001[s]
Range (min–max)	90–150	—	90–150	—	8–90	—	
Severe oedema	19	63.60%	1	3.40%	0	0.00%	b0.001[s]
Profuse urinary albumin	14	45.50%	20	68.20%	0	0.00%	b0.001[s]

s = significant
a value reached from ANOVA test
b value reached from chi square test
Group A = Preeclamptic pregnant women
Group B = Eclamptic pregnant women
Group C = healthy pregnant women

Table II shows systolic and diastolic blood pressure of the study patients, it was observed that majority (93.3%) patients had systolic blood pressure 140–230 mmHg in group A and 17(56.7%) in group B and none in group C. The mean systolic blood pressure (in mmHg) was 171.82±24.62 in group A, 159.5±21.49 in B and 111.82±10.53 in group C. The mean diastolic blood pressure (mmHg) was 115.68±13.3 in group A, 122.55±16.18 group B and 69.45±16.24 in group C. Almost two third (63.3%) patients had severe oedema in group A and 11(36.7%) in group B, 1(4.55%) patients urinary albumin had profuse urinary albumin in group A and 20(66.7%) in group B. The difference was statistically significant (p<0.05) among the three groups.

Table III: Distribution of the Study Patients According to Vitamin-D (n = 90)

Vitamin-D Level	Group A (n=30)	Group B (n=30)	Group C (n=30)	p-value
	n (%)	n (%)	n (%)	
< 20 ng/ml	21 (70.0%)	20 (66.7%)	3 (10.0%)	
≥ 20 ng/ml	1 (3.3%)	3 (10.0%)	27 (90.0%)	
Mean ± SD (ng/ml)	8.99 ± 4.27	10.89 ± 4.91	22.66 ± 8.01	0.001*
Range (min–max)	3.9–22.6	2.1–22.6	5.1–26.9	

*= significant
p value reached from ANOVA test
Group A = Preeclamptic pregnant women
Group B = Eclamptic pregnant women
Group C = healthy pregnant women

Table III shows vitamin-D of the study patients, it was observed that almost three fourth (70.0%) patient had <20 ng/ml in group A, 27(90.0%) in group B and 3(10.0%) in group C. The mean vitamin-D was 8.99±4.27 ng/ml in group A, 10.89±4.91 ng/ml in group B and 22.66±8.01 ng/ml in group C. The difference was statistically significant (p<0.05) among the three groups.

DISCUSSION

This cross-sectional study was conducted at DMCH Hospital, Dhaka, to compare serum vitamin D and calcium levels among pre-eclamptic, eclamptic, and healthy pregnant women. A total of 90 participants were enrolled—30 each in groups A (pre-eclampsia), B (eclampsia), and C (healthy controls). The mean ages and gestational ages were comparable, though gestational age differences were statistically significant (p<0.05), consistent with previous studies.[16] Socioeconomic analysis showed most participants in the lower-middle-income group, similar to other Bangladeshi studies.[17] Systolic and diastolic blood pressures were significantly higher in pre-eclamptic and eclamptic groups (p<0.05). Proteinuria and edema were also more frequent in these groups.

Vitamin D deficiency (<20 ng/ml) was found in 70% of pre-eclamptic, 90% of eclamptic, and only 10% of healthy women, showing a significant difference (p<0.05). The mean vitamin D levels were lower in affected groups (8.98±4.27 and 10.0±2.0 ng/ml) compared to controls (22.66±10.01 ng/ml). [18]

Low calcium may contribute to hypertension through increased parathyroid hormone and renin activity. [19] Both deficiencies in calcium and vitamin D appear interlinked in the pathophysiology of pre-eclampsia via endothelial dysfunction and placental dysregulation. Calcium supplementation during pregnancy has been shown to reduce pre-eclampsia risk. This study reinforces that hypocalcemia and vitamin D

deficiency are significantly associated with pre-eclampsia and eclampsia, indicating their potential role as predictive biochemical markers for these hypertensive disorders of pregnancy.

CONCLUSION

This study demonstrates that serum vitamin D and calcium levels are significantly lower in pre-eclamptic and eclamptic pregnant women compared to healthy controls. The findings suggest that deficiencies in these nutrients may contribute to the development of hypertensive disorders during pregnancy. Low calcium and vitamin D levels may influence vascular resistance and placental function, leading to elevated blood pressure. Routine screening and supplementation of these micronutrients during antenatal care could help in reducing the risk of pre-eclampsia and eclampsia. Therefore, maintaining adequate vitamin D and calcium levels is essential for better maternal health outcomes.

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