



Maternal Serum Vitamin D Level and Its Association with Preeclampsia

Marjan Sultana^{1*} , Sharmila Barua², Zeenat Rahena³, Maksuda Jahan⁴ , Nurun Nahar Ruma⁵, Lipika Chowdhury⁶, Joynab Begum Bobby⁷

ARTICLE INFO

Received: 22 Apr 2026
Accepted: 28 Apr 2026
Published Online: 5 May 2026

DOI: 10.5281/zenodo.20050341

Volume: 9, Number: 2, Page: 260-265

e-ISSN: 2789-5912
ISSN: 2617-0817

*Corresponding author



ABSTRACT

Background: Preeclampsia is a pregnancy specific hypertensive disorder with multi-system involvement, usually occurs after 20 weeks of gestation. Vitamin D insufficiency is highly prevalent in children and adults including pregnant women. During pregnancy, maternal vitamin D insufficiency could increase risks of several pregnancy complications and adverse birth outcomes. **Objectives:** The aim of the study was to evaluate the vitamin D levels in preeclamptic and normotensive pregnant women and the role of vitamin D deficiency in the etiology of preeclampsia. **Methods & Materials:** In this case-control study, 50 preeclamptic women and 50 normotensive pregnant women were selected from Obstetrics & Gynecology department of Chittagong Medical College Hospital in Chattogram, Bangladesh by convenient sampling technique. Two ml of venous blood sample was collected from each pregnant woman and the serum 25-OH-D level was measured by Chemiluminescent Microparticle Immunoassay method and reported in nanograms per milliliter. levels of 25-OH-D less than 20 ng/mL, between 20 ng/mL and 29 ng/mL and more than 30 ng/mL, were considered as deficient, insufficient and sufficient 25-OH-D concentrations, respectively. **Results** were analyzed by independent t-test, Mann-Whitney U test, Chi-square test, Fisher's exact test, and logistic regression. Results: Out of 50 preeclamptic cases, 28 (56.0%) had preeclampsia with severe features, and 22 (44.0%) had preeclampsia without severe features. The median serum vitamin D level of women with preeclampsia with severe features, preeclampsia without severe features and normotensive women were respectively 10.5 ng/ml, 11.9 ng/ml, and 17.5 ng/ml. This difference was

highly significant statistically ($p < 0.001$). Pairwise comparison between groups showed that preeclampsia with severe features and preeclampsia without severe features had significantly lower vitamin D levels than normotensive women, but the difference between the preeclampsia without severe features group and preeclampsia with severe features group was not statistically significant ($p = 0.420$). The majority of the cases (92.0%) had a low vitamin D level compared to 58.0% of control group ($p < 0.001$). Only one (2.0%) and 2 (4.0%) in cases and control groups respectively had adequate vitamin D levels in their serum ($p = 1.0$). Participants with vitamin D deficiency had a statistically non-significant higher odd for preeclampsia (OR = 1.11, 95% CI = 0.05-24.51, $p = 0.946$), compared to normotensive pregnant women. **Conclusions:** The prevalence of vitamin D deficiency was high in both normotensive pregnancies and pregnancies complicated by preeclampsia but amplified in preeclampsia. Additional studies are needed to explore the potential benefits and optimal dosing of vitamin D use in pregnancy.

Keywords: Preeclampsia, Normotensive, Vitamin D, Bangladesh.

1. Medical officer, Comilla Medical College Hospital, Comilla, Bangladesh (ORCID: 0009-0001-5092-8398)
2. Professor, Department of Obs & Gynae, Chittagong Medical College, Chattogram, Bangladesh
3. Assistant Professor, Department of Obs & Gynae, Chittagong Medical College, Chattogram, Bangladesh
4. Medical Officer, Raufabad Urban Dispensary, Chattogram, Bangladesh (ORCID: 009-0003-8178-0706)
5. Registrar, Department of Obs & Gynae, Chittagong Medical College Hospital, Chattogram, Bangladesh
6. Assistant Surgeon, Hathazari Upazila Health Complex, Chattogram, Bangladesh
7. Medical Officer, Colonel Hat Urban Dispensary, Chattogram, Bangladesh

INTRODUCTION

Vitamin D deficiency and insufficiency are global public health problems [1]. Vitamin D can be obtained from foods [in the form of 25(OH)D₂] or dietary supplements, but the main source for most people is synthesized in the skin from sunlight exposure containing sufficient ultraviolet B radiation. In skin, 7-dehydrocholesterol is converted to vitamin D₃ [25(OH)D₃]. Vitamin D₃ is hydroxylated by 25-hydroxylase in the liver to form 25-hydroxyvitamin D [25(OH)D]-the major circulating form of vitamin D; this is used as the determinant of vitamin D status in the body. The 25(OH)D is further hydroxylated in the kidneys by 1- α hydroxylase (a cytochrome P450 enzyme) to 1,25-dihydroxy vitamin D [1,25(OH)₂D]. The 1,25(OH)₂D is the active form of vitamin D that acts on vitamin D receptors throughout the body to exert its functions [2]. A high prevalence of

vitamin D deficiency among pregnant women living in urban and rural Bangladesh has been reported [3,4]. Adequate maternal vitamin D levels are important during pregnancy as both the pregnant woman and the growing fetus depend largely on maternal vitamin D stores. Vitamin D is essential in embryogenesis, especially fetal skeletal development and calcium homeostasis [5]. Preeclampsia is a major maternal health problem worldwide, as well as responsible for severe maternal and neonatal morbidity and mortality. This disease encompasses 2% to 8% of pregnancy-related complications, greater than 50,000 maternal deaths, and over 500,000 fetal deaths worldwide [6]. The aetiology of preeclampsia remains inconclusive. However, for years, PE has been hypothesized to be a two-stage disorder. In the first stage, placental perfusion is reduced, resulting in defective

placental implantation. In the second stage, reduced vascularization at the placental site activates a maternal inflammatory response [7]. This leads to generalized endothelial dysfunction and the release of excessive anti-angiogenic factors into the maternal bloodstream, resulting in hypertension. Vitamin D levels may affect these processes [8]. Since vitamin D exerts potent immunomodulatory properties, and results of observational studies suggested that lower vitamin D levels could be associated with higher preeclampsia risk, some intervention studies have tried to evaluate this association [9]. However, the results of meta-analyses on intervention studies on vitamin D and the risk of Preeclampsia are still controversial [10,11]. Only a few studies have addressed hypovitaminosis D's influence on preeclampsia risk in the Bangladeshi setting, where sunshine is considered abundant [12]. Preeclampsia is

one of the leading causes of maternal and perinatal morbidity & mortality in Southeast Asia, especially in Bangladesh. According to NIPORT (National Institution of Population Research and Training), 24% maternal mortality happens due to preeclampsia and its complications. That may assist obstetrician for making decisions about vitamin D supplementation during the antenatal period to reduce the risk of preeclampsia [13]. This study was designed to evaluate the association between maternal hypovitaminosis D and preeclampsia.

METHODS & MATERIALS

This case-control study was conducted in the Department of Obstetrics and Gynecology, Chittagong Medical College Hospital, Bangladesh, over a period of one year from July 2020 to June 2021. The study population consisted of pregnant women with a gestational age of more than 28 weeks attending the obstetrics and gynecology department during the study period. A convenient sampling technique was applied for participant selection. Based on the sample size calculation formula considering the expected mean difference of vitamin D levels between normotensive and preeclamptic pregnant women, the required sample size was determined to be approximately 50 participants in each group. Therefore, a total of 100 participants were included in the study and divided into two groups:

Group A (n=50): Pregnant women diagnosed with preeclampsia

Group B (n=50): Normotensive pregnant women

Inclusion Criteria

- Preeclamptic woman
- Normotensive pregnant woman
- Gestational age more than 28 weeks
- Singleton pregnancy
- Patient who gave consent for the study

Exclusion Criteria

- Multiple pregnancies
- Chronic hypertension
- Diabetes mellitus
- Chronic kidney disease
- Autoimmune disease
- Thrombophilia
- Subjects taking vitamin D supplements
- Patient who did not give consent for the study

Data Collection

Data were collected using a pretested case record form containing a structured questionnaire and checklist. Information regarding socio-demographic characteristics (age, educational status, occupation, socioeconomic status, and residence), clinical variables (gravida, parity, gestational age, height, weight, body mass index, systolic blood pressure, and diastolic blood pressure), and biochemical parameters (serum vitamin D level) were recorded.

After obtaining written informed consent, clinical information and physical examinations were documented. A 10–12 hour fasting venous blood sample (2 ml) was collected from the antecubital vein using standard aseptic techniques and placed into vacutainers without additives. The blood samples were then centrifuged at 3500 rpm at 4°C for 10 minutes, and the serum was stored at -25°C until laboratory analysis. Serum 25-hydroxyvitamin D [25(OH)D] levels were measured using the Chemiluminescent Microparticle Immunoassay (CMIA) method with the Architect 1000si analyzer.

Preeclampsia was further classified into:

Preeclampsia without severe features:

- Systolic BP 140–≤160 mmHg and/or diastolic BP ≥90–<110 mmHg measured 4 hours apart after 20 weeks of gestation
- Proteinuria ≥2+ on dipstick
- No evidence of organ dysfunction

Preeclampsia with severe features:

- Systolic BP ≥160 mmHg and/or diastolic BP ≥110 mmHg after 20 weeks of gestation
- Proteinuria ≥2+ on dipstick or
- New-onset hypertension with thrombocytopenia (platelet count <100,000/μl), renal insufficiency (serum creatinine >1.1 mg/dl), impaired liver function (transaminases ≥ twice the normal level), pulmonary edema, cerebral or visual symptoms, oliguria (<400 ml/24 hours), or severe upper abdominal pain.

Vitamin D levels were categorized according to the Endocrine Society Clinical Practice Guidelines:

- **Vitamin D deficiency:** <20 ng/ml
- **Vitamin D insufficiency:** 21–29 ng/ml
- **Vitamin D sufficiency:** 30–100 ng/ml

Statistical Analysis

After collection, the data were entered into Microsoft Excel to create a master database and subsequently analyzed using Statistical Package for Social Sciences (SPSS) version 23. Continuous variables were expressed as mean±standard deviation (SD) or median with interquartile range (IQR) depending on the distribution of data. Differences between preeclamptic and normotensive groups were analyzed using the independent sample t-test or Mann-Whitney U test as appropriate. The Kruskal-Wallis test was used to compare median values among three groups. Categorical variables were presented as frequency and percentage and compared using the Chi-square test or Fisher's exact test. Logistic regression analysis was performed to determine the association between vitamin D levels and the risk of preeclampsia, expressed as odds ratio (OR) with 95% confidence interval (CI). A p-value <0.05 was considered statistically significant.

Ethical Considerations

Prior approval was taken from the Ethical Review Committee of Chittagong Medical College. Informed consent was taken after explaining the nature and objectives, and participants role in the study. Refuse to participate in the study would not affect the ongoing management of the subjects in the hospital. Strict confidentiality was maintained for the information. All measures were taken to protect the anonymity. The name and address of the patient were recorded on a separate sheet. Specific codes were put to the examination schedule and given to the patient for conducting the interviewer.

RESULT

A total of 100 participants were included in this study, comprising 50 cases and 50 controls. Most participants in both groups were aged 20–29 years, accounting for 72.00% of cases and 58.00% of controls. The majority of respondents were housewives (96.00% in both groups). Regarding educational status, secondary education was most common among cases (44.00%), while primary education was slightly higher among controls (44.00%). Most participants belonged to the lower socio-economic class (68.00% of cases and 76.00% of controls). The majority also resided in rural areas (78.00% of cases and 88.00% of controls) *Table 1*.

Table I
Baseline Socio-Demographic Characteristics of the Study Participants Between Case and Control Groups (*n* = 100).

Variables	Case (N=50)		Control (N=50)		P value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Age groups					
< 20 years	5	10.00	5	10.00	0.309
20-29 years	36	72.00	29	58.00	
30-39 years	9	18.00	15	30.00	
≥40 years	0	0.00	1	2.00	
Occupation					
Housewife	48	96.00	48	96.00	1
Service	2	4.00	1	2.00	
Student	0	0.00	1	2.00	
Education					
Illiterate	7	14.00	10	20.00	0.078
Primary	20	40.00	22	44.00	
Secondary	22	44.00	14	28.00	
Higher secondary	1	2.00	2	4.00	
Graduate	0	0.00	2	4.00	
Socio-economic class					
Lower	34	68.00	38	76.00	0.342
Lower middle	16	32.00	11	22.00	
Upper middle	0	0.00	1	2.00	
Residence					
Rural	39	78.00	44	88.00	0.287
Urban	11	22.00	6	12.00	
Distance from hospital					
1-10 km	9	18.00	8	16.00	0.294
11-20 km	4	8.00	10	20.00	
21-30 km	17	34.00	18	36.00	
≥31 km	20	40.00	14	28.00	

Multiparous women were more common in cases (70.00%) than controls (58.00%). Women with parity ≥2 accounted for 36.00% of cases versus 16.00% of controls, while nulliparous women were more frequent in controls (42.00%). Most cases were at 33–36 weeks of gestation (54.00%), whereas most controls were at 37 weeks (60.0%) *Table II*.

Table II
Obstetric Characteristics of the Study Participants in Case and Control Groups (*n* = 100).

Variables	Case (n=50)		Control (n=50)		P value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Parity					
0	15	30.00	21	42.00	0.071
1	17	34.00	21	42.00	
≥2	18	36.00	8	16.00	
Gravida					
Primi	15	30.00	21	42.00	0.211
Multi	35	70.00	29	58.00	
Gestational age					
28-32 weeks	12	24.00	5	10.00	0.001
33-36 weeks	27	54.00	15	30.00	
37 weeks	11	22.00	30	60.00	

Mean height was similar between groups (152.5±1.6 cm in cases vs 152.4±1.9 cm in controls; *p*=0.866). Mean weight and BMI were higher in cases (72.5±6.6 kg and 31.1±2.6 kg/m²) than controls (64.9±3.7 kg and 27.9±1.6 kg/m²), both *p*<0.001. Obesity (BMI ≥30 kg/m²) occurred in 70.0% of cases versus 18.0% of controls (*p*<0.001). Systolic and diastolic blood pressures were also higher in cases (161.2±28.4 mmHg and 105.6±10.3 mmHg) than controls (112.6±6.9 mmHg and 70.6±7.9 mmHg), *p*<0.001 (*Table III*).

Table III

Comparison of Anthropometric Measurements and Blood Pressure Between Case and Control Groups (*n* = 100).

Parameters	Case (n=50)		Control (n=50)		P value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Height, cm	152.5±1.6		152.4±1.9		0.866**
Weight, kg	72.5±6.6		64.9±3.7		<0.001**
BMI, kg/m ²	31.1±2.6		27.9±1.6		<0.001**
BMI category					
BMI <30.0 kg/m ²	15	30.00	41	82.00	<0.001*
BMI ≥ 30.0kg/m ²	35	70.00	9	18.00	
SBP, mm Hg	161.2±28.4		112.6±6.9		<0.001**
DBP, mm Hg	105.6±10.3		70.6±7.9		<0.001**

The median vitamin D level was highest in the normotensive group (17.5 ng/ml) and lowest in the preeclampsia with severe features group (10.5 ng/ml). Significant

differences were observed between the normotensive group and both preeclampsia groups (*p*<0.001 and *p*=0.001 respectively), whereas the difference between the two

preeclampsia subgroups was not statistically significant (*p*=0.42) *Table IV*.

Table IV

Pairwise Comparison of Serum Vitamin D Levels Among Normotensive, Preeclampsia Without Severe Features, and Preeclampsia with Severe Features Groups.

Pair wise comparison	Vitamin D level, Median (IQR), in ng/ml	P value
Normotensive vs. PE with severe features	17.5 (14.9-22.3) vs. 10.5 (5.6-13.2)	<0.001
Normotensive vs. PE without severe features	17.5 (14.9-22.3) vs. 11.9 (10.1-13.0)	0.001
PE without severe features vs. PE with severe features	11.9 (10.1-13.0) vs. 10.5 (5.6-13.2)	0.42

Vitamin D deficiency (<20 ng/ml) was markedly higher among cases (92.0%) compared with controls (58.0%), which was statistically significant (*p*<0.001). Among

women with preeclampsia without severe features, 86.36% were vitamin D deficient, whereas in the severe preeclampsia group the proportion increased to 96.43%, both

significantly higher than the normotensive group (*Table V*).

Table V

Distribution and Comparison of Serum Vitamin D Status Among Case and Control Groups and According to Severity of Preeclampsia.

Degree of vitamin D deficiency	Case (n=50)		Control (n=50)		P value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Distribution of patients according to serum vitamin D status					
Vitamin D Deficient (<20.0ng/ml)	46	92.00	29	58	<0.001*
Vitamin D Insufficient (20.0-29.9 ng/ml)	3	6.00	19	38	<0.001*
Vitamin D Sufficient (30-100ng/ml)	1	2.00	2	4	1
Distribution of patients with preeclampsia according to serum vitamin D status					
Degree of vitamin D deficiency	preeclampsia without severe features (n=22)		Normotensive group (n=50)		0.044
Vitamin D Deficient (<20.0ng/ml)	19	86.36	29	58.00	
Vitamin D Insufficient (20.0-29.9 ng/ml)	2	9.09	19	38.00	
Vitamin D Sufficient (30-100ng/ml)	1	4.55	2	4.00	
Distribution of patients with preeclampsia according to serum vitamin D status					
Degree of vitamin D deficiency	Preeclampsia with severe features (n=28)		Normotensive group (n=50)		0.001*
Vitamin D Deficient (<20.0ng/ml)	27	96.43	29	58.00	
Vitamin D Insufficient (20.0-29.9 ng/ml)	1	3.57	19	38.00	
Vitamin D Sufficient (30-100ng/ml)	0	0.00	2	4.00	

Obesity (BMI ≥30 kg/m²) was significantly associated with the risk of preeclampsia (OR=8.34; 95% CI: 2.59–26.78; *p*<0.001). Earlier gestational age was also associated

with higher risk, particularly at 28–32 weeks (OR=13.65; *p*=0.005) and 33–36 weeks (OR=8.03; *p*=0.001). However, serum vitamin D levels did not show a

statistically significant association with preeclampsia after adjustment (*Table VI*).

Table VI

Unadjusted and Adjusted Odds Ratios for Vitamin D Status, BMI, and Gestational Age Associated with the Risk of Preeclampsia.

Variables	Odds ratio (OR)	95% confidence interval for OR	P-value
Unadjusted odds ratios for different vitamin D levels for preeclampsia (Degree of vitamin D deficiency)			
Vitamin D Sufficient	Reference category	-	-
Vitamin D Insufficient	0.3	0.0-4.7	0.401
Vitamin D Deficient	3.7	0.3-36.6	0.355
Adjusted odds ratios for different vitamin D levels for preeclampsia (Vitamin D level)			
Vitamin D Sufficient	Reference category	-	-
Vitamin D Insufficient	0.04	0.00-1.31	0.071
Vitamin D Deficient	1.11	0.05-24.51	0.946
BMI			
BMI <30.0 kg/m ²	Reference category	-	-
BMI ≥ 30.0kg/m ²	8.34	2.59-26.78	<0.001
Gestational age			
37 weeks	Reference category	-	-
33-36 weeks	8.03	2.30-28.03	0.001
28-32 weeks	13.65	2.18-85.27	0.005

DISCUSSION

The present study investigated the relationship between preeclampsia which is one of the most common forms of hypertensive disorders in pregnancy, and serum vitamin D level. This study also assessed the proportion of vitamin D deficiency in normotensive pregnant and preeclamptic in the Bangladeshi population. The majority of the cases (92.0%) in the Preeclamptic group had deficient vitamin D status compared to 58.0% of the normotensive pregnant group. In the current study, the median (IQR) serum vitamin D level in preeclamptic women was 10.9 (7.5-13.5) ng/ml, and in the normotensive pregnant women, it was 17.5 (14.9-22.3) ng/ml. This difference was highly significant statistically ($p < 0.001$). This finding is consistent with other studies [12,14-18]. On the contrary, Hashemipour et al. observed no difference in vitamin D levels between preeclamptic women and the normotensive pregnant women in Iran [19]. The differences in the findings of these studies could be attributed to the lack of uniformity in the cut-offs used to define vitamin D deficiency in the various studies, seasonal changes, diet, race, geographical location, and use of vitamin D supplements. Regarding the relationship between severity of preeclampsia and serum vitamin D levels, the current study failed to establish any significant difference in the median vitamin D levels between preeclampsia with severe features and preeclampsia without severe features. In the present study, out of 50 preeclamptic cases, 56.0% had preeclampsia with severe features, and 44.0% had preeclampsia without severe features. The median serum vitamin D level was 10.5 (5.6-13.2) ng/ml in preeclampsia with severe features women, and this value was 11.9 (10.1-13.0) ng/ml in preeclampsia without severe features women. This was in agreement with the findings of Singla et al. [14]. Vitamin D levels between mild and

preeclampsia with severe features were similar in their study. The severity of vitamin D deficiency did not correlate with the severity of preeclampsia in another study [20]. These results suggest that vitamin D has a preventive role, and once preeclampsia sets in, it may not be effective in altering the course or controlling the severity of the preeclampsia. After the onset of disease, the level of oxidative stress, inflammatory mediators, vascular endothelial damage, and immune responses of an individual dictates the course. In this study, the results revealed that vitamin D deficiency in pregnancy was associated with almost 4-fold odds of preeclampsia with severe features (OR = 3.7). Though this was not statistically significant, this result was in line with Pashapour et al.'s study, which reported that vitamin D deficiency is a significant risk (OR = 4.79, CI = 1.45-9.87, $P = 0.01$) for preeclampsia and with Abedi et al.'s study which reported that vitamin D deficiency is a significant risk (OR = 24.04, CI = 2.10-274.8, $P = 0.01$) [16,21]. These results indicated that there is a relationship between vitamin D deficiency and preeclampsia. According to these results, maternal vitamin D deficiency in pregnancy may be associated with an increased risk of preeclampsia and a lower serum concentration of 25-OH-D among preeclamptic women signifies the underlying role of vitamin D deficiency in the pathogenesis of preeclampsia. In his study, Jindal et al. reported none of the cases with preeclampsia with severe features had normal levels of Vitamin D [17]. Ullah et al. concluded that the odds of developing preeclampsia and eclampsia increased up to five times in women with Vitamin D insufficiency [12]. One of the important findings of the current study was that 75.0% of the participants had vitamin D deficiency and another 22.0% had vitamin D insufficiency. Recently Ahmed et al. reported from a large group of rural

pregnant women of Bangladesh that 17.3% of the women had vitamin D deficiency, and another 47.2% had vitamin D insufficiency [4]. An earlier study among rural pregnant women in Northern Bangladesh reported a prevalence of 64% of vitamin D deficiency [22]. Another study of pregnant women conducted in Dhaka city also said that 63% had serum 25(OH)D < 30 ng/ml [3]. All the above findings indicated a very high prevalence of hypovitaminosis D in Bangladeshi pregnant women. Another study from India showed an alarmingly high prevalence of vitamin D deficiency among pregnant women. Nearly 84% of the women were deficient, and the rest of them mostly had insufficient levels [14]. The overall prevalence of vitamin D deficiency among normotensive pregnant women and preeclamptic women in Ghana was 81.7% [18]. The reasons may be lack of sun exposure, fortification of food with vitamin D, and irregular intake of prenatal vitamins. The differences in the findings of these studies could be attributed to the lack of uniformity in the cut-offs used to define vitamin D deficiency in the various studies, seasonal changes, diet, race, geographical location, and use of vitamin D supplements. Although several factors affect vitamin D synthesis in the body, the skin represents the primary source of vitamin D, especially in the tropics [23]. However, the observed high vitamin D deficiency in the present study and the studies conducted in similar tropical areas suggest that factors other than sun exposure may play essential roles [14-18]. Pregnant women in Bangladesh have been prescribed the daily recommended allowance of folic acid and other hematonic medicines. However, the use and prescription of vitamin D supplements is not a common practice, especially for pregnant women (Personal experience). In the present study majority of the women (78.0% in the preeclamptic group and 88.0% in the normotensive group) reside in rural areas. In

Bangladesh, vitamin D fortified foods are limited and are highly unlikely to be available in rural areas [24]. Furthermore, the consumption of vitamin D fortified foods and vitamin D supplements improves vitamin D status [11].

LIMITATIONS

1. The sample size was small.
2. Samples were selected conveniently from a single tertiary care hospital located in the southeastern part of Bangladesh.
3. Another limitation was the late gestational age across the two groups in the majority of the cases.
4. Proteinuria was measured by qualitative method not by quantitative method
5. Dietary data and data regarding time spent outdoors or exposure to sunlight were not collected in the study.
6. Also, the vitamin D status of the participants was measured at the same time as the preeclampsia status. So, the temporal association between these two variables were not explainable by this study design

CONCLUSION

Vitamin D deficiency and insufficiency are highly prevalent among pregnant women attending a public tertiary hospital in Bangladesh. According to these results, maternal vitamin D deficiency in pregnancy may be associated with an increased risk of preeclampsia. A lower serum concentration of 25- OH-D among preeclamptic women signifies the underlying role of vitamin D deficiency in the pathogenesis of preeclampsia.

RECOMMENDATIONS

Further prospective studies using a larger sample size to explore the cause-effect relationship between vitamin D status and preeclampsia are necessary. Moreover, the findings suggest a comprehensive intervention strategy, including considering low-dose vitamin D supplementation to prevent deficiency in pregnant women, is essential.

FUNDING

No funding sources

CONFLICT OF INTEREST

None declared

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

REFERENCES

1. Palacios C, Gonzalez L. Is vitamin D deficiency a major global public health problem?. *The Journal of steroid biochemistry and molecular biology*. 2014 Oct 1;144:138-45.
2. Nair R, Maseeh A. Vitamin D: The "sunshine" vitamin. *Journal of pharmacology and pharmacotherapeutics*. 2012 Jun;3(2):118-26.
3. Asaduzzaman M, Basak R, Islam MS, Juliana FM, Ferdous T, Islam MJ, Al-Mamun A, Sabrina S, Uddin MM, Islam MK. Vitamin D deficiency and insufficiency in healthy pregnant women living in Dhaka, Bangladesh. *IOSR-JDMS*. 2018;17(4):66-73.
4. Ahmed F, Khosravi-Boroujeni H, Khan MR, Roy AK, Raqib R. Prevalence and predictors of vitamin D deficiency and insufficiency among pregnant rural women in Bangladesh. *Nutrients*. 2021 Jan 29;13(2):449.
5. Larqué E, Morales E, Leis R, Blanco-Carnero JE. Maternal and foetal health implications of vitamin D status during pregnancy. *Annals of Nutrition and Metabolism*. 2018 Mar 13;72(3):179-92.
6. Socol FG, Bernad ES, Craina M, Abu-Awwad SA, Bernad BC, Socol ID, Farcas SS, Abu-Awwad A, Andreescu NI. Genetic Insights and Neonatal Outcomes in Preeclampsia and Eclampsia: A Detailed Analysis of the RS5707 Genotype. *Diagnostics*. 2024 Jun 27;14(13):1366.
7. Redman CW. 10 Immunological aspects of pre-eclampsia. *Bailliere's clinical obstetrics and gynaecology*. 1992 Sep 1;6(3):601-15.
8. Purswani JM, Gala P, Dwarkanath P, Larkin HM, Kurpad A, Mehta S. The role of vitamin D in pre-eclampsia: a systematic review. *BMC pregnancy and childbirth*. 2017 Jul 15;17(1):231.
9. Aghajafari F, Nagulesapillai T, Ronsley PE, Tough SC, O'Beirne M, Rabi DM. Association between maternal serum 25-hydroxyvitamin D level and pregnancy and neonatal outcomes: systematic review and meta-analysis of observational studies. *Bmj*. 2013 Mar 26;346.
10. Mirzakhani H, Litonjua AA, McElrath TF, O'Connor G, Lee-Parriz A, Iverson R, Macones G, Strunk RC, Bacharier LB, Zeiger R, Hollis BW. Early pregnancy vitamin D status and risk of preeclampsia. *The Journal of clinical investigation*. 2016 Dec 1;126(12):4702-15.
11. Roth DE, Leung M, Mesfin E, Qamar H, Watterworth J, Papp E. Vitamin D supplementation during pregnancy: state of the evidence from a systematic review of randomised trials. *Bmj*. 2017 Nov 29;359.
12. Ullah MI, Koch CA, Tamanna S, Rouf S, Shamsuddin L. Vitamin D deficiency and the risk of preeclampsia and eclampsia in Bangladesh. *Hormone and Metabolic Research*. 2013 Sep;45(09):682-7.
13. Streatfield PK, El Arifeen S, Al-Sabir A. Bangladesh maternal mortality and health care survey 2010: summary of key findings and implications. Dhaka, Bangladesh: National Institute of Population Research and Training (NIPORT). 2011.
14. Singla R, Gurung P, Aggarwal N, Dutta U, Kochhar R. Relationship between preeclampsia and vitamin D deficiency: a case control study. *Archives of gynecology and obstetrics*. 2015 Jun;291(6):1247-51.
15. Mohaghegh Z, Abedi P, Dilgouni T, Namvar F, Ruzafza S. The relation of preeclampsia and serum level of 25-hydroxyvitamin D in mothers and their neonates: a case control study in Iran. *Hormone and Metabolic Research*. 2015 Apr;47(04):284-8.
16. Pashapour S, Golmohammadlou S, Behroozi-Lak T, Ghasemnejad-Berenji H, Sadeghpour S, Ghasemnejad-Berenji M. Relationship between low maternal vitamin D status and the risk of severe preeclampsia: A case control study. *Pregnancy hypertension*. 2019 Jan 1;15:161-5.
17. Jindal S, Sharma JC, Sharma M. Association of deficiency of maternal vitamin D levels with severity of preeclampsia. *Epidemiology International*. 2019;4(3):10-6.
18. Fondjo LA, Tashie W, Owiredo WK, Adu-Gyamfi EA, Seidu L. High prevalence of vitamin D deficiency among normotensive and hypertensive pregnant women in Ghana. *BMC pregnancy and childbirth*. 2021 Apr 26;21(1):331.
19. Hashemipour S, Esmailzadehha N, Ziaee A, Khoeiniha MH, Darvishgofar E, Mesgari Z, Pashazade F, Abotorabi S. The relationship of vitamin D and calcium level with preeclampsia severity: a case-control study.
20. Arumaikannu J, Rani SU, Shanthi S. Role of vitamin D in preeclampsia: Our experience. *J Clin Obstet Gynaecol*. 2018;2(2):29-32.
21. Abedi P, Mohaghegh Z, Afshary P, Latifi M. The relationship of serum vitamin D with pre-eclampsia in the Iranian women. *Maternal & child nutrition*. 2014 Apr;10(2):206-12.
22. Schulze KJ, Mehra S, Shaikh S, Ali H, Shamim AA, Wu LS, Mitra M, Arguello MA, Kmush B, Sungpuag P, Udomkesmelee E. Antenatal multiple micronutrient supplementation compared to iron-folic acid affects micronutrient status but does not eliminate deficiencies in a randomized controlled trial among pregnant women of rural Bangladesh. *The Journal of nutrition*. 2019 Jul 1;149(7):1260-70.
23. Holick MF, Chen TC. Vitamin D deficiency: a worldwide problem with health consequences. *The American journal of clinical nutrition*. 2008 Apr 1;87(4):1080S-6S.
24. Jeong JH, Korsiak J, Papp E, Shi J, Gernand AD, Al Mahmud A, Roth DE. Determinants of Vitamin D Status of Women of Reproductive Age in Dhaka, Bangladesh: Insights from Husband-Wife Comparisons. *Current developments in nutrition*. 2019 Nov 1;3(11):nzz112.