

Prevalence and Determinants of Vitamin D Deficiency during the First Trimester: Evidence from a Major Metropolitan City in Bangladesh

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ABSTRACT:

Background: Vitamin D deficiency in early trimesters can have detrimental effect on feto-maternal outcomes. This research aimed to determine the prevalence and possible associated factors with vitamin D deficiency during first trimester in Chattogram city, Bangladesh.

Methods: This was a cross-sectional study conducted from July to September, 2023 in Chattogram metropolitan city with purposive sampling. After obtaining consent a questionnaire was provided and blood was drawn for biochemical analysis. Statistical inference was done through SPSS V25.

Results: Total 398 women participated in this study with mean age of 27 years. More than half (51.8%) were suffering subpar vitamin D level, with 15.1% being deficient and 36.7% having insufficient vitamin D level. Most participants were housewives (78.6%) with over half (57.5%) completing their undergraduate degree. Private service (40.5%) was the most prevalent spouse's profession. Most of the women were primigravid (41.2%). 34.4% and 34.4% of participants had one instance of cesarean section and abortion respectively. High prevalence of anemia was present (49.2%) and was statistically significant with subpar vitamin D level ($p < 0.05$). Husband's occupation and covered clothing style was also found to be statistically significant.

Conclusion: There is significant prevalence of vitamin D deficiency in early pregnancy in Chattogram metropolitan region. Further research and early intervention should be implemented to prevent and mitigate this deficiency and prevent associated adversities.

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Introduction

Vitamin D is an essential fat-soluble vitamin responsible for human growth and development, including calcium and phosphorus homeostasis, bone formation, resorption and mineralization, and immune system enhancement, among other functions.¹ Despite the importance of its physiological functions, 25-hydroxyvitamin D deficiency affects 15.7% of the world's population². Typically, vitamin D deficiency (VDD) does not manifest itself physically; however, even mild VDD, if it occurs chronically, can contribute to chronic hypocalcemia and hyperparathyroidism, leaving individuals susceptible to osteoporosis, fractures, etc. VDD can also increase the risk of chronic diseases such as obesity, diabetes, hypertension, depression, neurodegenerative diseases, and numerous types of cancer.³ Women are more susceptible to developing VDD, particularly during pregnancy.² Pregnant women have been identified as a high-risk group for VDD, with a prevalence between 20% and 40%.⁴ The mother's body adapts to provide the additional calcium required for the fetus's skeletal and bone development, necessitating an increase in vitamin D consumption.⁵ Vitamin D is also believed to be responsible for placental development, immune regulation, and infection control, in addition to skeletal growth.⁶ This additional need makes pregnant women especially susceptible to VDD and severe complications such as pre-eclampsia and eclampsia, gestational diabetes mellitus, an increased risk of cesarean section, prematurity and preterm birth, and intrauterine growth restriction.^{5,7,8} This deficiency was found to be more prevalent among women from low-income nations.^{2,9}

VDD continues to be a prevalent health concern in Bangladesh. According to a meta-analysis, Bangladesh had the second highest incidence of VDD, at approximately 67%, which is alarming.⁹ Although there are several studies on VDD in non-pregnant women in Bangladesh, few studies have examined the state of VDD in pregnant women. Early detection of VDD allows for faster intervention and may reduce VDD-mediated adverse pregnancy and postnatal outcomes. Our study aims to determine the prevalence of vitamin D deficiency among expectant women in their first trimester as well as the relationship between socioeconomic and pregnancy-related factors and the status of deficiency.

Methods

This was a descriptive cross-sectional study, conducted between July to September, 2023 in Chattogram city, Bangladesh. Purposive sampling method was used and proportional sampling determined the sample size of 357. Inclusion criteria included women 18 years and above in their first trimester of pregnancy (<13 weeks). Women <18 years, who previously had antenatal check-up during current pregnancy, women taking any routine vitamin or mineral supplementations, suffering from any chronic disease or taking any drugs which can alter vitamin D metabolism were excluded from this study. Patients attending private clinics were selected after providing written informed consent and a questionnaire containing socio-demographic information including age, education level, occupation, husband's occupation, para, gravida, previous history of cesarean section (C/S), abortion was given. After providing information the participant's random venous blood sample was collected through a disposable syringe, five millilitres in quantity in a private biochemical lab and was analyzed promptly. Participant's weight was measured to the nearest 100g using a digital weight scale (EB9013, Camry, Hong Kong). Height was measured using a manual stadiometer with 200cm marking. Serum Vitamin D level was estimated measuring total 25-hydroxyvitamin D [25(OH)D] using electrochemiluminescence immunoassay analyzer (Vitros, ECI, Ortho Clinical Diagnostics, New York, USA). Hemoglobin level was measured through Sysmex XN-1000 hematology analyzer (Sysmex Corporation, Kobe, Japan). After obtaining the results, the data was entered in the specific participant's questionnaire. There is lack of definition regarding the adequate vitamin D status, especially for pregnant women. We used cut-off value for vitamin D level suggested by the Institute of Medicine where $25(\text{OH})\text{D} \geq 20$ ng/mL was considered sufficient, $25(\text{OH})\text{D} = 12-19$ ng/mL was considered insufficient and $25(\text{OH})\text{D} < 12$ ng/mL was deficient.¹⁰ We considered anemia at $<11\text{g/dl}$ as defined by WHO during pregnancy.¹¹ Ethical permission for the research was obtained from ethical review board of Chittagong Medical College, Chattogram, Memo no-59.27.0000.013.19.PG.2023.009/298. Statistical analysis was done using SPSS V25. After providing descriptive statistics, correlation was done through Chi-square test. P value of <0.05 was deemed significant.

Results

Table 1: Socio-demographic information of the patients

Variables	Mean (SD)	Frequency	Percentage
Age	27(\pm 5.18)		
Education			
Primary		5	1.26
SSC		82	20.60
HSC		82	20.60
Undergraduate		105	26.38
Post-graduate		124	31.16
Occupation			
Housewife		313	78.6
Student		26	6.5
Teacher		21	5.3
Private service		16	4
Others		22	5.6
Husband's occupation			
Service		161	40.5
Business		125	31.4
Emigrant		62	15.6
Others		50	12.6

Total 398 women participated in this study. The mean age of the participants was 27 years with SD (\pm 5.18). Most of the women were educated with more than half of participants, 229 (57.5%) completing their undergraduate degree. Most of the participants 313(78.6%) were housewives, followed by student (26,6.5%) and Teachers (21,5.3%). Other professions included private services, doctors, engineer, bankers etc. 161,40.5% of the husbands were in private service, closely followed by businessman (125,31.4%) and emigrants (62,15.6%). Other occupations included banker, doctor, engineer, teacher etc.

Table 2: Obstetric history of the participants

Variables	Frequency (n=398)	Percentage
Gravida		
1	164	41.2
2	109	27.4
3	76	19.1
\geq 4	49	12.4
Para		
0	164	41.2
1	107	26.9
2	74	18.6
3	35	8.7
\geq 4	18	4.5
Previous history of C/S		
0	167	42
1	48	12.1
2	14	3.5
3	3	0.8
\geq 4	2	0.6
Previous history of abortion		
0	166	41.7
1	57	14.3
2	7	1.8
3	4	1

Table 2 represents the obstetric history of the participants. Most of the women participating in the study were primigravida, 164(41.2%), while 49(12.4%) had 4 gravida or more. Para 0 or nullipara was considered for participants who were conceiving for the first time consisting 164(41.2%). The discrepancies between the para and gravida were due to twin pregnancies being considered as a single para. While calculating previous C/S and abortion history, the primigravida were excluded as it were not applicable. Out of 234 multigravida women out of 398, 68(34.4%) of women had at least one C/S previously, whereas 68 (34.4%) also suffered from at least one instance of abortion.

Table 3: BMI and Anemia level of the participants

	Frequency (n=398)	Percent
BMI		
Underweight	17	4.3
Normal	189	47.5
Overweight	144	36.2
Obese	48	12.1
Presence of anemia		
Anemic	196	49.2
Normal	202	50.8

Table 3 displays the BMI level of the patients and the frequency of anemic patient. Almost half of the participants suffered from being overweight (144,36.5%) and obese (48,12.1%). The hemoglobin level was measured to assess whether the women were anemic. A significant portion of the women, almost half, (196,49.2%) were suffering from different levels of anemia. The mean hemoglobin of the participants was 10.89 gm/dl (± 2.46) and mean BMI was 24.81 (± 4.3).

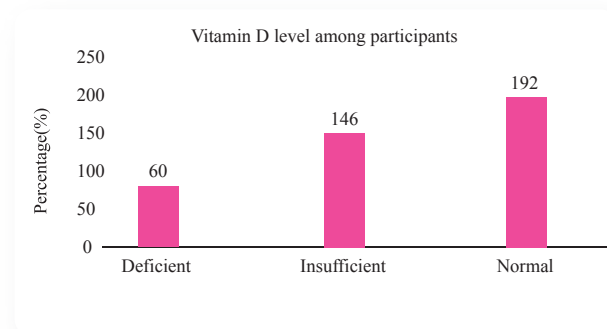
Fig 1: Vitamin D level among participants

Figure 1 displays the level of Vitamin D among the participants. More than half of the participants, 206 (51.8%) were suffering subpar vitamin D level, with 60 (15.1%) being deficient. The mean vitamin D level of the participants was 20.17ng/dl (± 17.14)

Table 4: Vitamin D level and possible associated factors

	Vitamin D level			p value
	Deficient	Insufficient	Normal	
Participants age (in years)				
18-24	19 (4.8%)	49 (12.3%)	68 (17.1%)	NS
25-29	19 (4.8%)	47 (11.8%)	73 (18.3%)	
30-34	16 (4.0%)	37 (9.3%)	35 (8.8%)	
35 and above	6 (1.5%)	13 (3.3%)	16 (4%)	
Participant's occupation				
Housewife	44 (11.1%)	122 (30.7%)	147 (36.9%)	NS
Others	16 (4%)	24 (6%)	45 (11.3%)	
Husband's occupation				
Service	37 (9.3%)	54 (13.6%)	70 (17.6%)	0.001
Business	12 (3%)	50 (12.6%)	63 (15.8%)	
Emigrants	4 (1%)	31 (7.8%)	27 (6.8%)	
Others	7 (1.8%)	11 (2.8%)	32 (8%)	
Parity				
Primipara	42 (10.6%)	101 (25.4%)	134 (33.7%)	NS
Multipara	18 (4.5%)	45 (11.3%)	58 (14.6%)	
Presence of anemia				
Present	22 (5.5%)	67 (16.8%)	107 (26.9%)	0.021
Absent	38 (9.5%)	79 (19.8%)	85 (21.4%)	
Dressing style				
Covered	55 (13.8%)	139 (34.9%)	82 (20.6%)	0.001
Uncovered	5 (1.3%)	7 (1.8%)	110 (27.6%)	
BMI				
Underweight	4 (1%)	5 (1.3%)	8 (2%)	NS
Normal	29 (7.3%)	67 (16.8%)	93 (23.4%)	
Overweight	20 (2%)	55 (13.8%)	69 (17.3%)	
Obese	7 (1.8%)	19 (4.8%)	22 (5.5%)	

NS = Not significant

To further evaluate the relationship between the different variables and VDD, chi-square test through contingency table was conducted and statistically significant association was discovered between type of dressing, husband's occupation level and presence of anemia with sub-normal vitamin D levels. The level of vitamin D was most deficient among husband's who were working in the private services ($p < 0.001$). The level of VDD also significantly correlated with presence of anemia ($p < 0.021$) and women who wore covered dressing ($p < 0.001$).

Discussion

According to the researchers, this study is the first to investigate the occurrence of VDD in first trimester pregnant women in Chattogram. Women in the initial stage of pregnancy are more susceptible to experiencing lack in vitamin D as a result of the hormonal and metabolic alterations.¹² Vitamin D is crucial for the growth and development of the fetus, and if there is a shortfall early on, it can lead to negative outcomes for both the fetus and the mother.¹³

A majority of our subjects (n=206, 51.8%) exhibited varying degrees of vitamin D inadequacy demonstrating a significant prevalence of suboptimal vitamin D levels in this region. This finding is consistent with the possibility that expectant women in Bangladesh have high incidence of VDD, as suggested by other regional studies. A recent review paper conducted in Bangladesh reported a prevalence of VDD ranging from 66% to 94.2% among pregnant women.¹⁴ A study conducted in a rural area by Ahmed et al.¹² discovered that 64.5% of women had below-average levels of vitamin D, with 17.3% being deficient and 47.2% being insufficient. In an urban environment, a study discovered that 31.4% of pregnant women experienced vitamin D insufficiency, while 60.7% had a severe deficiency, and 2.1% had severe deficiency.¹⁵ Despite the variations in the cut-off levels used to define vitamin D deficiency, the studies still indicate an overall inadequate level of vitamin D. Additionally, there is a dearth of national-level surveys on vitamin D levels within this specific population group, which hinders the ability to make broader conclusions based on the findings. The incidence of insufficient levels of vitamin D was higher among younger pregnant women (33.7%) under the age of 30, as compared to other age groups, which aligns with the findings of a previous study.¹⁵ While Ahmed et al.¹² discovered that younger patients had a 2.5 times higher likelihood of experiencing VDD, our study did not see any link between the variables. Our conclusion is consistent with previous research conducted in Malaysia.¹⁶ The disparity could be attributed to various factors, including variations in regional lifestyle and dietary habits. 41.2% of our population consisted of individuals who were primigravid. While a previous study identified a correlation between having parity over 2 and an increased risk of vitamin D deficiency, our investigation did not find any such association.¹⁷ Another longitudinal study yielded results that

were consistent with our own findings, since it too did not detect any link between the variables.¹⁸ The majority of our patients, accounting for 78.6%, were housewives. Pregnant housewives were found to be at an elevated risk of vitamin D insufficiency, although our study did not find such association.¹⁹ The occupation of the husband showed a strong correlation with low levels of vitamin D in our study ($p < 0.001$). 40.5% of the husbands in our study were employed in private service jobs. A separate study conducted in Bangladesh identified the occupation of the spouse as a significant risk factor for VDD in pregnant women.¹⁴ In contrast, no correlation of this nature was observed by Ahmed et al.¹² One such cause could be attributed to the socio-economic impact of the husband's profession. Anemia was found to be strongly associated with a low degree of vitamin D insufficiency ($p < 0.021$). The results of our study align with the results of a systematic analysis that discovered a 61% higher likelihood of anemia in pregnant women who have a deficient in vitamin D.²⁰ The precise correlation between anemia and vitamin D deficiency remains poorly understood. However, there is evidence suggesting that the enzyme cytochrome P-450 25-hydroxylase (CYP2R1), which contains heme, may have a significant role in the process of converting cholecalciferol into 25(OH)D₃ in the liver and thus hemoglobin deficiency can disrupt the metabolic pathway.²¹ Our findings did not discover any significant association between BMI and Vitamin D level, even though higher BMI has been associated with lower level of vitamin D deficiency,^{22,23} and our study lacked in depth data to explore this relationship further.

Our study also discovered a significant correlation between vitamin D insufficiency and women who favored a clothing style that covered their whole bodies. Our findings are supported by another research which discovered that concealing garments can potentially lead to vitamin D insufficiency.²⁴ The majority of women in Chattogram adhere to the Islamic faith and choose to wear concealing dress in their daily lives. This cultural practice may be a contributing factor to the elevated prevalence of vitamin D insufficiency among them.

The study's strength rests in its originality, as it explores a specific demography in Chattogram which was not previously studied. Stringent measures were taken to guarantee the collection of blood samples and the analysis of biochemical indicators. Despite the researchers' best efforts, the study was subject to some limitations. The

study employed a cross-sectional design and specifically targeted the urban population residing in the metropolitan area. Furthermore, this study exclusively recruited women who were in the first trimester of their pregnancy. Therefore, the outcome may not be applicable to other distinct populations. Additional potential biochemical markers that could potentially lead to vitamin D insufficiency were not included in this investigation.

Conclusion

The occurrence of vitamin D inadequacy and insufficiency is widespread among pregnant women in Chattogram during the first trimester. The study discovered a strong association between anemia, the husband's work, dressing style, and inadequate vitamin D levels. Interventions should be developed and executed to proactively address vitamin D insufficiency during the early stages of pregnancy and mitigate potential complications. Additional comprehensive and longitudinal research is required to gain a better understanding of the potential causes that may contribute to vitamin D insufficiency in this particular area.

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