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RESEARCH ARTICLE
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TO DETERMINE THE PREVALENCE OF VITAMIN D3 DEFICIENCY IN ANTENATAL WOMEN AND ITS ADVERSE MATERNAL AND FETAL OUTCOME

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Abstract

Background: This study was conducted to determine the prevalence of vitamin D3 deficiency in pregnancy (3rd trimester) and its adverse maternal and foetal outcomes.

Methods: This was a hospital-based clinical observational study conducted among 200 pregnant women in the third trimester of pregnancy attending labour ward, Department of Obstetrics and Gynaecology at S.C.B. Medical College Cuttack, over a period of 12 months from April 2021 to March 2022 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Results: Vitamin D3-deficient antenatal women; 87.1% had inadequate exposure to sunlight, and 12.9% had adequate exposure to the sun. There was a higher prevalence of vitamin D3 deficiency among those who had inadequate exposure to sunlight, which was statistically significant.

Conclusion: To conclude, our research does not demonstrate a connection between vitamin D insufficiency and other high-risk pregnancy variables or unfavourable foetal outcomes. However, vitamin supplementation is easy, affordable, and unlikely to be hazardous. For all pregnant women, we advised increasing supplementation or sun exposure in order to maintain blood levels of 25(OH)D within the adult normal range (>30ng/ml). It is necessary to encourage these ladies to engage in more outside activities during the day in order to enhance their exposure to sunlight.

Keywords: Vitamin D3 Deficiency, Antenatal Women, Adverse, Maternal and Fetal Outcome.

INTRODUCTION

Often called the "Sunshine Vitamin," vitamin D is a pro-hormone that is essential to many bodily processes. UVB radiation may cause the skin to create vitamin D, and some foods can also provide this nutrient.[1] A physically active form of vitamin D called calcitriol binds to the VDR (Vitamin D Receptor) and controls gene transcription and signal transduction pathways in cells that it targets. The control of calcium and phosphorus homeostasis is a well-established physiological role of vitamin D. Vitamin D guarantees that bone mineralization occurs properly by controlling these substances.

Moreover, the VDR has been found in cells that serve purposes other than maintaining calcium homeostasis. In muscle cells, vitamin D affects intracellular calcium management and differentiation. Additionally, it has a role in controlling the differentiation and growth of several cell types, such as hematopoietic and pancreatic β cells. The VDR regulates the immune response and is present in macrophages, monocytes, activated T cells, and cytotoxic T cells.[2] Vitamin D has also been connected in recent research to rheumatoid arthritis, cardiovascular disease, breast and colon cancer, type 1 diabetes, and infectious disorders.

The need for vitamin D for healthy bones has long been recognised; in fact, a vitamin D deficit can cause osteomalacia in adults, rickets in children, and a predisposition to osteoporosis.[3] Information also points to a possible involvement of vitamin D in other non-bone-related medical disorders. A broader variety of detrimental health effects, such as cancer (Orell–Kotikangas et al., 2012), diabetes (Choi et al., 2011), mental problems (Wilkins, Sheline, Roe, Birge, & Morris, 2006), and cardiovascular disease (Pilz et al., 2008), have been linked to low vitamin D status.[4] Due to its global prevalence, including in sunny nations, vitamin D insufficiency has emerged as a serious public health problem (Mithal et al., 2009).[5]

A woman requires more vitamin D to assist her foetus during pregnancy, in addition to meeting her personal demands for the mineral. Thus, more than in any other demographic, pregnant women must obtain and maintain appropriate levels of vitamin D.[6] Due to heightened requirements to promote foetal and infant growth and development, meeting vitamin D levels is particularly crucial during pregnancy and nursing.[7] An infant's primary sources of vitamin D are breast milk and vitamin D stores that are formed during pregnancy. Research has demonstrated that breast milk contains a low level of vitamin D and that maternal vitamin D and 25(OH)D do not easily transfer into the milk.[8] Infant rickets is linked to maternal vitamin D inadequacy, exclusive nursing, darker skin colour, and restricted sun exposure.

More and more research is demonstrating the importance of vitamin D levels during pregnancy for the health of the mother, the development of the foetus, the best possible results for the newborn, and the long-term health of the progeny (Camadoo et al., 2007; Lucas et al., 2008; Mahon et al., 2009; Zhang et al., 2008).[9]

AIMS AND OBJECTIVES

- To determine the prevalence of vitamin D3 deficiency in pregnancy (3rd trimester) and its adverse maternal and fetal outcomes.
- To determine the prevalence of vitamin D3 deficiency in an antenatal mother attending the labour room of SCB MCH Cuttack.
- To determine any adverse maternal outcome with regard to PROM, preterm labour, hypertensive disorder of pregnancy, GDM, and Infection
- To determine perinatal outcomes like Mode of delivery, LBW and SNCU admission.
- To compare the outcomes of the vitamin D3-deficient and sufficient groups.

MATERIALS & METHODS

This was a hospital-based clinical observational study conducted among 200 pregnant women in the third trimester of pregnancy attending labour ward to the Department of Obstetrics and Gynaecology at S.C.B. Medical College Cuttack, over a period of 12 months from April 2021 to March 2022 after obtaining clearance from the institutional ethics committee and written informed consent from the study participants.

Inclusion Criteria
All pregnant women at GA 28 to 40 weeks (as calculated by LMP), irrespective of age and parity.

Exclusion Criteria
The following cases were excluded: Pregnant woman with
1. Active thyroid disease like thyroiditis or Grave's disease.
2. Under medication for cardiac disease
3. On calcium channel blockers
4. With type 2 DM
5. With chronic hypertension
6. With pre-existing renal disease
7. With hypo/hyper parathyroidism
8. With a history of vitamin D3 consumption within the previous month

Statistical Methods
Statistical testing was conducted with the statistical package for the social science system version SPSS 21.0. Continuous variables are presented as mean±SD, and categorical variables are presented as absolute numbers and percentages. A non-normal distribution was analysed using the Mann-Whitney U test. $P<0.05$ was considered statistically significant.

RESULTS

Demographic Parameter		**Vitamin D Deficient N (%)**	**Vitamin D Sufficient N (%)**	**P-Value**
Age group	<25	84 (48.8)	18 (64.3)	0.302
	25-29	64 (37.2)	6 (21.4)	
	≥ 30	24 (14.0)	4 (14.3)	
Age Distribution of Antenatal Women				
Vitamin D3 Status		**Number**	**Percentage**	
Deficient (< 30 ng/ml)		172	86 %	
Sufficient (>30 ng/ml)		28	14 %	
Prevalence of Vitamin D3 among Antenatal Women				
Table 1				

Among the antenatal women with vitamin D3 deficiency, 48.8% were below 25 years of age, 37.2% were between 25 and 29 years of age and 14% were above 30 years of age.
Among the normal antenatal women, 64.3% were below 25 years of age, 21.4% were between 25 and 29 years of age and 14.3% were above 30 years of age.
So, there was no statistically significant age difference between vitamin D3-deficient and normal antenatal women. (P-value = 0.302)
Among the antenatal women, 86% were vitamin D3 deficient and 14% were vitamin D3 sufficient.

Exposure to Sun	**Vitamin D Deficient N (%)**	**Vitamin D Sufficient N (%)**	**P-Value**
INADEQUATE	148 (87.1)	2 (7.1)	0.0001
ADEQUATE	22 (12.9)	26 (92.9)	
Table 2: Distribution of Antenatal Women by Exposure to Sun			

Vitamin D3-deficient antenatal women; 87.1% had inadequate exposure to sunlight, and 12.9% had adequate exposure to the sun.
In vitamin D3-sufficient antenatal women, 92.9% had adequate exposure to sunlight, and 7.1% had inadequate exposure to the sun.
So, there was a higher prevalence of vitamin D3 deficiency among those who had inadequate exposure to sunlight, which was statistically significant. (p = 0.0001)

Mode of Delivery	**Vitamin D Deficient N (%)**	**Vitamin D Sufficient N (%)**	**P-Value**
VD	66 (38.4%)	2 (50%)	0.244
LSCS	22 (61.6%)	26 (50%)	
Mode of Delivery among Antenatal Women			
Outcome	**Vitamin D Deficient N (%)**	**Vitamin D Sufficient N (%)**	**P-Value**
Live	164 (95.3%)	26 (92.9%)	0.575
Still birth	8 (4.7%)	2 (7.1%)	
Perinatal Outcome			
Table 3			

Caesarean sections occurred in 61.6% of cases with vitamin D3 deficiency in comparison to vitamin D3-sufficient antenatal women, in which the LSCS was 50%.
In our study, the caesarean section rate was 61.6%, which was higher than normal vaginal delivery (38.4%) in the vitamin D-deficient group.
So, there was no statistically significant difference in the rate of caesarean section between the vitamin D3-deficient and sufficient groups. (P-value = 0.244)
The live birth rate was 95.3% in vitamin D-deficient group and 92.9% in the sufficient group. Still birth in the sufficient group was 7.1% and in vitamin D-deficient group it was 4.7%. So, there was no statistically significant difference in live birth and IUD among the vitamin D3-deficient and sufficient groups**.** (p = 0.575)

Outcome		**Vitamin D Deficient N (%)**	**Vitamin D Sufficient N (%)**	**P-Value**
Birth Weight (in Kg)	<2.5	24 (14.6%)	4 (15.4%)	0.523
	2.5-3	116 (70.7%)	16 (61.5%)	
	>3	24 (14.6%)	6 (23.1%)	
Table 4: Comparison of Birth Weight of New-Born among Study Groups				

In the vitamin D3 deficient group, there were 14.6% of babies with a birth weight <2.5 kg, 70.7% with a BW of 2.5–3 kg, and 14.6% with a BW > 3kg.
In the vitamin D3 sufficient group, there were 15.4% of babies with birth weight <2.5 kg, 61.5% with BW 2.5–3 kg, and 23.1% with > 3kg. The difference in birth weight was statistically not significant. (P-value = 0.523)

DISCUSSION

Vitamin D deficiency is very prevalent due to changing lifestyles and occupations. Vitamin D3 deficiency has been associated with several adverse health outcomes like osteoporosis, rickets, osteomalacia, Depression, weakened muscles, and pregnancy difficulties are among the issues that have spread throughout the public health system. A 25-hydroxyvitamin D level of less than 30 ng/ml is considered vitamin D insufficiency in this study, whereas a level of more than 30 ng/ml is considered sufficient.

In our study, 200 antenatal women were screened and 172 women (86%) were found to have a deficiency of vitamin D3.
The prevalence of vitamin D3 deficiency was 86%, which was almost similar to the previous study (88%) at Patna, Bihar, by Prasad et al., (2018) and quite similar in comparison to the general population.
According to a research on expectant moms in India, "Deficiency of Vitamin D among Females of Northern India," published by Rekha Jalandra et al. [10], 74% of the mothers had vitamin D insufficiency (25OHD < 30ng/ml).
A study by Abbasian et al. indicates that vitamin D insufficiency is present in more than half of the mothers (60.2% of mothers).
Bondar et al.[11] in a study on 400 pregnant women and their neonates (200 blacks and 200 whites), reported some degrees of vitamin D deficiency. They reported insufficient vitamin D in 54.1% of black and 42.1% of white women.
In 2016 research conducted in Saudi Arabia, Nora A. Faris et al.[12] discovered that pregnant Saudi women had a significant rate of vitamin D insufficiency and deficiency. In this research, almost 90% of pregnant women had either inadequate or deficient vitamin D (<20 ng/mol).
The age group of antenatal women with vitamin D3 deficiency varied from 18 to 35 years in the present studies. In this study, 48.8% were below 25 years of age, 37.2% were between 25 and 29 years of age and 14% were above 30 years of age. The age distribution was similar in several studies for women with vitamin D deficiency. The age difference between women with vitamin D deficiency and sufficiency was not statistically significant.
In a study by Prasad et al., the majority of vitamin D3-deficient women (68.18%) were less than 30 years of age and 31.82% were > 30 years of age.
According to research by Kanan et al., women under 30 had higher levels of vitamin D deficiency than women over 30.
In the present study, 30.2% of women with vitamin D3 deficiency belonged to the lower middle class (III), 39.5% belonged to the upper lower class (IV) and 30.2% belonged to the lower class (V). Among the vitamin D3-sufficient women, 35.7% belonged to the lower middle class (III), 35.7% belonged to the upper lower class (IV) and 28.6% belonged to the lower class (V). This may be due to the fact that most patients belonging to the upper socio-economic class and having higher education status preferred private facilities more than government facilities. The diet of lower SES is deficient in vitamin D3.
In a study conducted by Prasad et al., among the vitamin D3-deficient group, 11.36% of women belong to the low-income group, 65.9% belong to the middle-income group, and 22.7% belong to the high-income group.
Consistent with previous research, 25.6% of the pregnant women with vitamin D3 insufficiency in this study were illiterate, whereas 74.4% were literate. It might be because, in contrast to housewives, who have more spare time for sun exposure and healthier meals, the majority of highly educated women work inside, receiving less sunlight and eating primarily fast food.
In a 2016 research, Nora A. Faris et al. found that pregnant women with greater levels of education had a considerably higher frequency of vitamin D insufficiency than women with lower levels of education.
In a study conducted by Prasad et al. (2018), out of 100 women with vitamin D3 deficiency, 54.55% had secondary education and 45.45% had primary education.
In the present study, among the antenatal women with vitamin D3 deficiency, 43.7% were primipara and 56.3% were multipara. Among the vitamin D3-sufficient antenatal women, 53.8% were primipara and 46.2% were multipara. There was no statistical significance between parity and vitamin D3 deficiency.
Prasad et al. (2018) showed that among vitamin D3-deficient women, 31.8% were primiparous and 68.8% were multiparous.

In our study, 61.6% of vitamin D3-deficient cases belonged to rural areas and 38.4% belonged to urban areas. Among the normal antenatal women, 64.3% belonged to rural areas and 35.7% belonged to urban areas. There is no effect of habitat on vitamin D3 deficiency.
In another study by Prasad et al., 27.3% of vitamin D3-deficient women belong to rural areas, and 72.7% belong to urban areas.
In our study, 83.7% of women with vitamin D3 deficiency were Hindu, 14% were Muslim, and 2.3% were Christian. Among the vitamin D3-sufficient antenatal women, 92.9% were Hindu, 0% were Muslim, and 7.1% were Christian. This may be due to the major population being Hindu.
In our study of vitamin D3-deficient antenatal women, 87.1% had inadequate exposure to sunlight, and 12.9% had adequate exposure to the sun. There was a higher prevalence of vitamin D3 deficiency among those who had inadequate exposure to sunlight.
In a research, Nora A. Faris et al. discovered that women who exposed themselves to the sun more often than those who did not had a considerably reduced prevalence of vitamin D insufficiency.
According to Godar et al. (2011), adults in the USA spent between 90 and 100 minutes outside each day on average.
According to a research by Nageshu et al.[13] people who had just one to two hours of sun exposure (65.1%) had the lowest 25(OH)D concentrations (insufficient levels), and 54.5% had inadequate levels. The subjects who had been exposed to the sun for two to four hours had the highest amounts (11.5%). Our study was not in accordance with this study. This may be due to a lack of standardised parameters.
In our study, pregnancy complications were seen in 34% of women in the deficient group, which included preterm labour (10.5), (PROM 5.8%), infection (4.7%), GDM (8.1%), HDP (8.1%), preterm labour (7.1%), HDP (22.2%), GDM (7.1%), with no infections, and PROM in women with vitamin D sufficiency.
According to a 2018 research by Prasad et al., preterm labour (39.39%), PROM (18.18%), infection (15.15%), GDM (12.12%), preeclampsia (6.06%), and preexisting hypertension (9.09%) are among the pregnancy complications in the deficient group.
There was no discernible correlation between maternal outcome and 25(OH)D concentrations in a research by Shailaja Nageshu et al. 81.8% of those with low vitamin D levels experienced no problems, compared to 92.3% of those with normal levels. But out of those with hypovitaminosis D, 16% experienced PIH, 15.2% gave birth before term, and 2.3% experienced GDM.
8.1% of the women in our research who were vitamin D3-deficient developed GDM. According to a research done in India by Jayaramam Muthukrishnan et al.[14] among the Armed Forces in Pune, low vitamin D levels are linked to GDM. Nevertheless, vitamin D replenishment does not make glucose intolerance go away. Currently, there are no established protocols or grounds for routinely screening all pregnant women who are prenatal for vitamin D deficiency.
According to research by Wei, S.Q. et al.[15] vitamin D concentrations less than 20 ng/L were linked to a 1.38 odds ratio for gestational diabetes.
The vitamin D levels and 2-hour postprandial glucose levels were measured between 26 and 28 weeks of gestation in the multi-ethnic Asian cohort - GUSTO (Growing Up in Singapore Towards a Healthy Outcome) study, as reported in the publication "Association of maternal vitamin D status with glucose tolerance and LSCS in the multi-ethnic Asian cohort."[16] They came to the conclusion that pregnant women, especially those of Malay and Indian descent, frequently lack enough vitamin D. This is linked to a higher incidence of emergency LSCS in Chinese and Indian women as well as an elevated fasting blood glucose level in Malay women.
In this study 8.1% of women with vitamin D3 deficiency had hypertensive disorder of pregnancy.
However, a research carried out in the Middle East,[17] where almost two-thirds of the population reported inadequate sun exposure and poor supplement consumption, found that women with preeclampsia had considerably lower blood vitamin D levels (18.1 ng/ml).
In a 2020 investigation, Sharma et al.[18] discovered that pregnant women with hypertension problems had low blood vitamin D levels.

Mehmood et al.[19] found that serum 25(OH)D concentration was significantly lower in cases (preeclampsia, eclampsia and gestational hypertension) compared to controls. 6.78 ng/ml in cases and 9.43 ng/ml in controls ($p = 0.002$).
In another study by Nageshu et al. in women with vitamin D3 deficiency, 16% had PIH.
In our study 10.55% of vitamin D3-deficient antenatal women had PTL.
According to Luk J et al. research[20] pregnant women with pregnancies affected by vitamin D deficiency produced more inflammatory cytokines. This finding raises the possibility that vitamin D may have an anti-inflammatory and immunomodulatory impact on avoiding spontaneous preterm delivery.
When Bodnar et al. examined a cohort of twin pregnancies in pregnant women of mixed race in America, they discovered that 75 of the women who delivered before the 35th week of pregnancy had far lower vitamin D levels than the 136 who did so after the 35th week. 49.4% of women with vitamin D concentrations below 75 nmol/L gave birth before their due date, whereas 26.2% of women with vitamin D concentrations over 75 nmol/L gave birth before their due date.
The studies conducted by Shand et al., Fernández-Alonso Thorp et al., J.M.; Camargoet and colleagues, Schneuer et al., Bhupornvivat et al. could not find any correlation between maternal vitamin D levels and premature labour.
Seven observational studies were combined into a meta-analysis,[21] but the results did not support a link between low maternal vitamin D and preterm delivery.
In our study, 4.7% of women with vitamin D3 deficiency also developed an infection. Patients with bacterial vaginosis had considerably lower quantities of vitamin D, according to American research including 146 pregnant women of mixed ethnicity, of whom 8.8% had bacterial vaginosis.
Two randomised studies have not demonstrated any benefit of vitamin D supplementation in decreasing the rates of bacterial vaginosis during pregnancy, contrary to Hensel et al.'s findings that vitamin D insufficiency was related to bacterial vaginosis exclusively in pregnant women and not in non-pregnant women.
In our study, caesarean sections were done in 61.6% of cases with vitamin D3 deficiency compared to 50% of vitamin D3-sufficient women.
In a study conducted by Prasad et al., of women with vitamin D3 deficiency, 54% underwent LSCS and 34% had vaginal delivery.
Women with 25(OH)D <37.5 nmol per litre were nearly four times more likely to give birth by caesarean section than women with 25(OH)D ≥37.5 nmol per litre (adjusted OR = 3.84; 95% CI: 1.71 - 8.62), according to research done in 2009 by Merewood et al.[22]
There is no correlation between vitamin D supplementation and the incidence of caesarean sections, according to a meta-analysis[23] of randomised controlled trials.
In our study, the live birth rate was 95.3% in the vitamin D deficient group and still birth rate was 4.7%; however, the live birth rate was 92.9% and still birth rate was 7.15 in the vitamin D sufficient group. This finding is clinically insignificant.
According to a 2018 study by Prasad et al., the live birth rate is 94.3% and the still birth rate is 5.7% in the group of those low in vitamin D.
In our study, in the vitamin D3-deficient group, 18.6% of babies had a birth weight <2.5 kg, 67.4% had a BW of 2.5–3 kg, and 14% had a BW > 3kg. In the vitamin D3 sufficient group, there were 14.3% of babies with a birth weight <2.5 kg, 64.3% with a BW of 2.5–3 kg, and 20% with >3 kg.
According to Prasad et al. (2018) (72) research, live births in the vitamin D-deficient group resulted in babies weighing between < 2.5 kg and > 2.5 kg (13.25% and 86.75%), respectively. A research by Nageshu et al. found that, in comparison to 15.4% of those with normal vitamin D levels, there was a strong correlation between low birth weight (<2.5 kg) and a deficient vitamin D status (45.5%). In a study by Abbasian et al., the serum vitamin D level of pregnant women had no significant association with neonatal birth weight.

According to research by Leffelaar et al. (2010),[24] children born to pregnant mothers with low vitamin D levels (classified as 25(OH)D < 30 nmol/L) had lower birth weights (-144.4 grammes, 95% confidence interval: -151.2 - -77.6).
Bowyer et al. research in Australia discovered that women who were immigrants, had darker skin tones, and covered up had a higher risk of developing vitamin D deficiency. Furthermore, there was a correlation found between the pregnant women's decreased vitamin D levels and a higher chance of low birth weight.
In our study, APGAR <7 at 5 minutes in the vitamin D deficient group was 16.3% and in the vitamin D sufficient group was 7.1%. APGAR >7 at 5 min in the vitamin D deficient group was 83.7% and in the vitamin D sufficient group was 92.9%.
In a study conducted by Prasad et al., APGAR at 5 minutes < 7 in the deficient group was 18.07%, and APGAR > 7 was 81.92%.
In our study, SNCU admission in the vitamin D deficient group was 18.6% and in the vitamin D sufficient group was 14.3%.
SNCU admission in the vitamin D deficient group (21.69%) and the vitamin D adequate group (18.18%) was demonstrated by Prasad et al. in 2018.
In a study by Nageshu et al., in 2016, in a population of 80, 36.6% of neonates with vitamin D3-deficient mothers were admitted to SNCU.
In 2011, Hansdottir and Monick found that newborns whose mothers were low in vitamin D3 had a higher risk of RTIs (Respiratory Tract Infections), which led to a rise in SNCU admissions. It has been hypothesised that vitamin D lowers the risk of RTIs caused by bacteria and viruses by immunomodulating the immune system, which includes reducing the generation of chemokines, inhibiting the activation of dendritic cells, and changing the activation of T cells.

CONCLUSION

After reviewing the literature, this study found that pregnant women had a high prevalence of vitamin D deficiency. Pregnancy-related complications such as preterm labour, gestational hypertension, preeclampsia, and gestational diabetes mellitus were not significantly associated with vitamin D deficiency, and our analysis was unable to establish a link between low vitamin D levels and unfavourable neonatal outcomes.
Therefore, to sum up, our research is unable to demonstrate a link between vitamin D insufficiency and other high-risk pregnancy variables and unfavourable foetal outcomes. However, vitamin supplementation is easy, affordable, and unlikely to be hazardous. For all pregnant women, we advised increasing supplementation or sun exposure in order to maintain blood levels of 25 (OH)D within the adult normal range (>30ng/ml).
Pregnancy problems and vitamin D insufficiency are frequently linked in meta-analyses of observational research; nevertheless, significant confounding bias must be taken into account. However, a number of randomised controlled trials were unable to demonstrate a link between vitamin D administration and a lower risk of different problems. This might be because the research had insufficient power or other drawbacks.
Recent research indicates that vitamin D administration may be helpful in lowering the risk of pregnancy disorders such gestational diabetes, preeclampsia, and premature labour, despite these interpretive issues.
For all pregnant or nursing women, vitamin D supplementation and treatment of vitamin D deficiency are safe and advised.
Since most pregnant women in India lack vitamin D, which is crucial for maintaining good health and regulating calcium metabolism, we think pregnant women's vitamin D status should receive more attention.
To increase these women's exposure to sunshine, we must urge them to spend more time outside during the day. To get adequate vitamin D for overall health, they should expose their skin-which includes their hands, arms, and face—to the sun.

Since fatty fish and dairy products from the local market are rich sources of vitamin D, it is recommended to increase consumption of these items. Furthermore, in order to prevent health consequences associated with vitamin D insufficiency, those at risk of the condition, such as pregnant women, should think about taking dietary supplements. Finally, to increase public awareness of this grave issue, successful national education campaigns aimed at pregnant Indian women are required.

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