Type: Original Research

Comparative Analysis of Vitamin D3 Deficiency Prevalence in Urban vs. Rural Pregnant Women During the First Trimester

Dr Vinkal Ladani*

*Assistant Professor Department of Obstetrics and Gynaecology, Gujarat Adani Institute of Medical Sciences, Bhuj, Gujarat, India

Corresponding author: Dr Vinkal Ladani, Department of Obstetrics and Gynaecology, Gujarat Adani Institute of Medical Sciences, Bhuj, Gujarat, India

Abstract:

Background and Aim: This study highlight that a deficiency in Vitamin D3 during pregnancy could adversely impact both the mother and the child. This study aims to compare the prevalence of vitamin D3 deficiency among Indian women during the first trimester of pregnancy, focusing on both urban and rural populations. Additionally, it seeks to determine the necessity of vitamin D3 supplementation during pregnancy.

Materials and Methods: A prospective comparative study examining the prevalence of vitamin D3 deficiency during the first trimester of pregnancy in both urban and rural settings was conducted at Department of Gynecology, Tertiary Care Institute of Gujarat. Blood samples were routinely collected from civil hospital for screening serum Vitamin D3 levels during the first trimester of pregnancy. Additionally, blood samples were obtained from rural women also. The analysis of serum concentrations of vitamin D3 was conducted using High Performance Liquid Chromatography.

Results: 84% of research participants (N=50) had vitamin D3 levels below 30ng/ml, indicating insufficiency. Vitamin D3 levels < 10 ng/ml were found in 6% of the population. Vitamin D3 levels averaged 21.21 ng/ml across the population. All 25 urban research participants had vitamin D3 levels below 30ng/ml. 8% of urban study participants had vitamin D3 values below 10 ng/ml, indicating insufficiency. The average urban vitamin D3 level was 18.48

ng/ml.Vitamin D3 concentrations were < 30ng/ml in 68% (N=25) of rural residents. Additionally, 8% of this rural sample had vitamin D3 levels < 10ng/ml. The rural population averaged 23 ng/ml vitamin D3. Rural inhabitants had higher vitamin D3 levels than urban populations, according to research.

Conclusion: Vitamin D insufficiency was common in urban early pregnant women. Education, occupational status, nutrition, clothes, number of pregnancies, multi-vitamin use, and sample season all contributed to this insufficiency. However, the study only examines vitamin D insufficiency prevalence, which limits it. A longer and more extensive follow-up is needed to assess maternal and neonatal outcomes. In metropolitan women, vitamin D3 deficiency during pregnancy is particularly high. Vitamin D supplementation and dietary and pregnancy counseling should be prioritized.

Keywords: First Trimester Pregnancy, Vitamin D3, Vitamin D3 Deficiency, Rural, Urban

Introduction

Vitamin D is classified as a secosteroid, with its most important source being the direct exposure of the skin to sunlight. Dietary sources, nutritional supplements, and food fortification are all viable means of obtaining this nutrient.[1] Vitamin D deficiency is recognized as a significant public health issue in numerous countries, particularly affecting pregnant women, who are considered a high-risk group. The prevalence of this deficiency among them varies between 20 and 40%.2,3 Vitamin D3 deficiency during pregnancy can adversely affect both the mother and the child. During the first trimester, the developing fetus gathers approximately 2-3 mg of calcium daily for its skeletal formation, a process that sees a significant increase, doubling in the final trimester.[4,5] The current study aims to compare the prevalence of vitamin D3 concentrations during the first trimester of pregnancy among Indian women in both urban and rural settings, with the goal of determining the necessity of vitamin D3 supplementation during pregnancy. Urban communities experience reduced sunlight exposure compared to their rural counterparts, largely due to lifestyle choices, dense living conditions, and the types of housing available.[6]

The study aimed to evaluate serum levels of 25-hydroxyvitamin D [25(OH)D]3 during the first trimester among pregnant women in both rural and urban settings. It sought to determine the prevalence of deficiency in these populations and to identify factors influencing serum vitamin D3 levels.

Materials and Methods

ISSN: 0975-3583, 0976-2833 || VOL 15, ISSUE 04, 2024

A study was conducted involving 50 pregnant women, comprising 25 from an urban setting who sought care at the Department of Gynecology at a Tertiary Care Institute in Gujarat during the first trimester of pregnancy (9th – 12th gestational weeks), and 25 from a rural area with a population of 30,000. Information regarding the season and gestational age at the time of sampling, along with maternal age, parity, the number of previous pregnancies and spontaneous abortions, maternal BMI, and smoking status, was collected from the medical records of women visiting the hospital. The Ethics Committee of our hospital granted approval for this study. All participants received detailed information regarding the study's purpose and were asked to participate following the provision of written consent. Participants were requested to fill out a questionnaire detailing their pregnancy characteristics and the factors linked to their vitamin D status. Blood samples were collected without fasting and subsequently analyzed for levels of 25(OH)D3. Only singleton pregnancies without gestational diabetes mellitus (GDM), a history of diabetes, and with blood pressure readings below 140/90 mmHg or without preeclampsia were included in the study. Patients who were smaller for gestational age (below the 5th percentile), smokers, individuals with any systemic diseases, or those on medications that influence vitamin D levels were excluded from the study. The collected data encompassed various factors including age, parity, body mass index (BMI), dietary habits, educational background, occupation, gestational age at the time of serum collection, mean blood pressure, blood sugar levels, dressing habits, and a history of multivitamin intake. The analysis of serum concentrations of vitamin D3 was conducted using the High-Performance Liquid Chromatography with a coulometric electrode array detector (HPLC-CEAD) method at the biochemistry laboratory of the civil hospital in Ahmedabad. The statistical analysis is conducted using Microsoft Excel version 13.0. While a definitive standard for the ideal 25(OH)D level remains elusive, vitamin D levels have been classified into distinct categories: serum 25(OH)D levels below 10 ng/mL are deemed deficient, those ranging from 10 to 30 ng/mL are considered insufficient, and levels between 30 and 100 ng/mL are recognized as sufficient. The data were presented as mean ± standard deviation (SD) and as percentages for categorical variables, with a comparison between urban and rural groups tabulated for clarity.

Sunlight serves as the primary source of Vitamin D for both children and adults, making the reduction in its production by the body the leading cause of Vitamin D deficiency. Factors that influence the transmission of UVB radiation or disrupt its ability to penetrate the skin will impact vitamin D production.[5]. The following risk factors include: The application of sunscreen with an SPF of 30 can inhibit the production of Vitamin D in the skin by more than 95%. People with darker skin possess a natural defense against the sun, thanks to melanin's ability to absorb UVB radiation. Consequently, they require 3-5 times more sun exposure to produce the same quantity of Vitamin D as those with lighter skin. The aging process, along with advancing age, diminishes the skin's ability to synthesize Vitamin D, primarily due to a reduced availability of 7-dehydrocholesterol. The second factor contributing to this issue is the decreased consumption of Vitamin D, given that only a limited number of foods, such as blue fish and egg yolks, are rich in this essential nutrient. Increasing the intake of this vitamin can be achieved through fortified products like dairy, yet the levels of Vitamin D they offer may fall short of what is necessary for maintaining adequate Vitamin D status.[7] Patients with severe liver failure, chronic granulomatous disease, specific lymphomas, and primary hypoparathyroidism exhibit an elevated metabolism of 25(OH)D into 1.25(OH)2D, resulting in a heightened risk of vitamin D deficiency.[7]

Results and Discussion

Table 1: Characteristics of the Study Population

Age	23.5±4years
Parity n,%	

-nulligravida	24(48%)
-multigravida	26(52%)
Body mass index	22.5±4
Diet n.%	
-non vegetarian	14(28%)
-vegetarian	36(72%)
Education n,%	
-no formal education	37(74%)
-finished high school	10(20%)
-post graduation	3(6%)
Occupation n,%	
-unemployed	34(68%)
-unskilled work	11(22%)
-skilled work	05(10%)
Gestational age at serum collection	10.5±2 weeks
Season – winter	50(100%)
Mean systolic BP	110mm hg
Mean diastolic BP	70 mm hg
Random blood sugar level	78mg/dl
Maternal multivitamin use n,%	
-yes	31(62%)

ISSN: 0975-3583, 0976-2833 || VOL 15, ISSUE 04, 2024

-no	19(38%)
Consumption of dairy products n,%	
-sufficient	19(38%)
-insufficient	31(62%)
Dressing habit n,%	
-covered	33(66%)
-uncovered	17(34%)

Table 2: Association of Serum Vitamin D3 Levels and Characteristics of Study Population

Variables	**<10ng/ml**	**10-30ng/ml**	**>30ng/ml**
Age	23.5±4years	23.5±4years	23.5±4years
Parity Urban area:			
-primigravida	0	10(40%)	0
-multigravida	1(4%)	14(56%)	0
Rural area:			
-primigravida	0	7(32%)	7(32%)
-multigravida	1(4%)	9(36%)	1(4%)
Body mass index	22.5±4	22.5±4	22.5±4

ISSN: 0975-3583, 0976-2833 || VOL 15, ISSUE 04, 2024

Diet Urban area:			
-non vegetarian	0	5(20%)	0
-vegetarian	2(8%)	18(72%)	0
Rural area:			
-non vegetarian	0	3(12%)	6(24%)
-vegetarian	1(4%)	13(42%)	2(8%)
Education			
Urban area:			
-non formal	0	1(4%)	0
-high school	1(4%)	3(12%)	0
-post graduation	1(4%)	19(76%)	0
Rural area:			
-non formal	0	13(42%)	5(20%)
-high school	0	3(12%)	3(12%)
-post graduation	1(4%)	0	0
Occupation Urban area:			
-housewife	2(8%)	18(72%)	0
-unskilled work	0	0	0
-skilled work	0	5(20%)	0

Rural area:			
-housewife	1(4%)	13(42%)	0
-unskilled work	0	3(12%)	8(32%)
-skilled work	0	0	0
Mean systolic BP	110 mmHg	110 mmHg	110 mmHg
Mean diastolic BP	70 mmHg	70 mmHg	70 mmHg
Blood sugar level	78mg/dl	78mg/dl	78mg/dl
Multivitamin intake			
Urban area:			
-yes	0	15(60%)	0
-no	2(8%)	8(32%)	0
Rural area:			
-yes	0	10(40%)	6(24%)
-no	1(4%)	6(24%)	2(8%)
Dairy product intake			
Urban area:			
-sufficient	0	5(20%)	0
-insufficient	1(4%)	19(76%)	0
Rural area:			
-sufficient	0	6(24%)	8(32%)

-insufficient	1(4%)	10(40%)	0

The characteristics of the study population and its components are presented in Table 1. Vitamin D3 levels measured in the first trimester of pregnancy. The majority of samples were collected between the 5th and 12th gestational weeks, predominantly during the winter season. A significant 84% of the study population (N=50) exhibited vitamin D3 concentrations below 30ng/ml, indicating a status of insufficiency. Among the population, 6% exhibited vitamin D3 concentrations below 10 ng/ml, indicating a deficient status. In contrast, only 16% recorded values exceeding 30 ng/ml, signifying sufficiency. The average vitamin D3 level across the entire population was found to be 21.21 ng/ml. A comparison was made between the vitamin D status of urban and rural populations. In the entire urban study population (N=25), vitamin D3 levels were found to be below 30ng/ml, indicating a deficiency in status. Eight percent of the population exhibited vitamin D3 concentrations below 10 ng/ml, indicating a deficiency in this essential nutrient. The average vitamin D3 level among the urban population was found to be 18.48 ng/ml.

A significant 68% of the rural study population (N=25) exhibited vitamin D3 concentrations below 30ng/ml, indicating an insufficient status of this vital nutrient. Among the population, 4% exhibited vitamin D3 concentrations below 10 ng/ml, indicating a deficient status, while 32% recorded levels exceeding 30 ng/ml, signifying sufficiency. The average vitamin D3 level among the total rural population was found to be 23 ng/ml. This indicates that the rural population exhibited higher levels of vitamin D3 in comparison to their urban counterparts.

We examined the relationship between vitamin D levels and parity in both urban and rural settings. The findings indicate a greater deficiency among multigravida individuals when compared to primigravida, with a notable increase in urban areas relative to rural settings. The comparison of diet types, specifically non-vegetarian versus vegetarian, was conducted in relation to vitamin D3 levels. The findings indicate a greater deficiency in vegetarian diets relative to non-vegetarian ones, with urban areas exhibiting higher levels of insufficiency compared to their rural counterparts. When examining occupational health disparities, it becomes evident that housewives and skilled workers experience greater insufficiency compared to their unskilled counterparts, with urban areas showing a higher prevalence of these issues than rural regions.

Research suggests a potential inverse relationship between vitamin D3 levels and education, likely attributed to the tendency for more indoor work among individuals with higher educational attainment. Research indicates that individuals with low dairy product consumption tend to have lower levels of vitamin D3, with a notable prevalence in urban populations compared to their rural counterparts. [8-10] Research indicates that individuals who tend to wear covered clothing, particularly in urban settings, exhibit a higher prevalence of vitamin D3 deficiency compared to those in rural areas. Our analysis revealed that there were no notable differences among the groups regarding maternal age, BMI values, blood sugar levels, as well as systolic and diastolic blood pressures during the baseline study visit, and gestational age at the time of serum collection. The study found no correlation between vitamin D3 levels during the first trimester and gestational age at birth among women who delivered post-term. Additionally, factors such as mode of delivery, fetal sex, birth weight, and length of hospital stay following birth did not show any association with these vitamin D3 levels (data not shown).

The findings of this study indicate that a significant majority of Indian pregnant women experiencing uncomplicated pregnancies were found to be deficient or insufficient in vitamin D3 during their first trimester. Only a small fraction, approximately 16%, exhibited sufficient levels, defined as greater than 30 ng/ml. Several factors influence maternal vitamin D3 concentrations, including the season of sampling, educational background, dietary choices, dressing habits, as well as maternal age, parity, residential area, and occupation.

Women should be provided with nutritional and general pregnancy counseling, with a greater emphasis on vitamin D supplementation. It is essential to consider all relevant factors when advising individuals on increasing their intake of naturally occurring vitamin D-rich foods, such as fatty fish, mushrooms, and eggs, as well as fortified foods. Regular supplementation and sun exposure should also be encouraged whenever possible.

Conclusion

The findings indicate that the increased prevalence of vitamin D deficiency in urban populations is associated with factors such as clothing choices, occupational activities, dietary habits—particularly the consumption of dairy products—and a tendency towards more indoor work. There is a pressing need for additional large multicentre clinical trials to clarify the role of vitamin D in human health and disease. This study contributes to the existing body of knowledge on the prevalence of vitamin D deficiency among seemingly healthy pregnant women. Nonetheless, the study has its limitations, as it focuses solely on the prevalence of vitamin D deficiency. A more extended and comprehensive follow-up is necessary to evaluate the impact on both maternal and neonatal outcomes.

References

[1] Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, et al. Evaluation, treatment, and prevention of Vitamin D deficiency: An endocrine society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(7):1911-1930.

[2] Farrant HJ, Krishnaveni GV, Hill JC, Boucher BJ, Fisher DJ, Noonan K, et al. Vitamin D insufficiency is common in Indian mothers but is not associated with gestational diabetes or variation in newborn size. Eur J Clin Nutr. 2009;63(5):646-652.

[3] Mulligan ML, Felton SK, Riek AE, Bernal-Mizrachi C. Implications of vitamin D deficiency in pregnancy and lactation. Am J Obstet Gynecol. 2010; 202:429.e1-9.

[4] Dawodu A, Wagner CL. Prevention of vitamin D deficiency in mothers and infants worldwide - a paradigm shift. PaediatrInt Child Health. 2012;32:3-13

[5] Sattar N, Welsh P, Panarelli M and Forouhi NG. Increasing requests for Vitamin D measurement: Costly, confusing, and without credibility. Lancet. 2012;379(9811):95-96.

[6] Chicote CC, Lorencio FG; Comité de Comunicación de la Sociedad Española de Bioquímica Clínica y Patología Molecular. Vitamina D: unaperspectiva actual. Barcelona: Comité de Comunicación de la Sociedad Española de Bioquímica Clínica y Patología Molecular; 2013.

[7] Ross AC, Manson JE, Abrams SA, Aloia JF, Brannon PM, Clinton SK, et al. The 2011 report on dietary reference intakes for calcium and vitamin D from the institute of medicine: what clinicians need to know. J Clin Endocrinol Metab. 2011; 96:53-8.

[8] Holick MF. Vitamin D deficiency. N Engl J Med. 2007; 357:266-81.

[9] Baker AM, Haeri S, Camargo CA, Stuebe AM and Boggess KA. A nested case-control study of first-trimester maternal Vitamin D status and risk for spontaneous preterm birth. Am J Perinatol. 2011;28(9):667-672.

[10] Thorne-Lyman A, Fawzi WW. Thorne-Lyman A and Fawzi WW. Vitamin D during pregnancy and maternal, neonatal and infant health outcomes: A systematic review and meta-analysis. Paediatr Perinat Epidemiol. 2012;26(Suppl 1):75-90.