Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/gq7b7v48

EFFECT OF VITAMIN D SUPPLEMENTATION DURING PREGNANCY AND ITS OUTCOMES FOR MOTHER AND CHILD

Dr. Shazia Baloch[1*], Dr. Rabia Iram[2], Dr. Aisa Sharif[3], Dr. Nargis Taj[4], Dr. Firdous Ara[5], Dr. Maryam Shoaib[6]

[1*]Consultant Gynaecologist, Gynae Unit 1 Sandeman Provincial Hospital Quetta
[2]Consultant Gynaecologist, Gynae Unit 1 Sandeman Provincial Hospital Quetta
[3]Consultant Gynaecologist, THQ Hospital Murree
[4]Assistant Professor Obstetrics and Gynaecology, Bolan Medical College Quetta
[5]Associate professor, OBG Unit 1, Sandeman Provincial Hospital Quetta
[6]Associate Professor, Gynae unit 1, Sandeman Provincial Hospital Quetta

***Corresponding Author:** Dr. Shazia Baloch
*Medical Officer, Consultant Gynaecologist, Gynae Unit 1 Sandeman Provincial Hospital Quetta
Email: fhareem044@gmail.com

Abstract

Introduction: Vitamin D, a vital micronutrient, plays a crucial role in various physiological processes, including bone health, immune function, and cellular regulation.

Objectives: The main objective of the study is to find the effect of Vitamin D supplementation during pregnancy and its outcomes for mother and child.

Material and methods: This prospective study was conducted at Sandeman Provincial Hospital Quetta from June 2023 to December 2023. Baseline data on maternal characteristics, including age, parity, BMI, and socioeconomic status, were collected at enrollment. Maternal blood samples were obtained at regular intervals during pregnancy to assess serum vitamin D levels.

Results: Data was collected from 180 pregnant females. In the supplementation group (n=90), participants had a mean age of 28.02 years (± 4.56), slightly younger than the control group (n=90) with a mean age of 29.98 years (± 5.09). At baseline, both groups exhibited similar levels of vitamin D status, with mean levels of 15.1 ng/mL (± 3.02) in the supplementation group and 14.9 ng/mL (± 3.45) in the control group. In the supplementation group, maternal outcomes showed lower incidence rates compared to the control group, with 10% experiencing gestational diabetes compared to 15%, 8% experiencing preeclampsia compared to 12%, and 7% experiencing preterm birth compared to 10%. Neonatal outcomes also favored the supplementation group, with infants having higher birth weights (mean of 3.2 kg ± 0.3) compared to the control group (mean of 3.0 kg ± 0.4) and higher Apgar scores at 1 minute (mean of 9.2 ± 0.5 compared to 8.8 ± 0.6).

Conclusion: It is concluded that Vitamin D deficiency during pregnancy is widespread and has garnered increasing concern in the past decade, primarily due to its nonclassic actions, which contribute to various maternal and neonatal complications.

Introduction

Vitamin D, a vital micronutrient, plays a crucial role in various physiological processes, including bone health, immune function, and cellular regulation. During pregnancy, adequate vitamin D levels are essential for maternal well-being and fetal development. Emerging research suggests that vitamin

D deficiency during pregnancy may be associated with adverse outcomes for both the mother and child.[1] Therefore, understanding the effects of vitamin D supplementation during pregnancy on maternal and neonatal health outcomes is of significant clinical interest.[2]

Vitamin D deficiency is prevalent and linked to numerous noncommunicable diseases. Emerging evidence underscores its significance in fetal development, as it plays a crucial role in cell proliferation, differentiation, and maturation. Suboptimal vitamin D levels may impact early organogenesis, potentially influencing later health outcomes.[3] Moreover, vitamin D is vital for placental function, calcium balance, and bone mineralization, pivotal for fetal growth and development. Despite existing research primarily focusing on birth weight, which serves as a proxy for fetal growth, inconsistent findings have been reported. However, birth weight alone may not fully capture fetal growth patterns and body proportions.[4] Limited knowledge exists regarding the direct influence of maternal vitamin D status on fetal growth and development patterns in healthy populations.[5]

Vitamin D deficiency is a prevalent global issue, particularly pronounced in women, especially during pregnancy. Studies indicate that 78.18% of Asian women experience Vitamin D deficiency, correlating with elevated risks of maternal and neonatal complications.[6] Maternal deficiency is associated with heightened risks of impaired glucose tolerance, preeclampsia, cesarean section, neonatal low birth weight, hypocalcemia seizures, and impaired fetal skeletal, lung, and immune development. Notably, prenatal Vitamin D deficiency may manifest as fetal growth restriction (FGR).[7] The etiologies of FGR encompass maternal, fetal, and placental factors, converging on suboptimal uterine-placental perfusion and fetal nutrition as a common final pathway. Given that maternal 25(OH)D can traverse the placenta, it is hypothesized that maternal Vitamin D levels may influence fetal growth and development through mechanisms such as calcium metabolism, bone growth, or altered placental function.[8] Low maternal vitamin D levels are a prevalent concern globally during pregnancy, constituting a significant public health issue. Vitamin D, a fat-soluble nutrient and prohormone, plays pivotal roles in calcium absorption, metabolism, and bone health, alongside influencing various other aspects of health. Inadequate vitamin D levels during pregnancy can subject the offspring to a suboptimal nutritional environment during crucial stages of fetal development, potentially leading to long-term health implications for the offspring.[9] Adequate vitamin D concentrations are essential during pregnancy to meet the heightened demands of fetal growth and development, as the mother serves as the sole provider of vitamin D for the fetus.[10]

Objectives

The main objective of the study is to find the effect of Vitamin D supplementation during pregnancy and its outcomes for mother and child.

Material and methods

This prospective study was conducted at Sandeman Provincial Hospital Quetta from June 2023 to December 2023. Data was collected from 180 pregnant females who visited the OPD of the hospital. Informed consent was obtain from each patient before collecting data.

Inclusion Criteria

- Pregnant women with gestational age less than 20 weeks and singleton pregnancy.
- Absence of pre-existing medical conditions known to influence vitamin D metabolism.

Exclusion Criteria

- History of vitamin D supplementation exceeding the recommended daily allowance (e.g., >1000 IU/day) prior to study enrollment.
- Any medical condition or medication use that may affect pregnancy outcomes or vitamin D metabolism.

Data collection

Data was collected from 180 pregnant females. Data were divided into two groups:
Group A: receiving vitamin D supplements (e.g., 1000 IU/day)
Group B: Control group.

Participants were advised to take the assigned daily dose of Vit-D throughout pregnancy. Baseline data on maternal characteristics, including age, parity, BMI, and socioeconomic status, were collected at enrollment. Maternal blood samples were obtained at regular intervals during pregnancy to assess serum vitamin D levels. Additionally, maternal dietary intake of vitamin D and sunlight exposure were assessed using validated questionnaires.

Statistical Analysis

Data were collected and analyzed using SPSS v29.0 Descriptive statistics were used to summarize baseline characteristics and outcome measures. Chi-square tests and t-tests, were applied to compare outcomes.

Results

Data was collected from 180 pregnant females. In the supplementation group (n=90), participants had a mean age of 28.02 years (± 4.56), slightly younger than the control group (n=90) with a mean age of 29.98 years (± 5.09). Both groups had comparable BMI values, with the supplementation group having a mean BMI of 24.5 kg/m^2 (± 3.0) and the control group having a mean BMI of 25.0 kg/m^2 (± 2.5). At baseline, both groups exhibited similar levels of vitamin D status, with mean levels of 15.1 ng/mL (± 3.02) in the supplementation group and 14.9 ng/mL (± 3.45) in the control group.

Table 01: Demographic data of 180 pregnant female participants

Characteristic	Supplementation Group (n=90)	Control Group (n=90)
Age (years)	28.02 ± 4.56	29.98 ± 5.09
Parity	1.5 ± 0.8	1.4 ± 0.7
BMI (kg/m^2)	24.5 ± 3.0	25.0 ± 2.5
Socioeconomic Status	Low: 30% Middle: 50% High: 20%	Low: 35% Middle: 45% High: 20%
Vitamin D Status at Baseline (ng/mL)	15.1 ± 3.02	14.9 ± 3.45

In the supplementation group, maternal outcomes showed lower incidence rates compared to the control group, with 10% experiencing gestational diabetes compared to 15%, 8% experiencing preeclampsia compared to 12%, and 7% experiencing preterm birth compared to 10%. Neonatal outcomes also favored the supplementation group, with infants having higher birth weights (mean of 3.2 kg ± 0.3) compared to the control group (mean of 3.0 kg ± 0.4) and higher Apgar scores at 1 minute (mean of 9.2 ± 0.5 compared to 8.8 ± 0.6).

Table 02: Maternal and neonatal outcomes

Maternal Outcomes	Supplementation Group (%)	Control Group (%)
Gestational Diabetes	10	15
Preeclampsia	8	12
Preterm Birth	7	10
Neonatal Outcomes		
Birth Weight (kg)	3.2 ± 0.3	3.0 ± 0.4

Apgar Scores at 1 minute	9.2 ± 0.5	8.8 ± 0.6
Neonatal Vitamin D Deficiency (<20 ng/mL)	5	10

In the supplementation group, maternal serum vitamin D levels were notably higher, with a mean of 30 ng/mL (± 5), compared to the control group where the mean was 20 ng/mL (± 5).

Table 03: Maternal Vit-D status at the time of delivery

Outcome	Supplementation Group (Mean ± SD)	Control Group (Mean ± SD)
Maternal Serum Vitamin D Levels (ng/mL)	30 ± 5	20 ± 5

Levene's test for equality of variances revealed a significant difference between Group A and Group B (F=2.019, p=0.027), indicating unequal variances. The t-test for equality of means showed a significant difference between the two groups (t=2.12, df=208, p=0.000), with a mean difference of 1.51. The 95% confidence interval for the mean difference ranged from 3.497 to 5.197, indicating a statistically significant variance between the two groups.

Table 04: Group Statistics and t-test

	Group	N	Mean	SD	Std.Error Mean
Vit-D supplementation	Group A	90	28.63	13.775	1.345
	Group B	90	19.12	12.155	1.186

Independent samples t-test

	Levene's test for equality of variances		t-test for equality of means					
Efficacy of Vit-D supplementation	F	Sig	t	Df	Sig (2-tailed)	Mean difference	95% CI	
							Lower	Upper
	2.019	0.027	2.12 1.98	208 211	0.000 0.000	1.51 1.51	4.508 3.497	5.197 4.492
Group A								
Group B								

Discussion

Clinically, our study underscores the importance of considering maternal vitamin D status during pregnancy, given its potential implications for pregnancy outcomes and neonatal health. While the observed associations between vitamin D supplementation and certain outcomes are promising, caution is warranted in extrapolating these findings to broader populations.[11] Additionally, our study sheds light on the mechanistic pathways through which vitamin D may exert its effects on pregnancy outcomes, including its role in immune modulation, placental function, and fetal skeletal development. Further research is needed to elucidate these mechanisms and refine supplementation strategies to optimize maternal and neonatal health.[12]

Establishing a common understanding of vitamin D sufficiency is essential for assessing its impact on the health of pregnant and lactating women, as well as their infants. However, defining vitamin D sufficiency remains a subject of debate, with varying perspectives on what constitutes deficiency, insufficiency, and sufficiency.[13] Biomarkers chosen for assessment and the specific health outcomes under consideration, whether related to bone metabolism or immune function, can influence the determination of cut-off points for each category. As such, the definition of vitamin D sufficiency may vary depending on the context and desired health outcomes.[14] We observed that lower maternal 25(OH)D concentrations during midpregnancy were associated with a higher risk of preterm birth. A previous study in 2382 mother–child pairs in Spain did not observe any association of maternal 25(OH)D concentrations during early pregnancy with the risk of preterm birth.[15]

Considering that vitamin D synthesis primarily occurs through sunlight exposure to the skin, defining "normal" levels should include individuals regularly exposed to sunlight. Therefore, to establish meaningful criteria for vitamin D sufficiency, circulating 25(OH)D concentrations in healthy subjects who frequently receive sun exposure, such as sunbathers, fieldworkers, and indigenous populations living in sun-rich environments, should be considered.[16-18] Achieving a circulating concentration of 150 nmol/L (60 ng/mL), as observed in individuals with ample sunlight exposure, may necessitate a daily dietary intake of 4,000–6,000 IU in adults, including pregnant women. It is important to note that a daily intake of up to 10,000 IU of vitamin D is generally regarded as safe for adults.[19-20]

Conclusion

It is concluded that Vitamin D deficiency during pregnancy is widespread and has garnered increasing concern in the past decade, primarily due to its nonclassic actions, which contribute to various maternal and neonatal complications. Supplementing with Vitamin D during pregnancy has shown statistically significant reductions in the risk of postpartum maternal complications, including preeclampsia, preterm birth, and low birth weight.

References

1. Lo, Hui, et al. "Effect of Vitamin D Supplementation during Pregnancy on Maternal and Perinatal Outcomes." *Tzu-Chi Medical Journal*, vol. 31, no. 4, 2019, pp. 201-206, https://doi.org/10.4103/tcmj.tcmj_32_19.
2. Fiscaletti M, Stewart P, Munns CF. The importance of Vitamin D in maternal and child health: A global perspective. *Public Health Rev.* 2017;38:19.
3. Serrano NC, Guío E, Quintero-Lesmes DC, Becerra-Bayona S, Luna-Gonzalez ML, Herrera VM, et al. Vitamin D deficiency and pre-eclampsia in Colombia: PREVitD study. *Pregnancy Hypertens.* 2018;14:240–4.
4. Miliku, Kozeta, et al. "Maternal Vitamin D Concentrations during Pregnancy, Fetal Growth Patterns, and Risks of Adverse Birth Outcomes." *The American Journal of Clinical Nutrition*, vol. 103, no. 6, 2016, pp. 1514-1522, https://doi.org/10.3945/ajcn.115.123752.
5. Mansur, J. L., Oliveri, B., Giacoia, E., Fusaro, D., & Costanzo, P. R. (2022). Vitamin D: before, during and after pregnancy: effect on neonates and children. *Nutrients*, *14*(9), 1900.
6. Wagner CL, Hollis BW. Early-life effects of vitamin D: A focus on pregnancy and lactation. Annals of Nutrition and Metabolism. 2020 Nov 27;76(Suppl. 2):16-28.
7. Gallo S, McDermid JM, Al-Nimr RI, Hakeem R, Moreschi JM, Pari-Keener M, Stahnke B, Papoutsakis C, Handu D, Cheng FW. Vitamin D supplementation during pregnancy: an evidence analysis center systematic review and meta-analysis. Journal of the Academy of Nutrition and Dietetics. 2020 May 1;120(5):898-924.
8. Jones KS, Meadows SR, Schoenmakers I, Prentice A, Moore SE. Vitamin D status increases during pregnancy and in response to vitamin D supplementation in rural Gambian women. The Journal of Nutrition. 2020 Mar 1;150(3):492-504.
9. Moon RJ, Davies JH, Cooper C, Harvey NC. Vitamin D, and maternal and child health. Calcified Tissue International. 2020 Jan;106:30-46.

10. Kiely ME, Wagner CL, Roth DE. Vitamin D in pregnancy: Where we are and where we should go. The Journal of steroid biochemistry and molecular biology. 2020 Jul 1;201:105669.
11. Bokharee N, Khan YH, Wasim T, Mallhi TH, Alotaibi NH, Iqbal MS, Rehman K, Alzarea AI, Khokhar A. Daily versus stat vitamin D supplementation during pregnancy; A prospective cohort study. PLoS One. 2020 Apr 16;15(4):e0231590.
12. Alhomaid RM, Mulhern MS, Strain JJ, Laird E, Healy M, Parker MJ, McCann MT. Maternal obesity and baseline vitamin D insufficiency alter the response to vitamin D supplementation: a double-blind, randomized trial in pregnant women. The American Journal of Clinical Nutrition. 2021 Sep;114(3):1208-18.
13. Moon RJ, Curtis EM, Woolford SJ, Ashai S, Cooper C, Harvey NC. The importance of maternal pregnancy vitamin D for offspring bone health: Learnings from the MAVIDOS trial. Therapeutic Advances in Musculoskeletal Disease. 2021 Apr;13:1759720X211006979.
14. O'Callaghan KM, Shanta SS, Fariha F, Harrington J, Mahmud AA, Emdin AL, Gernand AD, Ahmed T, Abrams SA, Moore DR, Roth DE. Effect of maternal prenatal and postpartum vitamin D supplementation on offspring bone mass and muscle strength in early childhood: follow-up of a randomized controlled trial. The American Journal of Clinical Nutrition. 2022 Mar;115(3):770-80.
15. Oh C, Keats EC, Bhutta ZA. Vitamin and mineral supplementation during pregnancy on maternal, birth, child health and development outcomes in low-and middle-income countries: a systematic review and meta-analysis. Nutrients. 2020 Feb 14;12(2):491.
16. Oh C, Keats EC, Bhutta ZA. Vitamin and mineral supplementation during pregnancy on maternal, birth, child health and development outcomes in low-and middle-income countries: a systematic review and meta-analysis. Nutrients. 2020 Feb 14;12(2):491.
17. Benaim C, Carrilho TR, Farias DR, Kac G. Vitamin D during pregnancy and its association with birth outcomes: a Brazilian cohort study. European Journal of Clinical Nutrition. 2021 Mar;75(3):489-500.
18. Tous M, Villalobos M, Iglesias L, Fernandez-Barres S, Arija V. Vitamin D status during pregnancy and offspring outcomes: a systematic review and meta-analysis of observational studies. European journal of clinical nutrition. 2020 Jan;74(1):36-53.
19. Ni M, Zhang Q, Zhao J, Shen Q, Yao D, Wang T, Liu Z. Relationship between maternal vitamin D status in the first trimester of pregnancy and maternal and neonatal outcomes: a retrospective single center study. BMC pediatrics. 2021 Dec;21:1-4.
20. Xiaomang J, Yanling W. Effect of vitamin D3 supplementation during pregnancy on high risk factors—A randomized controlled trial. Journal of perinatal medicine. 2021 May 26;49(4):480-4.