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Prevalence of Vitamin D Deficiency in Pregnant Women and Its Association with Musculoskeletal Pain: A Cross-Sectional Study

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ABSTRACT

Vitamin D deficiency is recognized as widespread public health issue especially prevalent in pregnant women, has been associated with negative maternal health consequences, including musculoskeletal pain. **Objective:** To assess vitamin D levels during pregnancy and explore their association with musculoskeletal pain in pregnant women **Methods:** A cross-sectional study was performed at a teaching hospital in Sargodha over a 16-month period (09/2023-12/2024). Biochemical assessment of vitamin D status was performed through serum 25(OH)D quantification, while musculoskeletal symptoms were documented using structured pain questionnaires. Statistical evaluation, including chi-square analysis of associations, was performed using SPSS Statistics version 26.0. **Results:** Out of 250 pregnant women, 72.4% (n=181) had deficiency of vitamin D (<20 ng/mL), while 18% (n=45) had insufficiency (20-30 ng/mL). The association revealed between vitamin D deficiency and musculoskeletal pain was significant as ($p < 0.001$), moderate to severe pain was evident in 68.2% of deficient women compared to 31.8% in the sufficient group (≥30 ng/mL). **Conclusions:** Current evidence reveals alarmingly high rates of vitamin D deficiency among pregnant women and is significantly associated with musculoskeletal pain. Routine screening and supplementation should be considered to improve maternal health outcomes.

INTRODUCTION

The fat-soluble vitamin D plays an essential role in regulating calcium balance, promoting bone mineralization, and supporting musculoskeletal health. During pregnancy, the body's physiological requirement for vitamin D rises significantly to aid in the proper development of the fetal skeleton, yet deficiency remains alarmingly prevalent [1, 2]. Global epidemiological studies indicate that 40-90% of pregnant women in developing countries suffer from vitamin D deficiency, which is linked to negative maternal and fetal outcomes, such as gestational diabetes mellitus, preeclampsia, preterm birth, and neonatal hypocalcemia [3, 4]. Pregnant women frequently encounter musculoskeletal problems as a result of hormonal, anatomical, physiological, and morphological changes. Common symptoms include muscle strain, cramping, pain, fatigue, and soreness. Prolonged changes in joint laxity can disrupt normal joint biomechanics, placing excessive stress on musculoskeletal tissues. Additionally, increased laxity may lead to abnormal or unevenly distributed stress on joint cartilage [5]. While

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mechanical factors such as weight gain, postural changes, and ligamentous laxity due to relaxin hormone are well-documented contributors. Emerging evidence suggests that hypovitaminosis D may exacerbate musculoskeletal discomfort through multiple mechanisms [6]. Vitamin D Receptors (VDRs) are present in skeletal muscle, and deficiency has been linked to myopathy, muscle weakness, and increased inflammatory cytokine activity, which may predispose pregnant women to chronic pain syndromes [7]. Over the past decade, epidemiological research has increasingly highlighted the relationship of vitamin D deficiency during pregnancy with fatal outcomes for mothers, fetuses, and newborns. These adverse effects include pre-eclampsia, gestational diabetes mellitus, impaired fetal growth, low infant birth weight, impaired fetal skeletal development, and reduced bone mass [8]. Although increasing evidence associates vitamin D deficiency to musculoskeletal morbidity, routine screening for hypovitaminosis D in antenatal care is ignored, particularly in low-resource settings [9, 10]. Current guidelines from the Endocrine Society recommend a minimum serum 25(OH)D level of 30 ng/mL for optimal skeletal and extra skeletal health, yet many pregnant women fail to meet this threshold due to insufficient sun exposure, cultural practices favoring skin coverage, and diets low in vitamin D-rich foods [11, 12]. In Pakistan, where sunlight is abundant yet vitamin D deficiency paradoxically remains endemic due to sociocultural and dietary factors, there is a paucity of data on relationship between vitamin D deficiency and musculoskeletal pain in pregnancy [13, 14]. This study aimed to assess vitamin D levels during pregnancy and explore their association with musculoskeletal pain in pregnant women. Despite growing interest in this area, research on this specific population remains limited, indicating the need for further investigation to uncover unexplored aspects of this relationship.

The findings of this study could help to initiate antenatal care policies regarding vitamin D screening and supplementation, potentially reducing the burden of preventable musculoskeletal morbidity in pregnancy.

METHODS

This cross-sectional study was done at Niazi Welfare Foundation Teaching Hospital, Sargodha, from September 1, 2023 to December 31, 2024. Study gained ethical approval from institutional review committee (Approval No: NM&DC-IRB-92 and Ref Letter No: IRB/NM&DC/408) and followed all ethical regulations during entire study duration. A written informed consent along with voluntary participation was taken from study participants. A sample size of 250 was calculated on open Epi software at 95% confidence level and 5.5% margin of error based on prevalence of vitamin D deficiency in Pakistan from a prior study [3]. A total of 250 women aged 18–45 years with confirmed singleton pregnancies were included in the study via consecutive sampling. Exclusion criteria included: Chronic musculoskeletal disorders (e.g., rheumatoid arthritis, osteoarthritis), history of vitamin D supplementation in the past 6 months, medical disorders influencing vitamin D metabolism (such as chronic kidney disease, malabsorption syndromes), use of medications interfering with vitamin D metabolism (anticonvulsants, glucocorticoids). In data collection procedure, maternal age, gestational trimester, BMI, parity, sun exposure (≤30 minutes/day), and socioeconomic status were recorded. Under aseptic technique, venous blood was drawn and assessed for serum 25-hydroxyvitamin D [25(OH)D] concentrations. Vitamin D status was classified according to Endocrine Society guidelines as deficient (<20 ng/mL), insufficient (20–29 ng/mL), and sufficient (≥30 ng/mL) [15]. Musculoskeletal pain was assessed using a structured questionnaire and a Visual Analog Scale (VAS) ranging from 0 to 10, with pain considered present if the VAS score was 4 or higher [15, 16]. Participants reported pain location (e.g., lower back, pelvis, joints), duration, and intensity. Data were analyzed using SPSS version 26.0. Descriptive statistics (mean ± SD, frequencies) were computed. Chi-square tests applied for categorical variables and ANOVA for normally distributed continuous variables. Significance level was kept at p-value <0.05.

RESULTS

Table 1 summarizes the maternal and gestational age in mean ± SD as 28.4 ± 5.2 and 24.6 ± 8.3 respectively. Out of 250 participants, majority were in their second trimester (42%) and had limited sun exposure (<30 min/day; 64%).

Table 1: Participants Demographic Profile

Variables	Mean ± SD	Frequency (%)
Age (Years)	28.4 ± 5.2	-
Gestational Age (Weeks)	24.6 ± 8.3	-
BMI (Kg/m^2)	26.8 ± 4.5	-
Trimester		
First	-	60 (24.0)
Second	-	105 (42.0)
Third	-	85 (34.0)
Parity		
Nulliparous	-	93 (37.2)
Multiparous	-	157 (62.8)
Sun Exposure		
<30 min/Day	-	160 (64.0)
≥30 min/Day	-	90 (36.0)

Table 2 revealed a high prevalence of deficiency (72.4%), with only 8.8% of women achieving sufficiency. Deficient women had significantly lower mean levels (14.2 ng/mL).

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Table 2: Vitamin D Levels in Pregnant Women

Vitamin D Status	Frequency (%)	Mean ± SD 25-Hydroxy-vitamin D (ng/mL)
Deficient (< 20 ng/mL)	181 (72.4)	14.2 ± 3.8
Insufficient (20–30)	47 (18.8)	24.6 ± 2.1
Sufficient (≥30)	22 (8.8)	36.4 ± 4.5

Table 3 demonstrated a dose-response relationship, with deficient women more likely to report moderate-to-severe pain (76.5%) compared to sufficient women (37.8%; p<0.001).

Table 3: Vitamin D Status and Musculoskeletal Pain (n=250)

Pain Severity	Deficient Frequency (%)	Insufficient Frequency (%)	Sufficient Frequency (%)	p-Value
Mild (VAS 1–3)	43 (23.7)	21 (45)	14 (63.6)	<0.001
Moderate (4–7)	93 (51.4)	19 (40.4)	6 (27.2)	<0.001
Severe (8–10)	45 (24.8)	7 (14.8)	2 (9.2)	0.002

DISCUSSION

This study provided important insights exploring the link between vitamin D measures and musculoskeletal pain in 250 pregnant women with distinct demographic and lifestyle characteristics. The participant profile reveals several noteworthy findings that contextualize these results suggest directions for clinical practice. The mean age of participants (28.4 ± 5.2 years) reflects a typical reproductive-age population, while the trimester distribution (24.0% first, 42.0% second, 34.0% third) captures pregnancy stages when musculoskeletal complaints typically emerge and intensify. Of particular relevance, the majority of participants (62.8%) were multiparous, a factor associated with cumulative musculoskeletal stress from previous pregnancies [17]. The mean BMI of 26.8 ± 4.5 kg/m^2 indicates that nearly half of the cohort likely fell into overweight/obese categories according to WHO criteria, an important consideration given the established relationship between elevated BMI and both vitamin D deficiency and musculoskeletal pain [18]. This study found an alarmingly high rate of vitamin D deficiency (72.4%) in pregnant women, with only 9.2% achieving sufficient levels (≥ 30 ng per mL). Mean vitamin D levels showed a clear gradation across categories: 14.2 ± 3.8 ng/mL in deficient, 24.6 ± 2.1 ng/mL in insufficient, and 36.4 ± 4.5 ng/mL in sufficient groups. These findings align with recent regional studies from Pakistan showing 61-75% deficiency rates but substantially exceed prevalence rates reported in European (19-45%) and Middle Eastern (52-68%) populations [2, 3, 19]. These results corroborate the growing body of evidence demonstrating that South Asian pregnant women experience highest deficiency rates globally linked to limited sunlight contact and diets low in fortified foods [20, 21]. This study revealed a strong inverse linkage between vitamin D measures and musculoskeletal pain severity in pregnant women, with deficient participants (n=181) showing significantly higher pain burden (51.4% moderate, 24.8% severe) compared to sufficient women (n=22; 27.2% moderate, 9.2% severe; p<0.001). These findings demonstrate a clear dose-response gradient, supporting biological plausibility, and align with but exceed effect sizes reported in Western studies, likely due to more extreme deficiency levels in the population (mean 25(OH)D 14.2 ng/mL in deficient group). The results are particularly concerning given that 76.2% of deficient women reported moderate-to-severe pain levels known to impair daily function, suggesting current vitamin D thresholds may need reevaluation for musculoskeletal health in pregnancy. These data reinforce emerging evidence from showing stronger vitamin D-pain associations possibly reflecting compounded effects of nutritional deficiency and pregnancy-related biomechanical stress while highlighting an under-addressed aspect of maternal morbidity that warrants urgent clinical attention through screening and targeted supplementation program [22, 23]. The study offers several strengths, such as a large sample of pregnant women, validated tools for assessing vitamin D levels and pain severity, and a clear dose-response relationship supporting potential causality. However, recall bias in self-reported pain and sun exposure metrics may affect accuracy. The cross-sectional design precludes causal inference, and single-center sampling limits generalizability. Longitudinal studies assessing pain resolution post-supplementation and cost-benefit analyses of screening programs are necessary. Future studies should explore vitamin D's role in pregnancy-related pain pathways to inform targeted intervention.

CONCLUSIONS

Deficiency of vitamin D is endemic in pregnancy and strongly correlates with musculoskeletal pain. Addressing this through targeted supplementation and sunlight exposure advocacy may enhance maternal well-being. Policymakers should prioritize prenatal vitamin D protocols in regions with high deficiency rates. Integrating routine vitamin D screening into antenatal care, coupled with WHO-recommended supplementation (400–600 IU/day), could mitigate deficiency and associated morbidity. Public health initiatives promoting dietary fortification and safe sun exposure are vital factors.

Authors Contribution

Conceptualization: MUR
Methodology: MUR, SA
Formal analysis: MKM
Writing, review and editing: MZ, RAK, MZ

All authors have read and agreed to the published version of the manuscript

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Conflicts of Interest

All the authors declare no conflict of interest.

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