Original Article

Correlation of Vitamin-D Level and Chondromalacia Patellae (Anterior Knee Pain) in Pregnancy

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Abstract

Objectives: To determine the level of vitamin D and its correlation in pregnant females presented with Chondromalacia patellae (anterior knee pain).
Methodology: A cross-sectional study design carried out on 300 pregnant females either in their first trimester or second trimester presented in the Orthopedic Department OPD of Aziz Bhatti Shaheed Teaching Hospital, Gujrat in collaboration with Pathology department of Nawaz Sharif Medical College Gujrat from March 2023 to Nov 2023. A total of 300 pregnant between the age of 18y ears and 35years either in their first trimester or second trimester having knee pain were included in the study
Visual Analog Scale for pain was used to assess the pain and disability in terms of severity. The scale is graded on a scale of 0 to 10, with 0 score, 1-3, 4-6 and 7 to 10 showing severity of pain. Statistical analysis was done using Microsoft excel 16 and SPSS 27 for the determination of frequency, percentage, mean, and standard deviation for the demographic characteristics of the patients and vitamin D levels among pregnant females
Results Vitamin D levels were analyzed for each pregnant woman and the results showed that 93(31%) had severe deficiency (<7ng/ml), 54(18%) had deficiency (7ng/ml to 20ng/ml), and 114(38%) had insufficient levels (20ng/ml to 29ng/ml). A negative correlation was found between the vitamin D levels and the severity of anterior knee pain at based on visual analog scale.
Conclusion: There is increased prevalence of vitamin D deficiency in pregnant females associated with chondromalacia patellae.
Keywords: Pregnancy, chondromalacia patellae (CMP), vitamin D levels, VAS.

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Introduction

Pain at the joint between the patella and the femur is referred to as chondromalacia patella, also known as patellofemoral pain syndrome (PFPS). The term "chondromalacia" was originally derived from Greek term chondros indicates cartilage whereas Malakia means softening. [1] Patellofemoral arthritis is the most common cause of pain in the knee in younger adults, especially in athletes who play professional or recreation sports.[2] There are two different terms for anterior knee pain: chondromalacia patellae and patellofemoral pain syndrome. Young females are more likely to develop chondromalacia patellae, or degenerative abnormalities on the undersurface of the patella. Going up and down stairs, performing deep squats, and spending a lot of time sitting with a flexed knee can all aggravate chondromalacia-related pain problems. All these actions lead to an increase in the patella's posteriorly directed forces, which puts more pressure on the chondral surfaces.[3, 4]

Many factors can contribute to the etiology of CMP, such as direct trauma to the patella, increased cartilage susceptibility following arthrotomy or casting

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rehabilitation, abnormal patellar kinematics such as patella alta, valgus knees, and excessively laterally placed tibial tubercles. It may also be the result of occupational dangers experienced by army people, athletes in training, and workers in occupations involving a lot of crouching and kneeling. Due to the obvious patellar dislocation, subluxation is possibly the most frequent cause of CMP and is often missed. [5]

Vitamin D deficiency is a prominent and major cause of osteomalacia in the younger population; it appears to be an etiology for PFPS or chondromalacia.[6] Osteoblast metabolism, which maintains healthy bones and encourages bone mineralization, is significantly influenced. It is essential for the metabolism of bone and the absorption of calcium. It also has a role in cell division and proliferation, which has an impact on the immune system.

A steroid with hormone-like properties, vitamin D controls the expression of many different genes. Serum 25-hydroxyvitamin D (25OHD) concentration is measured to evaluate vitamin D status. The metabolism of calcium and bone, hormone release, immunological response, and the renewal and differentiation of cells all depend on vitamin D.[7] In humans, 90% of the vitamin D source comes from sunlight, with the remaining 10% coming from food. Consequently, sun exposure may offer defense against hypovitaminosis D.[8] Vitamin D deficiency is common and a major problem during pregnancy. Pregnant women are considered a high-risk population about 20–40% of population is Vit D deficient, and it has been documented as a major community health problem in many countries. According to estimates, the percentage of pregnant women with 25OHD concentrations below 25 nmol/L 7 is 18% in England, around 80% in Iranian pregnant females, 42% in Northern India, and nearly 84% in the Netherlands.

Studies linking vitamin D deficiency during pregnancy to a variety of harmful results for the health of mothers, fetuses, and newborns have been piling up in the epidemiological literature over the past ten years.[9] The adverse effects of vitamin D deficiency during pregnancy include pre-eclampsia, gestational diabetes, small-for-gestational age, low birth weight, poor fetal skeletal development and decreased bone mass, and intrauterine growth.[10]

Recent research has revealed an connection between vitamin D levels and knee pain, highlighting the complex relationship of biomechanics and nutritional conditions during pregnancy.[11,12] In the obstetric population, musculoskeletal issues are common; one in every four women represents with musculoskeletal problems.[13] The musculoskeletal system is affected by changes in musculoskeletal function that happen during pregnancy. Pregnant women often experience musculoskeletal issues, which typically affect the lower extremities, due to changes in hormones, anatomy, physiology, and morphology. Muscle strain, cramping, pain, fatigue, and soreness in the knees are typical symptoms. Long-term alterations in joint laxity can alter joint biomechanics and put an unparalleled amount of stress on the tissues of musculoskeletal joints. Moreover, increased laxity could lead to stresses in the cartilage that are either larger or distributed differently. When the body produces Relaxing during pregnancy, it can cause damage to the joint when it comes into touch with unusual stressors. Pregnancy-related increases in joint laxity may indicate knee problems such chondromalacia patella.[14]

Our study aims to determine vitamin D levels in the first and second trimester and its relationship with chondromalacia patella (anterior knee pain) in pregnant women. However very little research has been done on pregnant females and a lot more horizons are to be discovered yet.

Methodology

A cross-sectional study design carried out at Orthopeadic and Pathology department of Aziz Bhatti Shaheed teaching Hospital, Nawaz Sharif Medical College, Gujrat to measure the levels of vitamin D in pregnant females presenting at first and second trimester of gestation and its correlation with chondromalacia patella (anterior knee pain). A total of 300 pregnant females between the age of 18 years and 35years either in their first trimester or second trimester having knee pain were included in the study. These pregnant women have no history of any musculoskeletal problem or disease.

G Power software was used to compute the sample size in order to predict the incidence of vitamin D insufficiency in expectant mothers as well as the expected effect size for examining the possible correlation between knee discomfort and vitamin D levels.

Visual Analog Scale for pain was used to assess the pain and disability in terms of severity. The scale is graded on a scale of 0 to 10, with 0 score, 1-3, 4-6 and

7 to 10 showing severity of pain. Data was collected from the patients after approval from the Ethical review Board of Nawaz Sharif Medical College and Aziz Bhatti Shaheed Teaching Hospital Gujrat. Vitamin D samples were collected and performed on Cobas e 411 analyzer based on Electrochemiluminescence technique.

Statistical analysis was done using Microsoft excel 16 and SPSS 27 for the determination of frequency, percentage, mean, and standard deviation for the demographic characteristics of the patients and vitamin D levels among pregnant females. A calculation of Spearman's rho correlation coefficient was made in order to identify the linear link between pain using the VAS and vitamin D level. These statistical methods were applied to check the relationship between age, vitamin D levels, and severity of knee pain using visual analog scale.

Results

Physical characteristics of pregnant women are presented in table I.

Table I: Physical characteristics of pregnant women.

Variables	Mean ±SD
Age (yrs)	27±2
1st trimester (weeks)	11±1
2nd trimester (weeks)	18±2
Employed	11±6
Housekeeper	13±4
BMI (kg/m2)	26±3

Patients that arrived at the hospital, 261 (87%) had vitamin D deficiency, whereas 39 pregnant women (13%) had normal vitamin D levels. Out of 300 pregnant females 93(31%) had severe vitamin deficiency having vitamin D level <7ng/ml, 54(18%) showed vitamin D deficiency (levels between 7ng/ml to 20ng/ml), and 114(38%) had insufficient levels of vitamin D3 (20ng/ml to 29ng/ml). Whereas 39 (13%) pregnant females have vitamin D3 levels in normal range 30-100. Table II

Table II: Vitamin D Levels, Number and percentages among pregnant women.

Vit D3 levels	Number=300(%)	Reference range
Severe deficiency	93 (31%)	<7ng/ml
Deficiency	54 (18%)	7ng/ml to 20ng/ml
Insufficiency	114 (38%)	20ng/ml to 29ng/ml
Sufficient	39 (13%)	30-100 ng/ml.

The "none" patient category comprised individuals who did not report any knee discomfort or gave vague symptoms of pain and obtained a score of 0. The mean Vitamin D concentration was 36.2 ± 3.8ng/ml in the first trimester and 30.8 ± 2.5ng/ml in the second trimester with 0 VAS. Individuals experiencing minor knee pain, have a pain score ranging from 1 to 3, had an average Vitamin D concentration of 27.1±3.6ng/mL during the first trimester and 24.2 ± 2.8 ng/mL during the second trimester. Patients experiencing significant knee discomfort (scoring 4-6) had vitamin D deficiency. The average vitamin D levels were 17.4 ± 4.1 ng/ml and 14.2 ± 4.6 ng/ml, in the first and second trimester respectively. The category of patients with significant knee pain (scores 7-10) had the lowest levels of vitamin D, with mean values of 12.2 ± 2.6 ng/mL in the first trimester and 10.6 ± 2.4 ng/mL in the second trimester.

The table III classifies the severity of knee pain based on VAS into four levels such as None, Mild, Moderate, and Severe, with corresponding values ranging from 0 to 10.

Table III: Correlation between Vitamin D levels and Knee Pain Severity in Pregnancy.

Visual analog scale for pain		First Trimester	Second Trimester
		Vitamin D levels (ng/mL)	Vitamin D levels (ng/mL)
Knee Pain Severity	Score	Mean ± SD	Mean ± SD
None	0	36.2 ± 3.8	30.8 ± 2.5
Mild	1-3	27.1 ± 3.6	24.2 ± 2.8
Moderate	4-6	17.4 ± 4.1	14.2 ± 4.6
Severe	7-10	12.2 ± 2.6	10.6 ± 2.4

The data provided demonstrated that severe vitamin D deficiency were present in pregnant females with chondromalacia patellae, there exists a negative correlation (r=0.687) between vitamin D level and pain severity. Individuals with lower vitamin D levels had more intense and severe pain.

Discussion

Anterior knee pain is mainly caused by pathological conditions of the retropatellar joint cartilage. One of the major causes of anterior knee pain is Chondromalacia patella. It is a progressive condition that causes chondral defects, subchondral erosive changes fibrillation, thinning, ulcerous formations, and softening of the articular cartilage.[15,16] Half of healthy individuals over 20 years of age experience softening of the patellar cartilage being more common in young adult females either due to overuse, trauma, and/or excessive stresses on the knee.[17,18] The average age of the pregnant females presented with chondromalacia in our study is around 25 years. The mean BMI of these

females was 26±3 being on the higher side of overweight resulting in more stress on the front part of their knee.[19] Obesity is also a major cause of anterior knee pain.

Being a fat-soluble vitamin that is stored in body fat, vitamin D insufficiency and obesity are also related. Typically, early in pregnancy, plasma levels of 1.25(OH)2 D—a physiologically active form of vitamin D—increase. They peak in the third trimester and revert to normal during nursing.[20] Patients experiencing anterior knee pain during pregnancy are closely linked to obesity and vitamin D insufficiency. The findings of Hong Kuan K et al.'s study, which showed that these individuals had considerably larger subcutaneous knee fat thicknesses than the normal group, indicate a correlation between obesity and chondromalacia. According to Creamer et al., BMI plays a significant role in determining how severe knee OA discomfort is.[15] The female patients also exhibited more severe CMP and greater subcutaneous knee fat.[5] These outcomes align with our research. However, research by Kim et al. shows no connection between obesity and age.

Given that most of our female population is active in-home chores and activities, a prospective study on knee pain and its risk variables found that age, past knee injuries, being obese, and knee-straining work were risk factors for knee pain. Their risk of knee injury is higher.[8,21] Between 20 and 85% of pregnant women are more likely to be vitamin D deficient.[21]

Our study also demonstrates that around 87% of the pregnant females are vit d deficient. Similar results were obtained by other studies carried out by Fatima et al where vitamin D deficiency was found in 90% of pregnant females in their first trimester.[22,23] 90% of pregnant Turkish women have a vitamin D deficit in 2014, according to Palacios et al. Comparable findings have been reported for Pakistan, Iran, and India, where there is an extended summer and high levels of solar exposure, with prevalence rates of 72, 67, and 96%, respectively, of vitamin D insufficiency during pregnancy. These findings are in accordance to our study. [21]

Another study conducted in Indonesia reported that 92 percent of the 143 pregnant women in good health who visited Jakarta's maternal clinics for the first time had vitamin D deficiency.[24] In a different study, hypovitaminosis D affected 90% of pregnant women who were in their first trimester. In second and third trimester, 60 and 37% of women had vitamin D deficiency level less than< 30 ng/mL, according to another study. A key part of the etiology of patellar chondromalacia is vitamin D insufficiency. It seems that vitamin D insufficiency is a predisposing factor for chondromalacia since it is a major cause of osteomalacia in the younger population. With a favorable effect on bone health, vitamin D is crucial for osteoblast metabolism and sustaining strong bones. Numerous studies have shown that providing osteoarthritis patients with a six-month vitamin D supplement reduced oxidative protein breakdown, lowered VAS, increased grip force, and improved physical presentation.

Patellar chondromalacia and osteomalacia are two recognized causes of PFPS. A large U.S. study found that blood levels of vitamin D less than 25 ng/mL were associated with increased pain sensitivity and persistent knee discomfort, especially osteoarthritis. Macfarlane et al. report that widespread discomfort is common in the South Asian population under study, and that this may be partly due to low vitamin D intake.[25] They commented that although osteomalacia is the most recognized musculoskeletal disorder associated with a vitamin D deficiency, it can also presents as disseminated skeletal pain.

Additionally, they demonstrated how frequent vitamin D insufficiency was among young females in the south Asian region and how it was linked to widespread nonspecific pain.

Another study showed that the process of bone remodeling, which is initiated by the high concentration of vitamin D receptors present in the knee joint and subchondral bone osteoblasts and osteoclasts, is hampered by a vitamin D deficit. This further plays a role in the mechanism of pain in PFPS as well as osteoarthritis in the knee. [23] The negative connection between type 1 collagen and serum 25(OH)D in pregnant women with serum 25(OH)22 has reinforced the link between low vitamin D levels and bone resorption during pregnancy, especially in the second and third trimesters.

A study was carried out to evaluate the effect of vitamin D supplementation on osteoarthritis in the knee. The results of the investigation show how effective it is by decreasing pain and improving knee function in patients with osteoarthritis. [9, 14, 15, 16] Another study demonstrated that vitamin D supplementation helped patients with KOA [16] experience less pain and function related to

WOMAC. The current meta-analysis's findings suggested that vitamin D may have an impact on patients' VAS.

The results imply that vitamin D could be able to delay the volume loss of tibial cartilage. Toll-Like Receptor 2 (TLR-2) activation increases prostaglandin E2, Matrix Metalloproteinases (MMPs), and nitric oxide production during osteoarthritis, which results in discomfort. Vitamin D deficiency is mostly associated with this procedure. The strength of the quadriceps was shown to be highly correlated with vitamin D insufficiency, indicating that vitamin D deficiency can exacerbate knee discomfort .[28]

Pregnancy-related elevated levels of estrogen and relaxin promote collagen remodeling and flexibility in the knees and other joints, which is the cause of anterior knee discomfort. A persistent shift in joint laxity that alters joint biomechanics may subject musculoskeletal tissues to supraphysiological stress. Furthermore, a different distribution or a larger amplitude of cartilage stresses might result from increased joint laxity. Chondromalacia patella can be the consequence of the joint being harmed by exposure to aberrant contact forces.[26]

At an average gestational age of 8.9 ± 4.2 weeks, 78% of women in a study at a tertiary military medical hospital in the Pacific Northwest of the United States had vitamin D insufficiency. Pregnant women are more prone to suffer from lateral stress on the patella based on the breadth of their pelvis. Leg adduction when sitting enhances the valgus moment at the knee, which may be another reason for increased patellar lateral pressure and consequent anterior knee pain. Recent research by Liu et al. demonstrated that local estrogen elevations can inhibit collagen formation, lowering the strength and shape of connective tissue.[29]

Compared to our data, which show that just 13% of pregnant females have appropriate vitamin D levels, a study by Perez et al. found that only 35.9% of pregnant women in the first trimester had adequate serum vit d levels greater than 30 ng/mL. The time of year when the serum was sampled was also determined to be significant, in line with earlier research that indicated lower vitamin D levels in the winter than in the summer. Since the current study largely examined the first trimester of pregnancy, it is possible that variations in 25(OH)D concentrations only become noticeable in the third trimester.[30]

Conclusion

Chondromalacia patellae in pregnancy is associated with Vitamin D deficiency in pregnant females. In our investigation, there was a strong inverse relationship between serum vitamin D levels and the intensity of pain in the knee joints. In order to properly treat PFPS and the resulting dysfunction, it is advised that target populations be given vitamin D supplements, that appropriate food and lifestyle be supported during pregnancy, and that musculoskeletal disorders should be modified. Extensive research conducted in many geographic regions is required to determine the precise impact of vitamin D on the health of expectant mothers.

Limitations of the study: First, there is no control group comparison in the statistical results since the study group consisted entirely of patients with anterior knee discomfort. we were unable to review the participants' use of vitamin D supplements, which is another drawback. Determining the vitamin D status in the first and second trimesters, as well as the third trimester, would be helpful in indicating any potential connections between vitamin D and pregnancy associated anterior knee discomfort.

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