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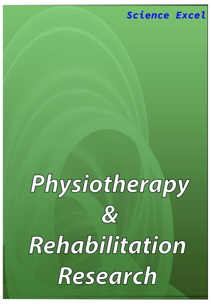

Impact of Vitamin D Deficiency on Corneal Health upon Children with Rickets

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Abstract

Background: *Vitamin D is crucial for enhancing general health, particularly in the development of strong bones and bolstering the immune system. In children, a substantial deficiency of vitamin D can lead to a condition known as rickets, characterized by weakened bones and skeletal abnormalities. While extensive research has been conducted on the impact of rickets on the musculoskeletal system, there is limited investigation into the effects of vitamin D deficiency on ocular health, specifically focusing on the cornea of the eye. This research aims to investigate the consequences of vitamin D deficiency on the cornea in children diagnosed with rickets.*

Objectives

1-To identify any effect on corneal or structural changes associated with vitamin D deficiency in these children.

2-To find relationship between vitamin D levels and corneal health.

Methodology: *A case-control study design to identify the impact of vitamin D deficiency on the corneal health in children diagnosed with rickets the study started from OCT20th, 2023 to Jan 5,2024 The study was carried out in pediatric clinics and hospitals across various locations in the Kurdistan Region and Najaf city of Iraq, with the informed consent of the children's parents being obtained such as Rehabilitation center, a nutrition clinic counseling from pediatric and ophthalmology center test*

A purposive sample of (50) child divided into two groups. The first group comprised 25 children (13 males and 12 females) diagnosed with rickets, selected from a nutrition clinic along with their parents and received counseling from pediatric and ophthalmology center test during the data collection period. The second group consisted of 25 healthy children (13 males and 12 females). The Questionnaire for this current study was gathered and conducted using study instruments to assess serum levels of Vitamin D, Calcium, and phosphate, along with ophthalmological evaluations. Additionally, participants will be given a questionnaire to gather variable's on their dietary pattern sun exposure, and lifestyle factors. Data were analyzed using SPSS 27. Descriptive statistics of range, mean and standard deviation were used, in addition to inferential statistic such as t-test to find significant difference in means. A p value less than 0.05 were considered significant.

The results of study reveal that the mean of vitamin D level in study group was found to be 9.1 ng/mL, significantly lower than the control group mean of 60.0 ng/mL ($p<0.001$). the study observed a marked difference in the mean calcium levels, where the patient group exhibited a mean of 1.3 compared to the control group's mean of 2.0 ($p<0.001$). Similarly, the mean phosphate levels in the patient children group were 1.3, significantly lower than the control children group mean of 2.2 ($p<0.001$).

Conclusion & Recommendation: *The mean vitamin D level in the study group was found to be 9.1 ng/mL, significantly lower than the control group mean of 60.0 ng/mL ($p<0.001$). the study observed a marked difference in the mean calcium levels, where the patient group exhibited a mean of 1.3 compared to the control group's mean of 2.0 ($p<0.001$). Similarly, the mean phosphate levels in the patient children group were 1.3, significantly lower than the control children group mean of 2.2 ($p<0.001$). according to this finding it is recommends to emphasize on post natal care for children to give immunization and give good nutrition with exposure to sun in morning*

Introduction

Vitamin D insufficiency is widespread on a global scale, with approximately half of the world's population displaying diminished levels [1,2] of this essential nutrient. Vitamin D, a fat-soluble pro hormone, is initially generated in the skin through exposure to sunlight and undergoes conversion into its active form through various metabolic processes. The liver catalyzes the first hydroxylation, leading to the synthesis of 25-hydroxyvitamin D (25(OH)D), also known as calcidiol. Subsequent hydroxylation in the kidneys transforms calcidiol into 1,25-dihydroxy vitamin D3 (1,25(OH)2D), or calcitriol. responsible for most biological actions [3]. Recent consideration of the serum level of 25(OH) D as the primary indicator of vitamin D status in the body reveals a range of

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25 to 80 ng/mL.[4]. Vitamin D, a steroid hormone, possesses a broad range of functions in human physiology, extending beyond its primary role in maintaining calcium homeostasis. It significantly influences immunomodulation, cellular differentiation, and proliferation [5]. The well-established immune modulatory effects of vitamin D are pertinent to both ocular surface immune cells and structural cells. Notably, the involvement of vitamin D in ocular surface disorders like dry eye disease (DED), keratoconus (KC), and post-surgical outcomes has garnered considerable and merited attention [6]. Clinical and experimental evidence indicates that vitamin D supplementation effectively enhances DED outcomes [7]. This improvement is attributed to the anti-inflammatory properties of vitamin D, which are deemed essential in the management of ocular surface conditions such as DED and KC. Furthermore, vitamin D exhibits a multifaceted role in corneal wound healing by virtue of its anti-inflammatory characteristics and its ability to remodel the extracellular matrix [8]. Patients with DED should be pro-actively screened for vitamin D status. Those with VDD should be treated as per the standard guidelines. The daily recommended dose of vitamin D supplementation depends on age of the individual, presence of risk factors for VDD,. The Institute of Medicine (IOM), USA, and the US Endocrine Society (ES) gave slightly differing definitions of VDD, 20 ng is considered as deficiency as per IOM, whereas ES considers serum vitamin D less than 30 ng as deficiency. This dissimilarity in the considerations of deficiency explains the differences in the recommended dietary intakes between the two committees. The Indian Council of Medical Research (ICMR) suggests recommended daily intake of 400 IU/day [9]. But, this amount of intake may be inadequate due to changes in lifestyle and increased time spent indoors by the population. The upper tolerable limit of supplement dose (oral 4000 IU per day in healthy individuals) should also be kept under consideration to avoid the risk of toxicity [10]. The daily supplement dose in healthy individuals is lower than the doses recommended for the deficient individuals [11]. This difference in the doses should be considered before suggesting the supplementation since high doses of supplementation in healthy individuals with normal serum levels of vitamin D can cause vitamin toxicity [12]. Similarly, one should strictly adhere to the duration of high dose supplementation in vitamin D-deficient individuals, since prolonged high dose supplementation could lead to vitamin D toxicity and hyperkalemia [13].

Methodology

Study design

A Descriptive case- control study was adopted in order to achieve the objectives the study began from OCT20th, 2023 to Jan 5,2024.

Study setting

The study was conducted in AL-Najaf city and Kurdistan region selected from a nutrition clinic along with their parents and ophthalmology center test also from Rehabilitation center

Study sample

Anon probability (purposive sample) of 25 children with mothers as case group and 25 healthy children as control group Tools and methods used for data collection

The instrument used the questionnaire forma consisted of many parts such as Age of children ,dietary pattern, sun exposure, and lifestyle factors. The methods used to assess serum levels of Vitamin D, Calcium, and phosphate, along with ophthalmological evaluations

Statistical analysis

Data were analyzed using SPSS 27. Descriptive statistics of range, mean and standard deviation were used, in addition to inferential statistic such as t-test to find significant difference in means. A p value less than 0.05 was considered significant.

Results

Results age range of 2.0 to 15.0 years, representing a mean age of ± 7-1, and a standard deviation of 3.9. Table 1 presents a summary of the demographic characteristics of the subjects. The mean vitamin D level in the patient children group was found to be 9.1 ng/mL, significantly lower than the control group mean of 60.0 ng/mL ($p<0.001$). Additionally, the mean vitamin D level in the case group was 16.8 ng/mL, in contrast to the control group with a mean of 86.0 ng/mL ($p<0.001$). Furthermore, the study observed a marked difference in the mean calcium levels, where the case group exhibited a mean of 1.3 compared to the control group's mean of 2.0 ($p<0.001$). Similarly, the mean phosphate levels in the case group were 1.3, significantly lower than the control group mean of 2.2 ($p<0.001$).

The outcomes were juxtaposed between two cohorts in the study, wherein the control group comprised 25 children exhibiting overall good health, while the case group consisted of 25 children afflicted with rickets and experiencing visual impairment characterized by retinal blurriness. Figure 1 illustrates the Vitamin D levels in cases as compared to controls, while Figure 2 displays the Vitamin D levels in mothers of cases compared to mothers of controls. Additionally, Figure 3 demonstrates the Calcium levels in cases versus controls, and Figure 4 depicts the Phosphate levels in cases compared to controls.

Discussion

The impact of vitamin D deficiency on corneal health in children with rickets is a multifaceted issue that involves both

Table 1. *Comparison of the findings in rickets cases with that of the controls (n=25)*

	Cases (n=25)				**Controls (n=25)**				**P value**
	Min.	**Max.**	**Mean**	**SD**	**Min.**	**Max.**	**Mean**	**SD**	
Age (years)	2.0	15.0	7.2	3.9	2.0	15.0	7.1	3.9	0.943
Calcium	0.9	1.8	1.3	0.3	2.0	2.7	2.2	0.2	< 0.001
Phosphate	0.8	1.4	1.2	0.2	0.7	1.5	0.9	0.2	< 0.001
Vitamin D child	8.0	10.0	9.1	1.0	32.0	60.0	40.0	7.3	< 0.001
Vitamin D mother	10.0	22.0	16.8	3.3	48.0	86.0	67.8	12.2	< 0.001

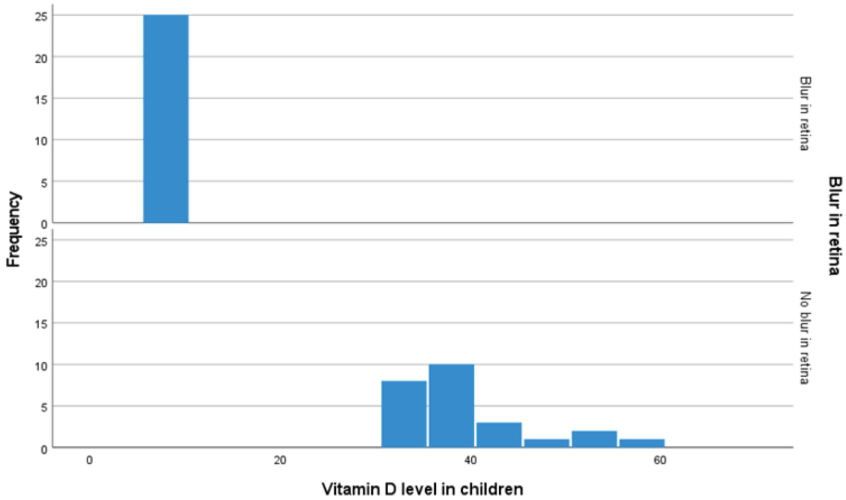

Figure 1. *Vitamin D level in cases compared to controls*

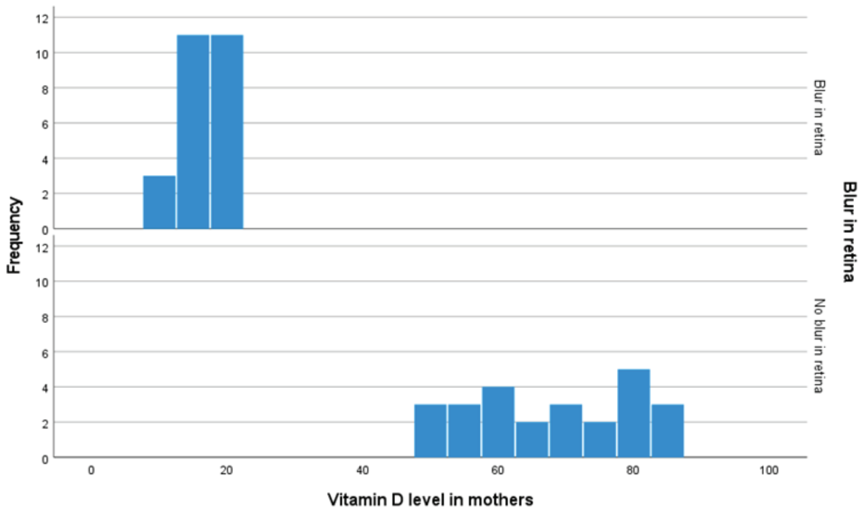

Figure 2. *Vitamin D level in mothers of cases compared to mothers of controls.*

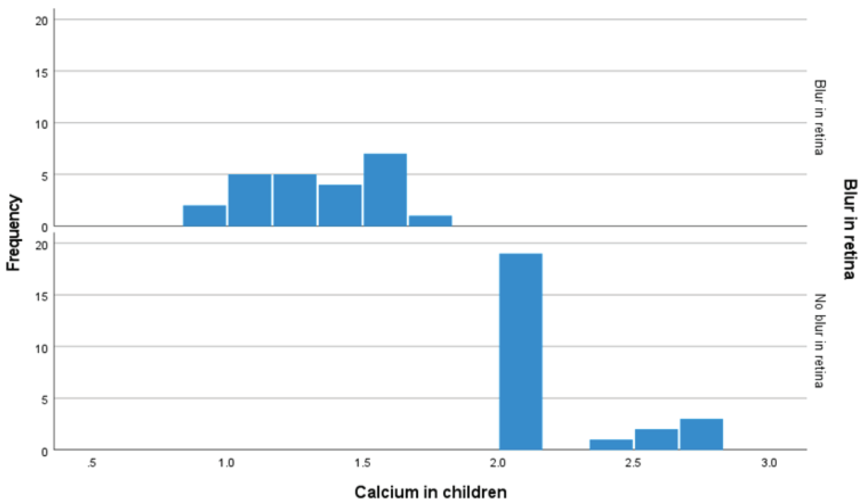

Figure 3. *Calcium level in cases compared to controls.*

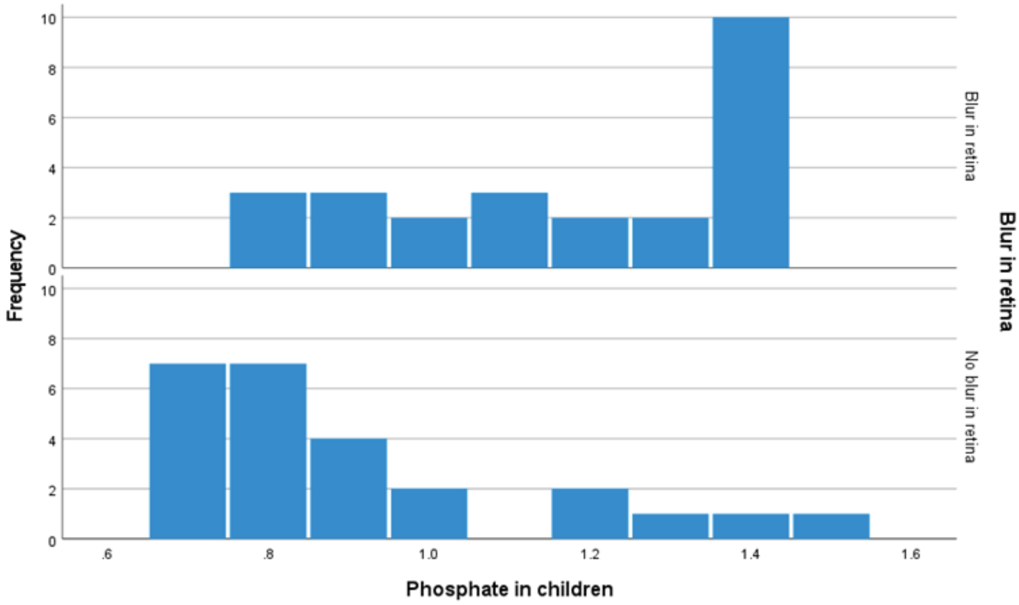

Figure 4. *Phosphate level in cases compared to controls.*

the musculoskeletal system and the ocular system. Rickets is a condition primarily caused by a deficiency in vitamin D, calcium, or phosphate, leading to weakened and deformed bones. The relationship between vitamin D deficiency and corneal health in these children is an important aspect to consider, as vitamin D plays a crucial role in maintaining overall health, including bone and eye development. This was further illustrated by the evident findings presented in Table 1, along with graphical representations and an explanation of the distinctions among vitamin D deficiency, rickets in children, and retinal and portal eye diseases.

Conclusion

Vitamin D deficiency (VDD) plays a noteworthy role in the development of Dry Eye Disease (DED). Adhering to these recommendations and proficiently addressing VDD in individuals afflicted with DED can forestall the exacerbation of the condition and mitigate post-operative complications. Guaranteeing adequate vitamin D levels in patients with ocular disorders represents a clinically prudent prophylactic approach, as it enhances the innate defense mechanisms of the human body and facilitates the resolution of diseases.

Role of Vitamin D in bone health: Discuss the fundamental role of vitamin D in promoting the absorption of calcium and phosphate in the gut, which is essential for bone mineralization.

Emphasize how rickets, as a consequence of vitamin D deficiency, can result in skeletal deformities and compromised bone strength in children.

Impact on corneal health: Examine the potential implications of vitamin D deficiency on the cornea, considering that the cornea is a transparent, avascular tissue that plays a vital role in vision.

Explore the existing literature and studies that may indicate a connection between vitamin D deficiency and corneal abnormalities in children with rickets.

Ocular manifestations of rickets: Highlight any known ocular manifestations associated with rickets, such as changes in the structure or function of the cornea.

Discuss how vitamin D deficiency may contribute to alterations in the ocular tissues and whether these changes are reversible with vitamin D supplementation.

Possible mechanisms of corneal involvement: Investigate potential mechanisms through which vitamin D deficiency might affect corneal health, considering factors like inflammation, immune response, or altered cellular processes.

Examine if there is a direct impact on the corneal structure or if the effects are secondary to systemic issues related to rickets.

Preventive measures and treatment: Discuss strategies for preventing vitamin D deficiency in children, including dietary interventions and sunlight exposure.

Explore the role of vitamin D supplementation in the management of rickets and its potential positive effects on both bone and corneal health.

Interdisciplinary approach: Emphasize the need for collaboration between pediatricians, ophthalmologists, and other healthcare professionals to address both the musculoskeletal and ocular aspects of rickets in children.

Consider the importance of early detection and intervention to prevent long-term complications.

Research gaps and future directions: Identify any gaps in the current understanding of the relationship between vitamin D deficiency, rickets, and corneal health in children.

Suggest potential areas for future research to further elucidate the mechanisms and explore more effective interventions.

In conclusion, the impact of vitamin D deficiency on corneal health in children with rickets is a complex issue that requires a comprehensive understanding of the interactions between vitamin D, bone health, and ocular development. Addressing this issue involves not only treating the underlying vitamin D deficiency but also considering the specific needs of the ocular system in affected children.

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