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ORIGINAL ARTICLE

Frequency of Vitamin D Deficiency in Children with Tuberculosis

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ABSTRACT

Objective: To find the frequency of vitamin d deficiency in children with tuberculosis**.**
Study Design: Case control study
Place and Duration of Study: Department of Pediatric Medicine Unit 2, Sandeman Provincial Hospital, Quetta from 1st December 2021 to 31st May 2022.
Methodology: One hundred children from 1 to 15 years which were divided into two groups. Group A had 50 patients/children suffering from tuberculosis while Group B had 50 healthy controls. A 2cc blood was withdrawn for the vitamin D3 testing. The results and confounding factors for vitamin D deficiency were compared within both groups.
Results: The mean age of the cases and controls was 7.5±2.3 and 4.2±1.2 years respectively. There were more boys in cases with vitamin D deficiency while higher number of girls was observed in the vitamin D deficient controls. The Vitamin D levels of children with tuberculosis were compared with the controls and it was observed that 34% cases with severe vitamin D deficiency and 32% with mild vitamin D deficiency where a significant variance of controls results was noticed with 20% and 24% cases of severe and mild vitamin D deficiency.
Conclusion: The frequency of vitamin D deficiency in children with tuberculosis was 66% reported.
Keywords: Frequency, Vitamin D deficiency, Children, Tuberculosis

INTRODUCTION

Vitamin D is a seco-steroid which is related in various anti-inflammatory, anti-proliferators processes in addition to regulation of bone calcium levels. Vitamin D has two main forms Vitamin D2 and D3. The D3 form is produced under the skin through the activation of sunlight where as D2 is produced in some plants. The major source of vitamin D in our body is through vitamin D3 as 25(oh) vitamin D3. Within the last decade the role of vitamin D3 has been highlighted in various diseases and conditions with positive outcomes on overall health system.[1-5]

There is a major conflict in the definition of vitamin D deficiency in the blood system. Majority of the researches reports a level <50nmol/L or as 10ng/ml to be defined as deficient. The deficiency of vitamin D (Vitamin D3) is seen to be highly prevalent all over the globe with many factors contributing to its deficiency. Countries like Pakistan which are near equator are also having a high level of vitamin D deficiency due les sun exposure of population, high melanin levels, low vitamin D sufficient diet as well as excessive smog causing reduction in UV light.[6-8]

Tuberculosis (TB) due to mycobacterium tuberculosis in children is a leading disease in developing and under developed countries. Vitamin D regulates its effects through vitamin D receptor which are immunomodulatory and are present on various dendritic cells, as well as endothelial cells. Post-exposure of the macrophages with vitamin D receptor the expression of various cytokine has been observed in literature. Out of these cytokine two namely, cathelicidin and b-defensin, which are antimicrobial peptides results in stimulation of autophagy of n Mycobacterium tuberculosis. However, in cases where the body is already deficient of vitamin D this process is compromised.[9-11]

In the present study the association between tuberculosis with vitamin D deficiency in children was observed for a complete understanding and better health management of the cases. The results of the study will assists in providing better treatment plan for the patients suffering from tuberculosis at very early age stage of their life.

MATERIALS AND METHODS

This case control study conducted at Department of Pediatric Medicine Unit 2, Sandeman Provincial Hospital Quetta from 1st December 2021 to 31st May 2022. The study included children from 1 to 15 years. A total of 100 children were included in the study which was divided into two groups. Group A had 50 patients/children suffering from tuberculosis while Group B had 50 healthy controls with no tuberculosis in them. The sample size was calculated by using WHO sample size calculator where 80% power of test and 95% CI was considered with 5% margin of error. Exclusion criteria consisted of all cases of severetuberculoma, autoimmune disorders or any other congenital abnormalities. An informed consent was taken from the parents and guardians of each patient and control. Each child was completely tested for the presence tuberculosis in them through sputum analysis. A 2cc blood was withdrawn for the vitamin D3 testing. The blood was converted into serum and the serum was separated by centrifugation of the clotted blood at 3000 rpm. A complete clinical history documentation as well as of factors related with vitamin D levels including sun exposure, urban or rural residency, as well as familial history was performed through a well structure questionnaire. A comparison of the tuberculosis cases with the healthy controls in context with their vitamin D levels was made and analysis was interpreted through SPSS-26. Chi square tool as well as odds ratio was used for analysis with a p value <0.05 taken for significance.

RESULTS

The mean age of the cases and controls was 7.5±2.3 and 4.2±1.2 years respectively. There were more boys in cases with vitamin D deficiency while higher number of girls was observed in the vitamin D deficient controls. A strong relation of sun exposure with vitamin D deficiency could be observed (Table 1).

The vitamin D levels of children with tuberculosis were compared with the controls and it was observed that 34% cases with severe vitamin D deficiency and 32% with mild vitamin D deficiency where a significant variance of controls results was noticed with 20% and 24% cases of severe and mild vitamin D deficiency (Fig. 1).

The odds ratio of cases verses controls showed that there was a higher number of cases in <50nmol/L than of controls with a comparison of 66% to 44% and having and odds ratio as 3.125. A confidence interval ranging from 1.13-8.7 was observed in comparison of deficient verses sufficient vitamin D levels in cases and controls (Table 2).

There was no significant difference in the urban and rural resident vitamin D levels, however there was a high number of cases who were receiving less sun exposure than those having higher sun exposure. There were 60% cases with low socioeconomic status (Table 3).

Table 1: Association of demographic characteristics with vitamin D deficiency in cases and controls

Variables	Vitamin D levels				P value
	Cases		Controls		
	<50nmol/L	>50nmol/L	<50nmol/L	>50nmol/L	
Age (years)					
1-5	12 (24%)	5 (10%)	10 (20%)	11 (22%)	0.045
6-10	17 (34%)	5 (10%)	7 (14%)	10 (20%)	0.003
11-15	4 (8%)	7 (14%)	5 (10%)	6 (12%)	0.65
Gender					
Boys	19 (38%)	10 (20%)	10 (20%)	18 (36%)	0.042
Girls	14 (28%)	7 (14%)	12 (24%)	10 (20%)	0.051
Sun Exposure					
Low	23 (46%)	7 (14%)	14 (28%)	5 (10%)	0.032
High	11 (22%)	9 (18%)	8 (16%)	23 (46%)	0.002
Tuberculosis Familial History	6 (12%)	4 (8%)	--	--	--

Table 2: Odds Ratio of cases versus control in association with vitamin D levels

Vitamin D (nmol/L)	Cases		Controls		Odds Ratio	95% CI	P value
	No.	%	No.	%			
<50	33	66%	22	44%	3.125	1.13-8.7	0.0282
>50	17	34%	28	56%			

Table 3: Factors effecting vitamin D levels in cases

Variables	No.	%	P value
Residents			
Urban	23	46	0.71
Rural	22	44	
Sun Exposure			
Less	30	60	0.049
High	20	40	
Socioeconomic status			
Low	30	60	0.042
Mediocre	17	34	
High	03	06	
Tuberculosis familial history	10	20	--

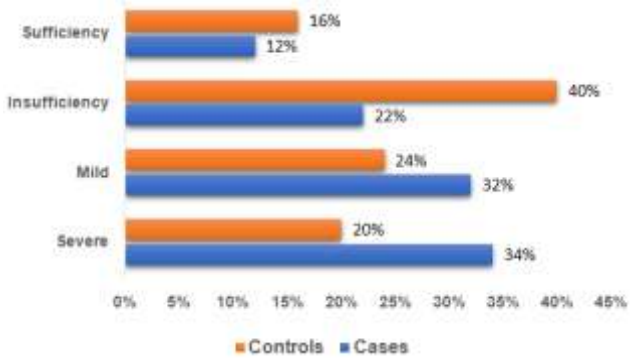

Fig. 1: Comparison of vitamin D levels of cases and controls

DISCUSSION

The present study was conducted on toddlers and children who were suffering from tuberculosis. The results of their study were compared with those of clinically healthy control children in the same age group. It was observed that male children were more prone to tuberculosis than female children. Similar findings have been reported by Stival et al. (12) in a cohort study on tuberculosis in children in Tuscany.

Vitamin D deficiency may be a contributing factor in the development of Mycobacterium tuberculosis due to the justification that vitamin D is involved in various immune pathways. Its deficiency causes decreases in immunity and production of chemokines, as well as activation of dendritic cells and alterations in T cell activation. Children in developing countries with vitamin D deficiency have a higher risk of developing tuberculosis in them.[13-16]

In this study, it was also observed that familial history as well as socioeconomic status were major contributing factors in the development of vitamin D deficiency in addition to sun exposure. Several studies have reported similar findings, highlighting contributing factors such as those mentioned above for the development of vitamin deficiency and increasing children's susceptibility to tuberculosis.[17-21]

Similarly, there are a few confounding factors that have also been researched and found to be associated with facilitating the formation of tuberculosis in children. These factors interact with vitamin D deficiency pathogenic pathways, resulting in the development of tuberculosis in children.[22]

CONCLUSION

In infants, children, and toddlers, a lack of vitamin D and an increased risk of tuberculosis is associated with each other in a significant way. 66% of youngsters diagnosed with tuberculosis were found to have vitamin D insufficiency, according to the reports.

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