

# Frequency of Vitamin D Deficiency in Pediatric Fractures Presenting to A Tertiary Care Hospital

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## Authorship and contribution Declaration:

Each author of this article fulfilled ALL 04 Criteria of Authorship:

1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
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## ABSTRACT

**Objective:** Majority of childhood fractures occur due to high impact trauma and immediate fracture management is crucial for future healing process. While treating fractures in children it is often a missed opportunity to assess osteopenia risk factors such as poor calcium intake, vitamin D deficiency, and sedentary life style. However, many fractures are related to bad bone health. This study aims to estimate the burden of vitamin D deficiency (VDD) in pediatric population with fracture, so that timely intervention and strategy to replace vitamin D can be taken.

**Methods:** This study was conducted at Department of Orthopedic and Accident and Emergency Department, Jinnah postgraduate medical center, Karachi, from July 2019 to June 2020. Three hundred and forty five pediatric patients with fracture confirmed by X-ray were included to observe the vitamin D deficiency. Blood sample was taken from the accessible peripheral vein in vacutainer without additives. Serum 25(OH) D was measured and all the information were recorded in predesigned proforma.

**Results:** The average age of the children was  $9.10 \pm 3.76$  years 317 (91.88%) were boys and 28 (8.12%) girls. Frequency of vitamin D deficiency in pediatric fractures was observed in 34.20% (118/345). Rate of VDD was significantly high in those children whose BMI was less and equal to  $20 \text{ kg/m}^2$ . Duration of fracture, cause of fracture and traumatic cause were also stratified for VDD but insignificant difference was observed.

**Conclusion:** The results of this study concluded that, vitamin D deficiency in pediatric population presenting with bone fractures is very high. Physicians who treat such children should take proper dietary history and notify the patient and their parents about the high level of prevailing vitamin D deficiency. The clinician should also advice regarding vitamin D supplementation and also notes the presence of potential risk factors. Vitamin D measurement and appropriate replacement can be considered in children who present with a fracture.

**Keywords:** Vitamin D, Vitamin D deficiency, Pediatric fractures, Serum 25(OH)D

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## INTRODUCTION

A large number of bone fractures are reported during childhood and fractures are one of the commonest cause of morbidity in children.<sup>1</sup> Boys tend to suffer more from fractures as compared to girls.<sup>2</sup> Increased physical activity, participation in competitive sports and the relatively low levels of bone mineralization of the skeleton during childhood may contribute to the high fracture rate.<sup>3</sup> Although most researchers have focused on adulthood fractures, there is emerging evidence that childhood fractures may be the initial insult that lead to lifelong bone fragility and increased incidence of fractures late in life.<sup>4</sup>

It has been observed that most of the time fractures occur due to high impact trauma like road traffic accident or a fall.<sup>5</sup> Because of the acute nature of problem the focus is on instantaneous bone break management, and the

serum level of vitamin D is often overlooked in pediatric population.

In the early part of life, the rate of bone formation needs to be greater than the rate of bone resorption for adequate mineralization of growing bones. This process of bone formation requires ample amounts of calcium and phosphate; if amounts of either are insufficient then the process of bone formation and mineralization is slowed down leading to decreased bone strength and density. Vitamin D is required for proper absorption of dietary calcium and phosphate.<sup>6</sup>

Although the prevalence of VDD in the general population has already been described in detail<sup>7</sup>, the prevalence of VDD in the pediatric fracture population is shown to vary from 8% to 47%.<sup>8,9</sup> Another difficulty in the diagnosis of vitamin D deficiency is that we cannot depend on X-rays as the radiologic signs may be very weak or not

present at all in cases of children even with severe deficiency of vitamin D in blood. This problem is even more important in children younger than 1 year.<sup>10</sup>

Vitamin D deficiency is on the rise throughout the world, such that it is now regarded as an endemic.<sup>11</sup> Pakistan is an under developed country which is facing a lot of economic problem, out of them nutritional deficiency is a major concern. Vitamin D deficiency is also prevalent in Pakistan<sup>12</sup>; but the total burden of VDD in Pakistani population, especially in children with fracture is underestimated. If vitamin D is not replenished timely then younger children suffer from rickets and bones have reduced strength and density in older children, making them more susceptible to fractures. There is very limited data available from Asia subcontinent including Pakistan for this issue. Finding VDD in this age group is crucial as replacing vitamin D in such patients has significant impact on fracture healing as well as bone growth. This study aims to estimate the burden of VDD in pediatric population with fracture, so that timely intervention can be made and strategy can be made to replace vitamin D prophylactically.

### METHODS

This cross-sectional study was done at Department of Orthopedic and Accident and Emergency Department, Jinnah postgraduate medical center, Karachi from July 2019 to June 2020. This study included 345 patients. EPI info sample size calculator was used for sample size calculation where Desired precision= 0.5%, Expected prevalence=34%<sup>13</sup> and Confidence level= 95%. Non-probability, consecutive sampling technique was used.

Patients of both genders, with age between 6 months and 16 years who presented with traumatic or non-traumatic fractures of any bone confirmed by X-ray were included in this study. Patient with associated illnesses as Tuberculosis, Chronic Liver Diseases, chronic renal failure and malabsorption syndrome, primary or secondary tumors involving bone, (osteosarcoma, leukemia or lymphoma), endocrine disorders, (Hyperparathyroidism, Cushing syndrome) and patients taking medication, (Vitamin-D supplement, Calcium supplement or steroids) were excluded from the study.

All the patients presented with fracture, fulfilling the inclusion criteria were included this study. The idea and method of the study was explained and an informed consent was taken from the patients or attendant of the patient. A comprehensive history was taken and thorough examination of the musculoskeletal system was done. Pre-approved Performa was used to collect and document data. All data was kept confidential.

5 cc blood sample was taken from the accessible peripheral vein in vacutainer without additives, Greiner Bio-One Vacuette, and centrifuged for 10 min within 30 min of collection. The obtained serum was stored at -80°C until further analysis. Serum 25(OH)D was measured by electro chemiluminescence immunoassays (ECLIAS) on the automated Elecsys e601 analyzer (Roche Diagnostics, Switzerland). Vitamin-D deficiency was labeled if Serum Vitamin-D level <30 ng/dl. (Normal is >30 ng/dl).

Statistical analysis was done using SPSS version 20. Mean and standard deviation was calculated for variables like age, weight, height, BMI, duration of fracture and vitamin D level. Frequency and percentage were calculated for gender, cause of fracture, obesity and vitamin D status. Stratification was done to see the effect of age, gender, obesity, duration of fracture and cause of fracture on the outcome. Chi-square test was applied. P-value <0.05 was taken as significant.

### RESULTS

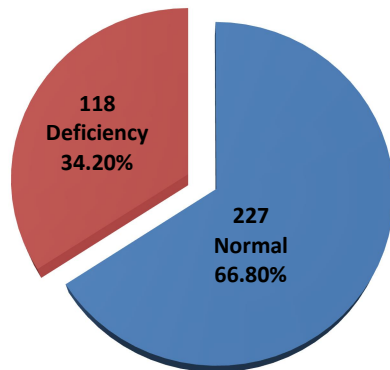
Three hundred and forty five pediatric patients with fracture confirmed by X-ray were included to observe the vitamin D deficiency. The average age of the children was 9.10±3.76 years. Maximum number of patients 221(68.06%) were 6 to 10 years of age. In our study population, 317 (91.88%) were boys and 28 (8.12%) girls. Other demographic and clinical finding was also reported in table 3. 306(88.7%) cases had traumatic causes and 39(11.30%) non-traumatic causes of fracture. Out of 306 traumatic, cases, most of them were due to road traffic accident 198(64.71%), followed by fall 56 (18.30%) and assault 52(15.99%). Other descriptive statistics of patients is presented in table 1.

**Table 1:** Descriptive statistics of patients

Variables	Mean	Std. Deviation	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
Age (years)	9.10	3.76	8.72	9.49
Weight (kg)	23.53	5.13	22.99	24.07
Height (cm)	103.08	13.30	101.67	104.49
BMI (kg/m <sup>2</sup> )	22.16	3.05	21.84	22.49
Duration of fracture	1.88	0.68	1.81	1.96
Vitamin D level	29.33	10.72	28.20	30.47

**Table 2:** Correlation of age, gender, BMI, duration of fracture and cause of fracture with vitamin D deficiency in children presenting with fractures.

Variables	VITAMIN D DEFICIENCY		Total	P-Value
	Yes	No		
<b>Age Groups (Years)</b>				
≤ 5	3(25%)	9(75%)	12	0.674
6 to 10	74(33.5%)	147(66.5%)	221	
11 to 16	41(36.6%)	71(63.4%)	112	
<b>Gender</b>				
Male	113(35.6%)	204(64.4%)	317	0.057
Female	5(17.9%)	23(82.1%)	28	
<b>BMI (kg/m<sup>2</sup>)</b>				
≤ 20	37(45.1%)	45(54.9%)	82	0.020
21-25	79(31.6%)	171(68.4%)	250	
>25	2(15.4%)	11(84.6%)	13	
<b>Duration of fracture</b>				
< 1 month	19(33.3%)	38(66.7%)	57	0.916
1 to 2 months	82(34.9%)	153(65.4%)	235	
>2 months	17(32.1%)	36(67.9%)	53	
<b>Cause of Fracture</b>				
Traumatic	106(34.6%)	200(65.4%)	306	0.727
Non-Traumatic	12(30.8%)	27(69.2%)	39	
<b>Traumatic cause</b>				
Fall	15(26.8%)	41(73.2%)	56	0.190
RTA	76(38.4%)	122(61.6%)	198	
Assault	15(28.8%)	37(71.2%)	52	



Frequency of vitamin D deficiency in pediatric fractures was observed in 34.20% (118/345) as presented in figure 1.

**Figure 1:** Frequency of vitamin d deficiency in pediatric fractures

Rate of VDD was not significant among different age groups. It was also not significant between genders Rate of VDD was significantly high in those children whose BMI was below and equal to 20 kg/m<sup>2</sup>. Duration of fracture, cause of fracture and traumatic cause were also stratified and observed for VDD but insignificant difference was observed as shown in table 2.

## DISCUSSION

Trauma has remained the leading cause of death and morbidity in the world over and it is a major contributor to health cost. It has also been reported to be the commonest cause of death and morbidity among persons less than 19 years of age<sup>14</sup>. In low income countries like Pakistan major issues related to children’s health are considered to be infections and malnutrition. Pediatric trauma is often overlooked and as such is given lesser attention. Trauma has been recognized as a major cause of morbidity, mortality and disability in childhood. Fractures are one important component of pediatric trauma.<sup>15</sup> As the majority of fractures reported in children are due to trauma, the focus remains upon on immediate fracture management. The clinicians miss an opportunity to assess pediatric age population for avertible risk factors of fractures such as vitamin D deficiency, poor dietary calcium intake and inactive lifestyle.

The incidence of VDD has been amplified, and now it has become an endemic in many parts of the world.<sup>16</sup> Vitamin D deficiency has been widely reported in all age groups in recent years. Centers in Karachi and Lahore recently reported a prevalence of VDD of 92% and 81% in OPD patients.<sup>17,18</sup>

To determine the frequency of Vitamin D deficiency in pediatric fractures, 345 pediatric patients, from 6 months to 16 years of age, with fracture confirmed by X-ray were included in this study. The average age of patients in our study was 9.10±3.76 years. We found out of 345 patients 91.88% were male and 8.12% were females. These results

are supported by a study done in UK by Barlas K et al.<sup>19</sup> The mean age was of 9.0 years and 83% fractures occurred in males. The finding of male preponderance in pediatric fractures is also in line with records with other studies.<sup>20,21</sup> The fractures were more common in boys because they were more active, mobile and exposed to more traumas and are more likely to take risks. In our study the fractures occurred most commonly in the age group of 6-10 yrs. This could be because children are very active, playful and also careless in this period of age. In a local study conducted by Khan MA et al<sup>22</sup>, 71.7% of children were of 5-10 year of age with a mean age of 8.6 years. Our study agrees with other studies<sup>23,24</sup> that RTA is the most common cause of paediatric fracture (64.7%). However a study of paediatric fractures by Tahir and Hassan<sup>25</sup> found fall related incidents to be responsible for 75% of fractures in children seen in that environment while RTA accounted for only 23%. The difference in the prevalence of etiological factors between our study and others can be explained by the differences in road traffic density and vast cultural differences between the countries where the studies were conducted.

It is a proven fact that bone fractures occur due to low bone mineral level. Several investigators have suggested that the decreased mineral content of bones due to modifiable factors such as poor diet and decreased physical activity along with various genetic factors is associated with increased risk of fractures in normal children<sup>26,27</sup>. In our study the frequency of VDD in pediatric fractures was observed in 34.20% cases. A study was done by Al-Daghri et al. regarding the level of vitamin D in Saudi children. It included 234 cases with bone fracture and 1022 controls without bone fracture. The results of this study showed that children with history of bone fracture had lower the levels of 25 (OH) vitamin D than that of the controls.<sup>28</sup> Another researcher in Australia worked on the prevalence of vitamin D deficiency in children (2 to 17years). It consisted of 163 cases, 57 children (35%) had vitamin D levels less than 50 nmol/L, which 45 cases had moderate deficiency and 11 cases had mild deficiency. It was recommended to measure the level of vitamin D is for all children who present with bone fracture.<sup>23</sup> Our study found a significant correlation between BMI and VDD, p-value 0.02. A study by Ryan et al. tested for vitamin D level in African-American children with forearm fracture; 74 children were taken as controls, without forearm fracture while 76 cases had forearm fracture. This study showed that low serum vitamin D level, and obesity was associated with forearm fracture in children.<sup>26</sup>

## CONCLUSION

The results of our study revealed that children with bone fractures had high prevalence of vitamin D deficiency i. Physicians who treat such children should take proper dietary history and notify the patient and their parents about the high level of prevailing vitamin D deficiency. The clinician should also advice regarding vitamin D supplementation and also notes the presence of potential

risk factors. Vitamin D measurement and appropriate replacement can be considered in children who present with a fracture.

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