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NOT ONLY VITAMIN D BUT HAEMOGLOBIN IS ALSO ASSOCIATED WITH ARM FRACTURES IN PAEDIATRIC PATIENTS!!

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Abstract

Introduction:

Vitamin D deficiency usually linked with skeletal complications includes rickets, bone deformities, osteoporosis and fractures. The aim of the present study was to determine the prevalence of vitamin D deficiency in under 6 years paediatric patients presented with radiographically confirmed fracture of upper arm extremity.

Material and methods

This cross-sectional descriptive study was conducted at a tertiary care centre in western Maharashtra between Jan 2019 to Dec 2021. All pediatric patients under 6 years with radiographically confirmed fracture of upper extremity during the study period were compared with collected serum levels of 25(OH) vitamin D and haemoglobin by using an electronic statistical package SPSS software version 23.0 (SPSS, IBM, Chicago, IL, USA).

Results

A total of 62 children were enrolled in the study. In our study, almost three fourth (47, 75.8%) of children with upper extremity fracture were deficient (< 20ng/ml) in serum levels of 25(OH) vitamin D. The statistical comparison of median serum haemoglobin level and mode of injury by using Mann Whitney U test was significant, p-value = 0.002 whereas, statistical comparison of median serum levels of 25(OH) vitamin D and mode of injury was found to be non-significant, p-value = 0.133.

Conclusion

We found almost 75% children in our study were suffering from Vit D deficiency. However, this study showed a potentially important association between low serum haemoglobin levels and fracture due to low impact injury in children. This finding opens-up a window of opportunity for research on the effect of haemoglobin and possibly nutritional status on bone health.

Keywords: Vitamin D deficiency, Low impact upper extremity fractures, Low Hemoglobin, Arm fracture, High versus Low impact fracture, Anemia

Introduction

Vitamin D is fat-soluble vitamin responsible for intestinal absorption of calcium, magnesium, and phosphate, and many other biological effects.[1][2][3] It's deficiency most commonly occurs in paediatric age group when they have inadequate sunlight exposure. Inadequate nutritional intake of vitamin D, disorders limiting vitamin D absorption and some conditions which inhibits vitamin D conversion into active metabolites—including certain hepatic, kidney and hereditary disorders lead to Vitamin D deficiency in children.[2][4][5][6] Skeletal complications of vitamin D deficiency include rickets, bone deformities, osteoporosis and fractures.[2][6] The possible relationship between occurrence of fractures in paediatric ages and vitamin D deficiency has not yet been established.[7][8][9][10] A recent study showed that a lower vitamin D status is associated with fractures requiring surgery, but not with the occurrence of fractures.[11]

Although the prevalence of vitamin D deficiency in children in the general population has been well described[12][13], the prevalence of vitamin D deficiency in the paediatric fracture population is less often reported with a wide variation ranging from 8% to 47%. [7][8][9][10][11][14][15][16] Historically, the target serum vitamin D levels have been created using healthy population averages and standard deviations and sufficiency thresholdswere set at <11 ng/ml for deficiency, 11–20 ng/ml for insufficiency, and >20 ng/ml were considered normal. These thresholds were determined by task force from the Institute of Medicine (IOM) systematic review of contemporary literature in American and Canadian populations.[17][18][19] Whereas The Endocrine Society of India defines 25(OH)D levels >30 ng/ml (75 nmol/L) as adequate for most of the population and may provide greater benefit for individuals presenting with conditions such as osteoporosis. Serum 25(OH)D concentrations below 20 ng/ml have been associated with a higher risk of osteoporotic hip fractures, vertebral, wrist and proximal humerus fractures.[20] The primary aim of the present study was to determine the prevalence of vitamin D deficiency in under 6 years paediatric patients (OPD and indoor patients) with radiographically confirmed fracture of upper arm extremity.

Material and methods

The present cross-sectional descriptive study was conducted at a tertiary care centre in western Maharashtra between Jan 2019 to Dec 2021. All paediatrics patients under 6 years presenting to the hospital (OPD and admitted) with radiographically confirmed fracture of upper extremity (humerus, olecranon, condyle, radius, ulna, clavicle, elbow, forearm and radius) during the study period were included in the study. Children with chronic health conditions, severe developmental delays, or conditions affecting growth, such as cystic fibrosis. and conditions known to affect bone health, such as osteogenesis imperfecta or Marfan's syndrome, or if they were using medications such as barbiturates and corticosteroids, which may affect 25(OH)D concentrations or bone health or on oral Vit D supplementation were excluded.

All under six paediatrics patients with upper extremity fracture satisfying inclusion and exclusion criteria were recruited as study participants after obtaining informed consent from their parents/guardian. Blood sample for serum levels of 25(OH)vitamin D and haemoglobin was collected at the time of presentation. A pretested questionnaire was used to capture demographic details such as age, gender, mode of injury (low impact/high impact), mechanism of injury, etc. The current study defined vitamin D deficiency as a 25-hydroxyvitamin D concentration <11 ng/ml, insufficiency as 11 to 20 ng/ml, and sufficiency as > 20 ng/ml based on previously published literature.[17-19] The injuries leading to fracture were classified as low impact and high impact injuries. The Low-impact fracture was defined as a fracture occurring spontaneously or from a fall no greater than standing height, and high impact injuries were classified as those occurring due to accidents (motor vehicle accidents) or falls from height greater than standing height. [21]

Data was entered into an electronic spreadsheet (Microsoft Excel) and analyzed using an electronic statistical package SPSS software version 23.0 (SPSS, IBM, Chicago, IL, USA). Descriptive statistics was calculated for categorical variables as proportion and for continuous variable as mean and standard deviation. Chi square test was used for categorical variables. Pearson's correlation coefficient was calculated for ration scale variables. Statistical significance was represented by $P < 0.05$. The study was approved by institutional ethical review Committee.

Results

A total of 62 children were enrolled in the study. The mean age of study participants were 31.48 months with SD of 8.33. Almost half were male (29,46.8%). The mean serum levels of 25(OH)vitamin D among study participants were 16.98 ng/ml and mean serum haemoglobin level among study participants were 10.66 gm%. More than 2/3rd reported (24, 38.7) had high impact injury as a cause of upper arm fracture (Table-1).

Table-1: Baseline Characteristics

Variable	**Mean**	**Standard deviation**	**Range**
Age (in months)	31.48	8.33	17-53
Serum haemoglobin (gm%)	10.66	0.90	9-13
Vitamin D (ng/ml)	16.98	4.49	9-32
Variable	**Numbers**	**Percentage**	
Gender			
Male	29	46.8	
Female	33	53.2	
Mode of injury			
High impact	24	38.7	
Low impact	38	61.3	
Vitamin D			
deficiency (<11 ng/ml)	1	1.6	
insufficiency (11–20 ng/ml)	46	74.2	
Normal (>20 ng/ml)	15	24.2	

In our study, almost three fourth (47, 75.8%) of children with upper extremity fracture were deficient (< 20ng/ml) in serum levels of 25(OH) vitamin D. Only 24.2% Children (n=15) with upper extremity fracture had normal serum levels of 25(OH) vitamin D. The median level of serum levels of 25(OH)vitamin D was found to be marginally higher among children with upper arm fracture due to high impact injury as compared to children with low impact, but the difference was not statistically significant (Figure-1).

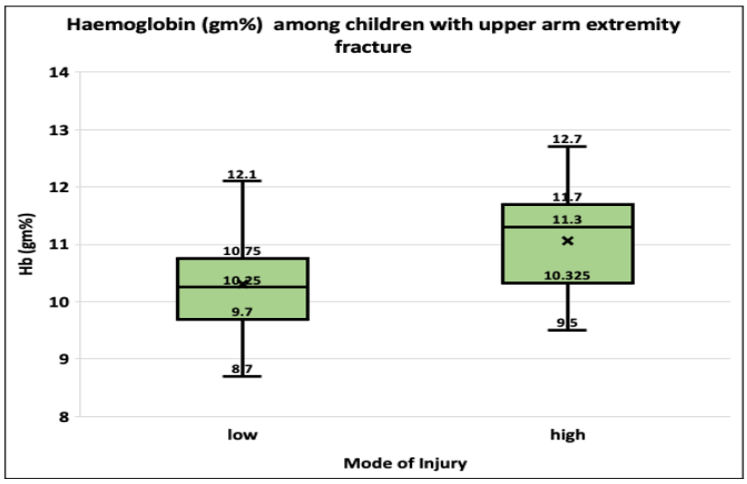

Fig 1: Box Whisker plot depicting Serum haemogobin levels (gm%) among children with upper arm extremity fracture as per mode of injury

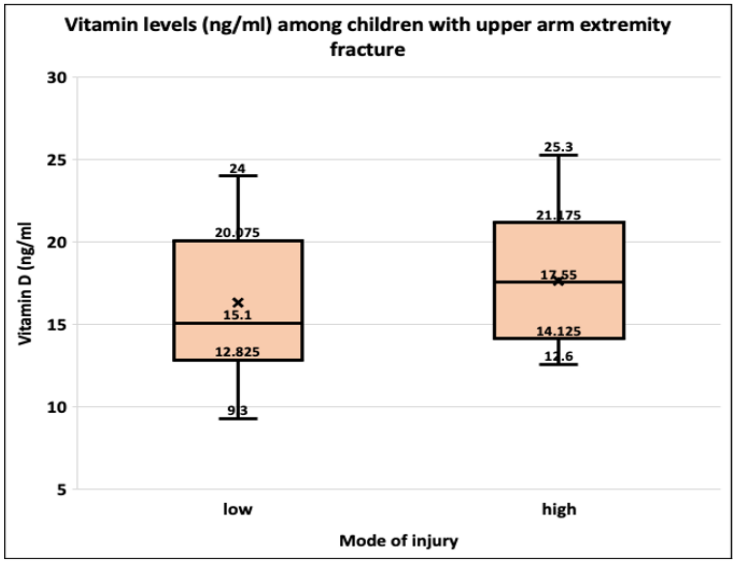

Fig2: Box Whisker plot depicting serum Vit D Level (ng/ml) among children with upper arm extremity fracture as per mode of injury

Interestingly, the median level of serum haemoglobin was found significantly lower among children with upper arm fracture due low impact as mode of injury compared to children with high impact injury (Figure-2)

There was no statistically significant difference between mode of injury and age category (P=0.90), gender (P= 0.56) or serum levels of 25(OH) vitamin D (P=0.724) however, serum haemoglobin level was found to be significantly associated with mode of injury p-value of 0.011(Table-2). The statistical comparison of median serum haemoglobin level and mode of injury by using Mann Whitney U test was found to be significant, p-value = 0.002 (Figure-1) whereas, statistical comparison of median serum levels of 25(OH) vitamin D and mode of injury was found to be non-significant, p-value = 0.133 (Figure-2)

Table 2: Association between mode of upper arm fracture and age, gender, Serum haemoglobin levels and Serum vitamin D

	Mode of injury		
Variable	**High Impact (%)**	**Low impact (%)**	**p value**
Age			
≤ 36 months	11 (45.8)	18 (47.4)	0.90
> 36 months	13 (54.2)	20 (52.6)	
Gender			
Male	16 (66.7)	29 (76.3)	0.56
Female	8 (33.3)	9 (23.7)	
Vitamin D			
deficiency (<11 ng/ml)	0 (0.0)	1(2.6)	0.724
insufficiency (11–20 ng/ml)	18 (75.0)	28 (73.7)	
Normal (>20 ng/ml)	6 (25)	9 (23.7)	
Hb (gm%)			
< 12	14 (58.3)	34 (89.5)	0.011
≥ 12	10 (41.7)	4 (10.5)	

Discussion

This study was aimed to determine the prevalence of vitamin D deficiency in under 6 years paediatrics patients (OPD and indoor patients) with radiographically confirmed fracture of upper arm extremity. The results of this study have shown that 75.8% (47 out of 62) children with upper

extremity fracture vitamin D deficiency. However, no patient had the clinical signs of rickets. However, there was no relationship between serum levels of vitamin D and mode of fracture i.e children with vitamin D deficiency were not associated with fracture due to low impact injury.

In the present study, we took a cut-off value for serum level of 25 (OH) vitaminD to define deficiency, but the optimal cut-off for defining Vitamin D deficiency is ambiguous. For e.g., some agencies consider optimal level of vitamin D to be more than 20 ng/ml, whereas the Endocrine Society defines it as> 30 ng/ml.[17][18][19] The definition of vitamin D deficiency used by Endocrine Society is most frequently used definition which describes vitamin D deficiency to be serum levels< 20 ng/ml, insufficiency as ≤ 30 ng/ml, and sufficiency as > 30 ng/ml.[20] However, we defined deficiency as < 20 ng/ml since there is evidence to suggest that there is a significant difference in bone quality in individuals with aserum 25(OH) vitamin D level of >20 ng/ml vs those having Serum 25(OH) vitamin D level of >30 ng/ml.[21]

Interestingly, this study shows statistically significant association between serum haemoglobin levels and mode of injury (P=0.004). Study by Vogiatzi et al. shows fracture incidence rate in children more than 6 years varied significantly among the thalassemia syndromes (p = 0.014).[22] There is dearth of literature showing association between low serum haemoglobin level and mode of fracture injury in children less than 6 years of age but there are various studies showing association of low serum haemoglobin and risk of bony injuries in elderly age group.[23][24] The low levels of haemoglobin can be considered as marker for poor nutritional status of young children, which may be the reason for more frequent fractures, as such low haemoglobin has been associated with low bone mineral density and high risk of bone fracture in adults.[25,26]

This study has some limitations. First, it is a single-site study,which may limit the ability to generalize the results. Second, the sample size was small due to various restriction of COVID-19 pandemic. In addition, we excluded many children experiencing chronic disease or if they were using medications such as barbiturates and corticosteroids, which may affect 25(OH)D concentrations or bone health. Also, any children on oral Vit D supplementation were excluded further limiting the generalizability of our results.

Conclusion

In the present study we found no relationship between vitamin D deficiency and risk of upper extremity fracture due to low impact injury, but interestingly almost 75% children in our study were suffering from Vit D deficiency, thus indicating high prevalence of vit D deficiency among paediatric population. In addition to vit D, our study found a potentially important association between low serum haemoglobin levels and fracture due to low impact injury in children. This finding opens-up a window of opportunity for research on the effect of haemoglobin and possibly notional status on bone health.

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