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Prevalence of Vitamin D Deficiency and its Associated Factors in the Age Group of 6 Months to 5 Years

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Abstract: ***Introduction: There is a widespread misconception that vitamin D deficiency and rickets are uncommon in India due to the country's plentiful sunshine, which is a major source of vitamin D. However, studies show that the world is currently experiencing a pandemic of vitamin D deficiency, and even the youngest children are not exempt. Recent changes in the city include a rise in industry, adoption of the western method of weaning, and dietary practices that may have an impact on a child's health. Objective: determine the prevalence of deficiency of vitamin D in children aged six months to five years and its contributing factors. Methods: At the Katuri Medical college And Hospital, Guntur, 100 patients who met the criteria and enrolled for the study after receiving informed consent, were the subjects of an observational, cross-sectional study over an 18-month period from September 2022 to February 2024. It was decided to estimate the amounts of serum 25 OH Vitamin D, serum calcium, serum phosphorus, and alkaline phosphatase using venous sample analysis. Results: We found that, out of 100 cases, 32 (32%) and 42 (42%) cases, respectively, exhibited vitamin D deficiency and insufficiency. Only 26 children (26%) had normal vitamin D levels. No statistically significant difference was seen in vitamin D levels among gender, religion, birth weight and socio-economic status in three groups. Among strictly vegetarians, when compared to insufficiency 5 (11.90%) and the normal group 3 (11.53%), vitamin D deficiency is more prevalent 7 (21.87%), which was statistically significant (p value 0.048). Among Preterm infants, it was statistically significant that, 18.75 % had vitamin D deficiency, 9.52 % had vitamin D insufficiency, and 7.69 % had normal vitamin D levels. However, no significant difference found between those 3 groups of full-term babies. In the vitamin D deficit, insufficient, and normal groups, respectively, exclusive breastfeeding was seen in 25 (78.12%), 34 (80.95%) and 20 (76.92%) cases, all without statistical significance (p value > 0.05). In present study, vitamin D deficiency occurred in 19 (59.37%) patients with respiratory infections, insufficiency in 3 (7.14%), and only normal vitamin D levels were present in 2 (7.69%) of the cases, which was statistically highly significant. No significant correlation between levels of vitamin D and clinical features of Rickets. Serum alkaline phosphatase levels are significantly elevated with p value <0.05 in deficiency, and there is no significant difference in serum calcium and serum phosphorous levels. Conclusion: Children between 2 and 3 years are more susceptible to deficiency, as are those who were born prematurely and those who were strict vegetarians. Estimating serum calcium and phosphorus levels may not be a reliable indicator of vitamin D deficiency, especially in the early stages.***

Keywords: Vitamin D deficiency, insufficiency, preterm, Term, Respiratory infections, Rickets, Alkaline Phosphatase

1. Introduction

Vitamin D, it's a fat-soluble vitamin that is vital to maintaining healthy human physiology [(1)]. The bone mineralization, contraction of muscles, nerve conduction, and overall cellular function in all body cells, including immune function, for inflammation, cell proliferation, and differentiation, are all important for bone health, according to scientific evidence. Vitamin D and calcium are also important for cell differentiation and proliferation[2].

Vitamin D is a prohormone. It is required for absorption of calcium in gastrointestinal tract. Its deficiency leads to hypocalcemia and hypophosphatemia with resultant rickets in children and osteomalacia in adults [3].

The major source of Vitamin D is the endogenous synthesis in skin on exposure to sunlight, namely, ultraviolet B (UV-B) radiation of wavelength 290–320 nm. There is a general belief that vitamin D deficiency and rickets are uncommon in India because of abundant sunshine. However, that is not true as the data shows that Vitamin deficiency is quite prevalent[4] Vitamin D deficiency and insufficiency has many causes, but lack of awareness of the importance of this deficiency in individual and public health is a crucial factor[4].

Main dietary sources are fish, fortified food, and supplements. Vegetables and grains are poor sources. The need for fortifying basic foods is ever more important since excessive sun exposure, a major source of this vital nutrient is related to skin cancers, and lifestyle changes have reduced the outdoor exposure of children[3].

Vitamin D deficiency is the most common nutritional deficiency and one of the most common undiagnosed medical conditions in the world[4].

Recent studies indicate that today the world is facing Vitamin D deficiency pandemic, even healthy and young are not spared.

Deficiency of Vitamin D is one deficiency if identified early, the adverse effects can be reversed if proper management of deficiency is implemented before damage is done.

Although majority of pediatric patients are asymptomatic, less severe deficiency has been associated with number of negative skeletal consequences including secondary

hyperparathyroidism, increased bone turn over, enhanced bone loss and risk of fractures [2].

Tetany or hypo calcemic convulsions can result from severe vitamin D insufficiency, especially in newborns and adolescents going through a time of rapid growth. Children with vitamin D deficiency frequently exhibit skeletal deformities starting at age 6 months (rickets). Although knock knees (genu valgum) can sometimes happen, bending the legs is more common (genu varum). Along with swelling at the wrist, noticeable costochondral junctions, and a soft, flexible skull (craniotabes), anterior bowing of the femur and internal rotation at the ankle are frequently observed[5]. Children who don't get enough vitamin D can be cranky, reluctant to carry their own weight, and show signs of stunted growth[6]. All of these have a lasting impact on a child's overall development and wellbeing over the course of their lifetime.

The city of Guntur is a city with a good percentage of the population in the pediatric age group. As there is a recent change in city with increase in industrialization, adaptation of the western way of weaning and food habits that can impact a child's health.

Numerous articles demonstrate the increased interest in vitamin D in the scientific, medical, and media communities as well as in the general population.

Most specialists assert that widespread vitamin D deficiency/insufficiency may have significant public health repercussions. Many people might find it surprising that vitamin deficiencies are so common in nations with such diverse and accessible dietary sources[7].

The research centre and that attached hospital where this study is conducted is a tertiary care centre which receives a good case load of children with deficiency and also this center had the latest technology and equipment necessary to assay its levels.

In view of this we conducted a study to find out the current prevalence and the associated factors of deficiency in the age group six months to five years.

2. Materials and Methods

2.1 Materials

An observational, cross- sectional study was done at Katuri Medical college and Hospital during a period of 18 months between September 2022 to February 2024 a total of 100 patients who fulfilled the criteria were enrolled for study after obtaining an informed consent.

Sample size: 100

Inclusion criteria

- Children between the age of six months to five years
- Only who are admitted in the ward

Exclusion criteria

- Children who are already on vitamin D supplementation
- Children those who are on anticonvulsants, anti-tubercular drugs and glucocorticoids
- Children with congenital skeletal disorders

A detailed careful history will be obtained from parents regarding gestational age at birth, birth weight, period of exclusive breast feeding, dietary intake of milk and egg, clinical features suggestive of rickets and present illness for which child was admitted.

Venous samples were taken and were tested for estimation of serum 25 OH Vitamin D, serum calcium, serum phosphorus and alkaline phosphatase levels.

- X ray wrist and or knee were done whenever required.
- Normal value of Vitamin D was taken as >30ng/ml
- Insufficiency as 20 to 30ng/ml
- Deficiency as <20ng/ml.

2.2 Data and Statistical Analysis

The demographic characteristics of the sample were summarized using descriptive statistics. The various characteristics were described using frequency and percentage.

The findings in were correlated to using inferential analysis, chi-square, ANOVA and analysis of variance done at level of significance $p<0.05$

All analysis was conducted using SPSS- version 22.

3. Results

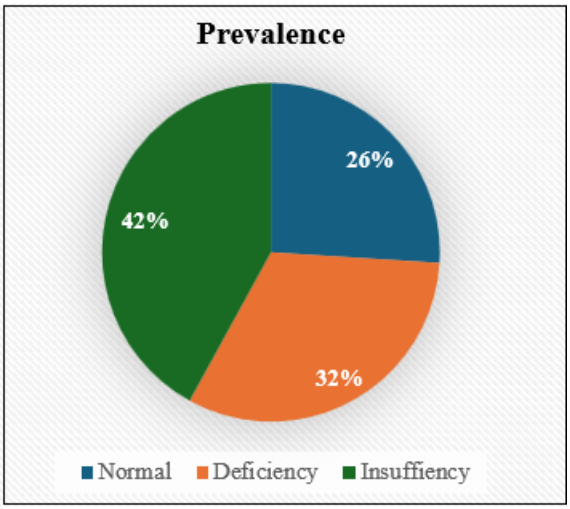

Figure 1: Prevalence of Vitamin D Deficiency

Table 1: Age Wise Distribution of Cases:

AGE	Vitamin D <20ng/ml		Vitamin D 20-30ng/ml		Vitamin D >30ng/ml		Total	
	Num	%	Num	%	Num	%	Num	%
6months – 1year	2	6.25%	5	11.90%	3	11.53%	10	10.0%
1 year	4	12.5%	4	9.52%	4	15.38%	12	12.0%
2 years	8	25.0%	11	26.19%	6	23.07%	25	25.0%
3 years	9	28.12%	14	33.33%	7	26.92%	30	30.0%
4 years	4	12.5%	5	11.90%	3	11.53%	12	12.0%
5 years	5	15.62%	3	7.14%	3	11.53%	11	11.0%
Total	32	100%	42	100%	26	100%	100	100%

Table 2: Gender Wise Distribution of Cases

Gender	Vitamin D levels <20ng/ml		Vitamin D Levels 20-30 ng/ml		Vitamin D levels >30ng/ml		Total	
	Num	%	Num	%	Num	%	Num	%
Female	14	43.75%	17	40.47%	12	46.15%	43	43.0%
Male	18	56.25%	25	59.52%	14	53.84%	57	57.0%
Total	32	100%	42	100%	26	100%	100	100%

Table 3: Religion Wise Distribution of Cases:

Religion	FREQUENCY							
	Vitamin D <20 ng/ml		Vitamin D 20-30 ng/ml		Vitamin D >30 ng/ml		Total	
Hindu	23	71.87%	32	76.19%	22	84.61%	77	77.0%
Muslim	7	21.87%	6	14.28%	2	7.69%	15	15.0%
Others	2	6.25%	4	9.52%	2	7.69%	8	8.0%
Total	32	100.0%	42	100.0%	26	100.0%	100	100.0%

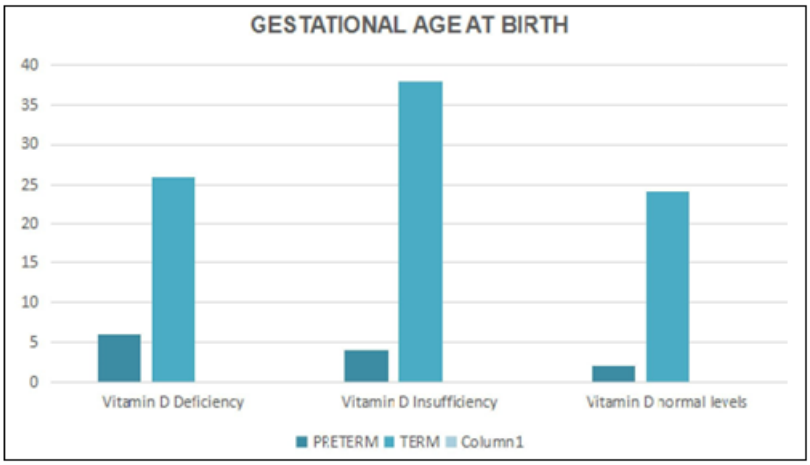

Figure 2: Distribution of cases according to gestational age at birth

Table 4: Distribution of Cases according to Birth Weight:

Birth Weight	Deficiency	Insufficiency	Normal
Mean	2.61	2.81	2.94
Median	2.7	2.8	3
Mode	2.8	2.8	3
Std.Deviation	0.340881	0.284736	0.291521
Minimum	1.9	1.9	2.2
Maximum	3.5	3.6	3.2

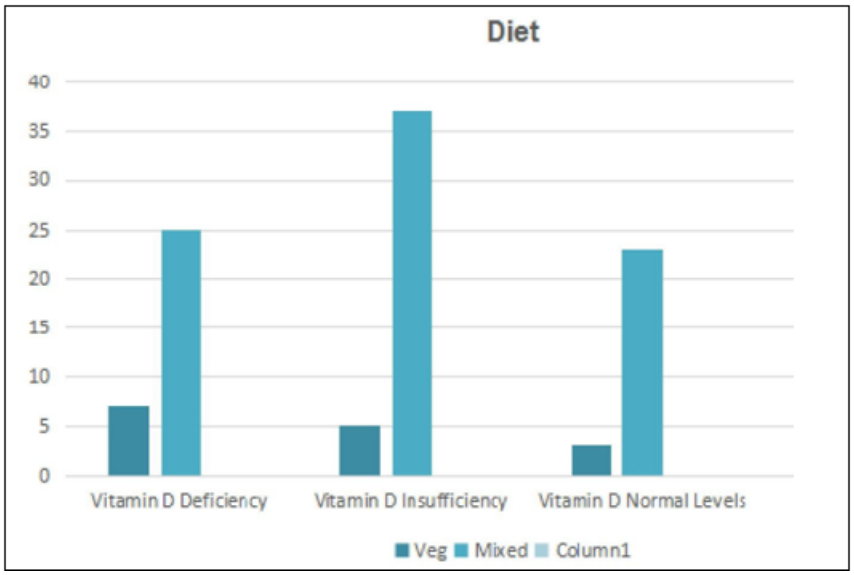

Figure 3: Diet wise distribution of cases

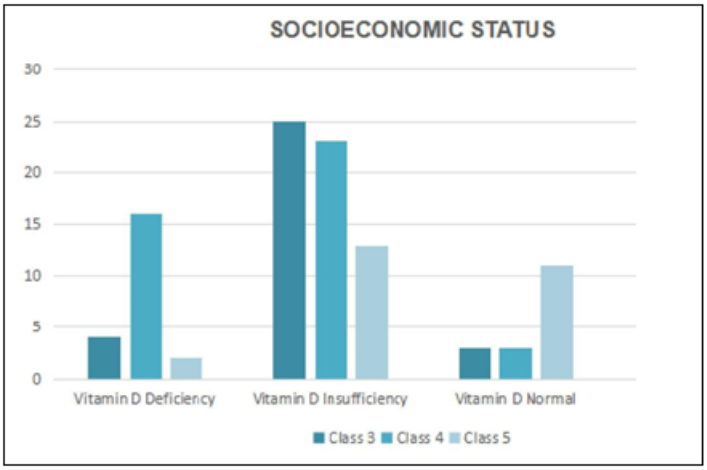

Figure 4: Case distribution as per socioeconomic status

Table 5: Case Distribution according to Breast Feeding Pattern

Exclusive Breast Feeding	Frequency			
	Deficiency	Insufficiency	Normal	Total
No	7 (21.87%)	8 (19.04%)	6 (23.07%)	21 (21.0%)
Yes	25(78.12%)	34 (80.95%)	20 (76.92%)	79 (79.0%)
Total	32	42	26	100 (100.0%)

Table 6: Distribution of Cases according to Clinical Features of Rickets

Head to Toe	Frequency			
	Deficiency	Insufficiency	Normal	Total
Nil	15 (46.87%)	42 (100%)	25 (96.15%)	82 (82.0%)
CT/FB/RR	1 (3.1%)	0	0	1 (10%)
FB	7 (21.87%)	0	1 (3.84%)	8 (8.0%)
FB/RR	7 (21.87%)	0	0	7 (7.0%)
RR	2 (6.25%)	0	0	2 (2.0%)
TOTAL	32	42	26	100 (100.0%)

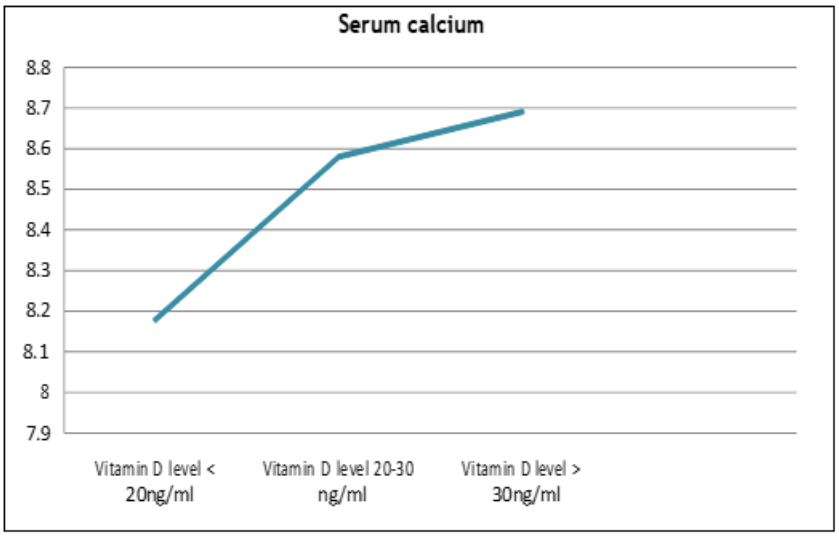

Figure 5: Distribution of cases according to serum calcium levels

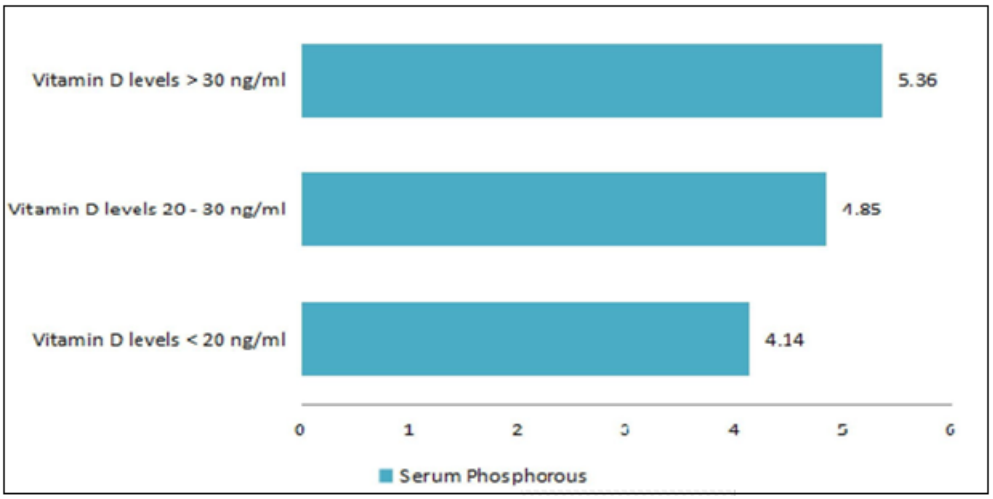

Figure 6: Distribution of cases according to serum phosphorous levels

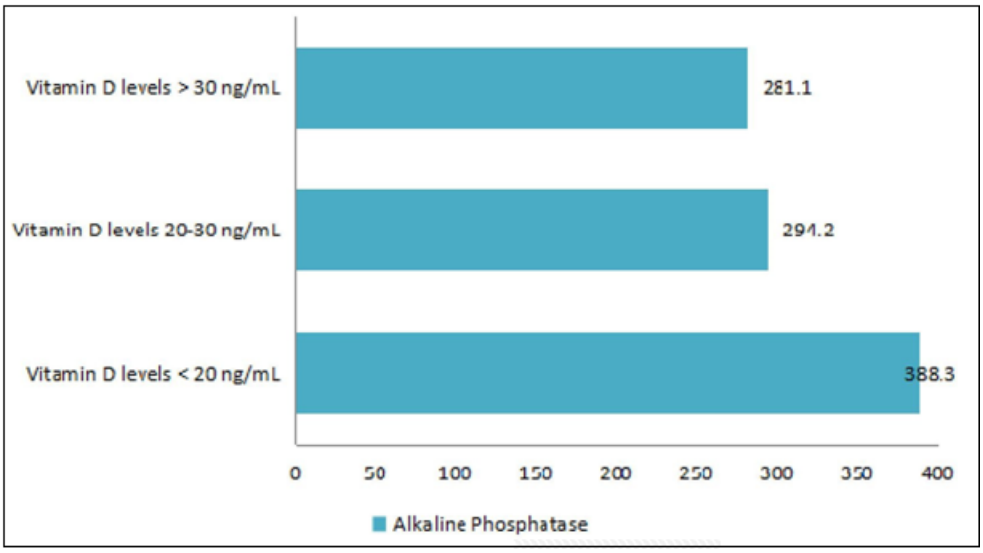

Figure 7: Distribution of cases according to Alkaline Phosphatase levels

4. Discussion

Clinical descriptions of hypovitaminosis D have become more variable since Glisson provided the first authoritative description of rickets in 1650, and McCollum and colleagues identified vitamin D deficiency as its cause in 1922[8]. As a result, the condition is less distinguishable because of its hazy presentation, which can mimic other diseases. While the ailment is still quite common in the globe, it may be avoided by taking vitamin D supplements.

Juhi Kumar et al[9] in their study stated that overall, 9% were

vitamin D deficient, Adith A. Ginde et al[9] found that 12% to 3% were vitamin D deficient over a ten-year period. Catherine M. Gordon et al[10] in their study stated that seventy-four patients (24.1%) were vitamin D deficiency.

In the present study, there was prevalence of 32% vitamin D deficiency and 42% cases had vitamin D insufficiency. Only 26% children had normal level of vitamin D.

Xin Zhao et al[11] in their study stated that serum 25(OH)D levels of young children at the age of 1–3 years, 2,903 boys and 2,668 girls ranged from 20.6–132.9 nmol/L (Median: 71.5 nmol/L). 16.1% of the population had vitamin D deficiency (<50 nmol/L), while 38.8% of the subjects had a sufficient (50–74.9 nmol/L) vitamin D level. An optimal vitamin D status (≥75 nmol/L) was found in 45.1% of the young children. The prevalence of vitamin D deficiency was higher in autumn (19.5%) than in summer (12.1%). There was no significant difference in vitamin D status between genders. In present study gender distribution, we found that 57 (57.0%) were male and 43 (43.0%) were females. However statistically there was no significant difference (p value >0.05).

In their study, Chowdhury R et al[12] found that 331 (34.5%) of the 960 patients whose vitamin-D concentrations were tested were vitamin-D deficient. They discovered that the risk of ALRI was considerably greater among the vitamin-D deficient group after adjusting for pertinent possible confounders (age, sex, breastfeeding status, wasting, stunting, underweight, anemia status, and season).

Javed, Muhammad et al[13] descriptive study was conducted at department of pediatric medicine at National Institute of Child Health Karachi to determine the frequency of nutritional rickets in children hospitalized with severe pneumonia among 137 children were included in the study and were investigated for presence of rickets with serum calcium, phosphorus and alkaline phosphatase. Out of 137children 101(74%) cases were having frequency of nutritional rickets. Investigator concluded that rickets may be more common in children who are breast fed and those who have less exposure to sunlight. In the present study it was found that about 19 (59.37%), 3 (7.14%) and 2 (7.69%) cases have vitamin D deficiency, insufficiency and normal vitamin D levels respectively having recurrent respiratory infections which is having highly statistically significance. This might be due to immune modulatory function of vitamin D.

Mahmoud Rafii et al[14] on children <6 months of age found 25cases (61%) had exclusive breast-fed and in 16 cases (39%) breast-feeding was the predominant mode of nutrition. The study concluded that early occurrence and presence of rickets in breast-fed infants below 6 months of age with no vitamin D supplementation is documented. In the present study we found that exclusive breast feeding was seen in 25 (78.12%), 34 (80.95%), 20 (76.92%) in the vitamin deficiency, insufficiency and normal respectively. However, it did not differ statistically in the three groups (p value >0.05). Maternal vitamin D status and low content of vitamin D in breast milk may also be the causes for deficiency of vitamin D levels in exclusively breast-fed infants.

In our study, there was high ALP in vitamin D deficiency group, which was statistically significant, but there is no statistical significance with serum calcium and phosphorous. This suggests that ALP is better biochemical marker compared to serum calcium and phosphorous.

Most of the children 61 (61.0%) in our study belongs to class 4. However, socio- economic status did not differ in influencing vitamin D deficiency, which may be due to diet which child has been provided. Overall birth weight did not differ statistically in the three groups (p value > 0.05). In the present study 88(88.0%) children were born at term and 12 (12.0%) born at preterm. In preterm born children 18.75% were vitamin D deficient, 9.52% had vitamin D insufficiency and 7.69 had normal levels of vitamin D which was statistically significant (p=0.003). However, there was no significant difference in 3 groups who were born at term. Religion wise 23 (71.87%) and 32(76.19%) Hindus had vitamin D deficiency and insufficiency respectively. However statistically there was no significant difference in the three groups (p value >0.05).

In the present study we found that 8(8.0%) had frontal bossing alone, out of them 7 had deficiency and 1 had normal vitamin D value. We also found that among vitamin D deficiency group 7 had frontal bossing, rachitic rosary, 2 had rachitic rosary and 1 case had craniotabes, frontal bossing and rachitic rosary. This suggests that features of rickets will not manifest in early stages and appears only when there is significant fall in vitamin D levels. So even if the child is looking clinically normal it doesn't mean that child is not having vitamin D deficiency.

5. Conclusion

In the present study we conclude the following: -

Vitamin D deficiency is common in children between 2 to 3 years of age, especially those who were born preterm and common in children who were pure vegetarians. Merely estimation of serum calcium and phosphorus may not reflect of vitamin D deficiency especially at early stages of deficiency.

6. Limitations

The present study was done only on in patients, if the study had included outpatients also it might be better representation of population.

Along with vitamin D levels if we have done parathormone levels it might be better correlated with vitamin D levels. But due to higher cost we couldn't do parathormone levels.

7. Summary

An observational, cross- sectional study was done at the Katuri Medical College and Hospital, Guntur on children between the age of six months to five years during a period of 18 months between September 2022 to February 2024. A total of 100 patients who fulfilled the criteria were enrolled for study after obtaining an informed consent. This is the summary of our findings

1) Out of 100, 32(32.0%) were having vitamin D deficiency 42(42.0%) were have insufficiency and 26(26.0%) were having normal vitamin D levels.
2) There was highest prevalence of vitamin D deficiency seen between 2 and 3 years of age, insufficiency with vitamin D levels 20 to 30ng/ml was the commonest in all age groups. However, there was no statistically significant difference in the three groups with a p value > 0.05.
3) Gender wise case distribution, 57(57.0%) were males and 43(43.0%) were females with no significant difference in the groups (p value >0.05).
4) As per gestational age at birth 88 (88.0%) children were born at term and 12 (12.0%) born at preterm. In preterm born children 18.75% were vitamin D deficient, 9.52% have vitamin D insufficiency and 7.69% have normal level of vitamin D which was statistically significant (p=0.003), but there is no significance in children born at term.
5) As per religion wise 23 (71.87%) and 32(76.19%) Hindus were having vitamin D deficiency and insufficiency respectively. However statistically there was no significant difference in the three groups (p value >0.05).
6) Overall birth weight did not differ statistically in the three groups (p value > 0.05). The overall mean weight in the study was 2.78 kgs.
7) In those with vitamin D deficiency 7 (21.87%) who were exclusively vegetarians as compared to 5 (11.90%) in the vitamin D Insufficiency and 3 (11.53%) in the normal group. This difference is statistically significant with a p value 0.048.
8) Most of the children 61 (61.0%) belongs to class 4, however socio-economic status did not differ in influencing vitamin D deficiency.
9) Cases as per breast feeding pattern, we found that exclusive breast feeding was seen in 25 (78.12%), 34 (80.95%), 20 (76.92%) in the vitamin deficiency, insufficiency and normal level of vitamin D respectively, with statistically no significance in the three groups (p value >0.05).
10) In the present study we found that 8(8.0%) had frontal bossing alone, out of them 7 had deficiency and 1 had normal vitamin D value. We also found that among vitamin D deficiency group 7 had frontal bossing, rachitic rosary; 2 had rachitic rosary and 1 case had craniotabes, frontal bossing and rachitic rosary.
11) There was no significant difference in serum calcium and phosphorus among these groups, but mean ALP level elevated significantly with p value <0.05 in vitamin D deficiency groups.

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