Original Research Paper

Volume - 11 | Issue - 04 | April - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Pediatrics

STUDY OF SERUM VITAMIN D LEVELS IN SEVERE ACUTE MALNUTRITION AND MODERATE ACUTE MALNUTRITION CHILDREN FROM 6 MONTHS TO 59 MONTHS OF AGE: A HOSPITAL BASED STUDY

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ABSTRACT **Background:** Vitamin D plays several important roles in the metabolism and absorption of other minerals in the body. Vitamin D deficiency is a world-wide epidemic with recent estimates indicating that greater than 50 % of the global population is at risk. Protein-energy malnutrition is likely to be associated with vitamin D intake deficiency. The main objective of study was to evaluate vitamin D levels among children with severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) children from 6 months to 59 months of age. **Material and Methods:** The present study was undertaken in 60 children diagnosed as SAM, MAM with complications and admitted to NRC (Nutrition Rehabilitation Centre). SAM and MAM were classified according to the WHO classification. Vitamin D levels was done among the admitted children and classified according to the classification as deficient (Vitamin D level <20ng/ml), insufficient (Vitamin D level between 21-29ng/ml) and sufficient (Vitamin D level >30ng/ml).**Results:** Out of 60 children included in the study 50 (83%) were classified as SAM and 10 (17%) were classified as MAM. Out of 60 children 16 (32%) SAM and 3 (30%) MAM children were found to have deficient Vitamin D levels (<20ng/ml), 17 (34%) SAM and 4(40%) MAM children found to have insufficient Vitamin D levels (between 21-29 ng/ml), and 17(34%) SAM and 3(30%) MAM children found to have sufficient Vitamin D levels (>30 ng/ml). All children were given Vitamin D supplementation according to guidelines. The mean vitamin D level was 25.4 ng/ml.**Conclusion:** The high prevalence of Vitamin D deficiency in malnourished children underlines the need for active surveillance and aggressive management.

KEYWORDS : Vitamin D deficiency, severe acute malnutrition, moderate acute malnutrition, serum Vit D level

INTRODUCTION:

Vitamin D plays several important roles in the metabolism and absorption of other minerals in the body. Low levels of vitamin D lead to the release of parathyroid hormone, which causes calcium mobilization from the bone. Over time, excessive bone resorption can lead to rickets. Vitamin D deficiency (VDD) is prevalent in children worldwide and is recognized to be a major public health problem.[1] The development of vitamin D deficiency is associated with deteriorating bone health and in severe cases, hypocalcaemia, rickets, and osteomalacia in children and adults[2]. Those at greatest risk of vitamin D deficiency include patients with chronic illnesses (e.g., chronic kidney disease [CKD], cystic fibrosis [CF], asthma, and sickle cell disease), dark-pigmented skin, poor nutrition, and infants who are exclusively breastfed.[3,4] A high prevalence of vitamin D deficiency has been found across all age groups in all populations studied in countries around the globe [5] . It is estimated that 1 billion people worldwide have either vitamin D insufficiency or deficiency [6] PEM is globally the most important risk factor for illness and death, contributing to more than half of deaths in children worldwide, where child malnutrition was associated with 54 % of deaths in children in developing countries in 2001[7]. In India, the prevalence of severe acute malnutrition (SAM) in children between 6 months to 5 years is 6.4% [8] .It had been estimated that prevalence of Vitamin D deficiency in malnourished children ranges from 31% to 61% [9]. This study was undertaken in the nutritional rehabilitation centre of our hospital to know the prevalence of Vitamin D deficiency in SAM and MAM patients of 6 months to 59 months age.

MATERIAL AND METHODS:

A cross-sectional descriptive study of children with severe acute malnutrition and moderate acute malnutrition was conducted from October 2018 to July 2020. The study was undertaken in NRC of pediatric unit of R.D. Gardi Medical College and associated hospital, Ujjain. A total of 60 children of age between 6 months to 59 months of SAM and MAM classified according to the WHO classification were included in the study. Children with MAM with severe medical complications were admitted according to the guidelines of Government of Madhya Pradesh. Children with clinical signs of systemic illness were excluded. The primary outcome was the serum level of vitamin D. This information was collected in a structured questionnaire format. Detailed clinical examinations, anthropometric measurements and laboratory tests were recorded. All anthropometric measurements were done in a standard method as per the recommendations by WHO [6,7]. Serum vitamin D levels were determined using 25(OH) enzyme linked immunoassay. Children with vitamin D levels of <20 ng/ml were categorized as vitamin D deficient. Data was entered in EpiData Entry (Version 3.1, EpiData Software Association, Odense, Denmark) and statistical analyses was performed using Stata (Version 13.0, Statacorp. Texas, USA). Odds ratios (ORs) and confidence intervals (CIs) were used where appropriate. Sensitivity and specificity of wrist X-ray findings were determined using the receiver operating characteristic (ROC) curve.

WHO classification[6,7] of malnutrition are as follows:

- ***Moderate acute malnutrition (MAM)***, defined as weight-for-height z-score (WHZ) between −2 and −3 or mid-upper arm circumference (MUAC) between 11.5cm and <12.5cm. (WHO 2012)
- ***Severe acute malnutrition (SAM)***, defined as WHZ < −3 or MUAC < 11.5cm, or the presence of bilateral pitting edema, or both or severe visible wasting. (WHO 2013)

RESULTS:

The study was carried out in 60 children admitted in the pediatric unit with SAM or MAM in CRGH hospital of RD Gardi Medical College and associated hospital, Ujjain (MP). Out of 60 children included in the study 50 (83%) were classified as SAM and 10 (17%) were classified as MAM. Out of 60 children 16 (32%) SAM and 3 (30%) MAM children were found to have deficient Vitamin D levels (<20ng/ml), 17 (34%) SAM and 4(40%) MAM children found to have insufficient Vitamin D levels (between 21-29 ng/ml), and 17(34%) SAM and 3(30%) MAM children found to have sufficient Vitamin D levels (>30 ng/ml). All children were given Vitamin D supplementation according to guidelines.

Table 1 shows distribution of SAM and MAM children according to Vitamin D levels and their correlation (n=60)

Vitamin D levels	Number of Patients (n=60)	Percentage (%)	SAM n(%)	MAM n(%)	p-value
Deficient (<20ng/ml)	19	32	16 (84)	3 (16)	0.02
Insufficient (20-29ng/ml)	21	35	17 (81)	4 (19)	
Sufficient (>30 ng/ml)	20	33	17 (85)	3(15)	
Total	60	100	50	10	

Table 2 shows correlation of vitamin D levels with exclusively breast feeding children till 6 months of age (n=60)

	Vitamin D Levels		
Exclusive Breastfeeding	**Deficient + Insufficient n(%)**	**Sufficient n(%)**	**P Value**
Yes (n=30, 50%)	19 (48%, 63%)	11 (55%,37%)	0.03
No (n=30, 50%)	21 (52%, 70%)	9 (45%, 30%)	
Total	40	20	60

Table: 3 shows correlation of Vitamin D levels with various socio-economic variables and anthropometric variables (n=60)

Characteristics	Total	Vitamin D levels		p-value	Odds Ratio (OR)	95% CI
		Deficient + Insufficient	Sufficient			
Gender						
Male	36 (60%)	21 (58%)	15 (42%)	0.094	R	R
Female	24 (40%)	19 (79%)	5 (22%)		2.7	0.8-8.9
Residence						
Rural	42 (70%)	29 (72% , 69%)	13 (65% , 31%)	0.55	R	R
Urban	18 (30%)	11 (28%, 61%)	7 (35% , 39%)		0.7	0.2-2.22
Socio-economic status						
Lower class	48 (80%)	32 (80% , 67%)	16 (80%,33%)	0.68	R	R
Upper-Lower	10 (17%)	6 (15% , 60%)	4 (20%,40%)		0.75	0.18-3.4
Lower-middle	2(3%)	2(5%)	0		-	-
Overcrowding						
Yes	10 (17%)	7 (18% , 70%)	3(15% , 30%)	0.807	R	R
No	50(83 %)	33(82% , 66%)	17(85% , 34%)		0.83	0.19-3.6
Birth weight						
1.5-2.0	10 (17%)	8(20% , 80%)	2(10%, 20%)	0.597	R	R
2.0-2.5	21 (35%)	13(32% , 62%)	8(40%, 38%)		0.40	0.06-2.4
>2.5	29(48 %)	19 (48% ,65%)	10(50% , 35%)		0.47	0.08-2.7
Weight for Age						
<-3SD	50 (83%)	34 (68%, 85%)	16 (32%, 80%)	0.001	R	R
-2SD-3SD	9 (15%)	6 (67%, 15%)	3 (33% , 15%)		0.9	0.2-4.2
-1SD-2SD	1(2%)	0	1 (100%, 5%)		-	-
Height for age						
<-3SD	24 (40%)	16 (40% , 67%)	8 (40%, 33%)	0.734	R	R
-2SD-3SD	18(30 %)	11 (27% , 61%)	7 (35% , 39%)		0.78	0.22-2.8
-1SD-2SD	16(27 %)	11 (28% , 69%)	5 (25%, 31%)		1.1	0.28-4.3
Median -1SD	2(3%)	2 (5%)	0		-	-

DISCUSSION:

In our study we found that deficient levels of vitamin D were found in 31.67% of cases. In the present study out of 60 children enrolled, 60% (n= 36) were males with 58.33% (n=21) had deficient and insufficient levels of vitamin D and only 41.67% (n=15) had sufficient levels of vitamin D. Out of 24 females, 79.17% (n=19) had deficient and insufficient vitamin D levels while only 21.83% (n=5) had sufficient vitamin D levels. The data shows direct correlation of gender with vitamin D deficiency/ insufficiency (79.17% in females vs 58.33% in males). The malnourished female children have 2.7 times more chances of having vitamin D deficiency and insufficiency as compared to malnourished male children. But the data is statistically insignificant. (p value- 0.094)

Present study showed that 80% (n=48) children belonged to lower class while 17% (n=10) were from lower-upper class and only 3% (n=2) from lower middle class which means that the majority of the children in the present study belonged to lower socioeconomic status. A direct correlation was found between low socio economic status and malnutrition. Poverty is the known and biggest factor responsible for poor nutrition of whole family and particularly that of a child who requires appropriate and proper nutrition for growth which is very rapid during this period. Risk of SAM increases with poverty.[10] Similar results were seen in the studies done by Haidar et al[10] and Kikafunda et al [11] which showed that family income and low socio-economic status have been found as risk factors for severe acute malnutrition (SAM).

In the present study total malnourished children enrolled were 60. The study included both severely acute malnourished (SAM) children along with moderately acute malnourished (MAM) children of age group between 6 months to 59 months. Out of 60 children, 60% (were males whereas 40% were females. Similarly, study to evaluate Vitamin D levels in SAM children was done by Mehta et al [12] in 2017 in Indore, India , also had majority of males (60%) with n=100. In the present study 83.33% (n=50) children were below -3SD for weight for age,15% (n=9) were between -2SD-3SD of weight and only 1 child had weight for age between -2SD-1SD. The mean weight for age of patients is 6.4Kgs. In similar study done by Mathur et al [13] on burden of SAM in under five children, in Delhi, India, in 2017 , had 28.1% children severely underweight i.e. <-3SD and 50.4% were underweight. 31.67% of malnourished children in the study group are deficient in 25-OH cholecalciferol (less than 20ng/ml), 35% of malnourished children in study group have insufficient levels of 25-OH cholecalciferol (between 20-30ng/ml), and 33.33% of malnourished children in study group have sufficient levels of 25-OH cholecalciferol (more than 30ng/ml). The mean vitamin D level in the present study is 25.4±7.8ng/ml. Similar studies done by Nahida et al had 30.6% showed vitamin D deficiency in the malnourished children whereas in study done by Mehta et al 32% children had vitamin D deficiency. In the present study the prevalence of vitamin D deficiency in SAM patients is 32% and in MAM patients is 30% and the data is highly significant (p-value 0.001). In the present study, 83.3% were of SAM with 66% had deficient and insufficient levels of vitamin D whereas only 34% had sufficient levels of vitamin D. Out of 16.67% children of MAM , 70% had deficient and insufficient levels of vitamin D whereas only 30% had sufficient vitamin D levels. This observation is statistically highly significant showing high correlation between malnourished children and deficient and insufficient vitamin D levels. (p value- 0.002).

In the present study out of 60 children enrolled, 83.33% were severely wasted (<-3SD), 68% had deficient and insufficient levels of vitamin D whereas 32%(n=16) had sufficient levels of vitamin D. 15% children with -2SD to -3SD weight for age had 67% (n=6) deficient and insufficient levels of vitamin D whereas 33% had sufficient levels of vitamin D. There is high correlation between weight for age/wasting and vitamin D levels. The data is statistically highly significant. (p value-0.001)

In the present study out of 60 patients enrolled, 55% of exclusively breast fed children had sufficient levels of vitamin D where as 52.5% of children who were not exclusively breast fed had insufficient or deficient levels of vitamin D. The present study showed that 31.67% children were having bottle feeding and hence children are more prone to infection. In a similar study done by Mishra et al [14] 70% of the malnourished children were bottle fed.

CONCLUSION:

In conclusion, this study shows a significant association of serum vitamin D level with severe acute malnutrion and moderate acute malnutrition in the study population. Vitamin D supplementation is a part of routine management of SAM and MAM. Pediatrician should remember supplementation at the time of discharge of these children.

Recommendations:

1) Present study strongly recommends assessment of vitamin D levels in children with malnourishment whether SAM or MAM. 2) Study strongly recommends early supplementation of Vitamin D to all children who are found deficient or insufficient levels of vitamin D.

Limitation: The absence of data on the level of calcium, phosphorus and alkaline phosphatase from our study population.

ACKNOWLEDGEMENT:
We are thankful to the whole Pediatrics department, RD Gardi Medical College and our admitted patients of CRGH and Madhav Nagar Civil Hospital, Ujjain, without their support this study would not have been possible.

Funding: No funding sources
Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee of RD Gardi Medical College, Ujjain (MP)

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