Original Article

Vitamin D level in critically ill children 6 months–5 years age admitted to intensive care unit in tertiary care hospital of Central India

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ABSTRACT

Background: Vitamin D has an important role in maintaining bone health by regulating calcium metabolism in the body. Its level in serum plays a significant role in mortality and morbidity in children **Aim:** This study aims to determine the Vitamin D levels and its association with clinical outcome in children from the age of 6 months to 5 years admitted to pediatric intensive care unit (PICU). **Materials and Methods:** A case–control study conducted among children admitted to PICU for a period of 1 year, aged from 6 months to 5 years in the department of pediatrics of a tertiary care institution of Central India. Normal children in the same age group were controls and serum Vitamin D level was assessed by chemiluminescence immunoassay method. **Results:** The results of this study showed that the prevalence of Vitamin D deficiency was 63% and median Vitamin D and calcium level were 17.70 (13.40–24.97) and 8.90 (7.35–9.26) interquartile range. Among all cases, 6 (9.2%) had severe deficiency, 35 (53.8%) had Vitamin D deficiency, 17 (26.2%) had insufficiency, and only 7 (10.8%) had normal level. **Conclusion:** This study concludes that the proportion of Vitamin D deficiency was higher in critically ill children, as compared to healthy children, but no statistically significant association was found between the deficiency and outcome among critically ill children.

Key words: *Critically ill, Children, Clinical outcome, Vitamin D*

Vitamin D is an imperative hormone that is essential for optimal health and its deficiency associated with many diseases involving dysregulation of the immune, cardiovascular, and respiratory systems [1]. The term "Vitamin D" usually allied with compounds Vitamin D3 (cholecalciferol) or Vitamin D2 (ergocalciferol). Vitamin D3 is produced from the skin on exposure to sunlight where it is derived from 7-dehydrocholesterol by ultraviolet irradiation of the skin. It is also found in animal food sources, for example, fatty fish (e.g., salmon, mackerel, and tuna) cod liver oil, milk, etc. In contrast with Vitamin D3, Vitamin D2 is found in vegetable sources such as sun-exposed yeast and mushrooms. Notably, most dietary sources are not sufficiently rich in their Vitamin D content [2-5].

It has an immense role in maintaining bone health by regulating calcium metabolism in the body and its deficiency is associated with worsening bone health in children and adults [6]. Patients suffering from chronic illnesses, dark-pigmented skin, malnutrition, and breastfed infants have highest risk of the deficiency [7,8]. As Vitamin D is an imperative role in bone formation in early life, an adequate serum concentration of level is important in children.

Nowadays, Vitamin D deficiency is a highly prevalent condition in the developing world and the populous regions of Asia such as India and the Middle East [9,10]. The echelon of 25-hydroxyvitamin D (25[OH] D) is mostly used to evaluate the adequacy of Vitamin D. Level of Vitamin D in serum plays a significant role in mortality and morbidity in children admitted in intensive care unit (ICU). The apprehension is especially logical in developing countries where resources are limited. Hence, this study was planned to determine the Vitamin D level and its association with clinical outcome in children from the age of 6 months to 5 years admitted to pediatrics ICU (PICU).

MATERIALS AND METHODS

A case–control study was conducted among children admitted to PICU aged from 6 months to 5 years in the Department of Pediatrics, Gandhi Medical College, Bhopal. The study was conducted from March 2017 to February 2018 for a period of 1 year. Ethical clearance was obtained from the institutional ethical committee the children aged 6 months–5 years admitted to PICU with Glasgow coma scale ≤8 or shock of any origin defined by pediatric advanced life support guidelines or requirement of FiO_2 >40% to maintain SpO_2 above cutoff for that age was included in the study. Children with a history of chronic liver and renal failure, known cases of hypothalamic and pituitary disorders, history of Vitamin D megadoses in the past 2 months, on steroid therapy for >2 weeks, with malabsorption syndrome, on phenytoin therapy for the treatment of epilepsy, or whose length of PICU stay <24 h (death/discharge form PICU) were excluded from the study.

Eligible children aged between 6 months and 5 years of age admitted to PICU were taken as cases (n=65) and healthy children between with the same age group who visited immunization clinic were taken as controls (n=20).

Sample size was calculated using "right size" statistical software of Centers for disease control Atlanta by considering the target population of 1170 with 95% confidence coefficient and at 5% confidence interval. As a sample of 60 was required to investigate, we added 10% as non-response, thus a final sample size comprised 65 children. Statistical analysis was done with the Statistical Package for the Social Sciences version 22 using frequency distribution and Mann–Whitney U-test.

RESULTS

A total of 85 children participated in the study, in which 65 were cases and 20 were controls. Demographic distribution of the study participants is shown in Table 1.

The comparison of median serum 25(OH) Vitamin D and calcium between the study groups is given in Table 2.

Serum 25 (OH) Vitamin D levels in the study groups are mentioned in Table 3.

The evaluation of serum 25 (OH) Vitamin D level was done according to the age groups, gender, nutritional status, and socioeconomic background. As per sickness criteria, 19 participants with respiratory failure suffered from Vitamin D deficiency. Socioeconomic status of the study participants revealed that some of upper class participants had normal Vitamin D level, but none of the lower class had normal serum levels. The details are given in Table 4.

Table 1: Demographic profile of the study participants

Study parameters	Cases (n=65) (%)	Control (n=20) (%)
Gender		
Male	37 (56.9)	13 (65)
Female	28 (43.1)	7 (35)
Age group		
Up to 12	24 (36.9)	5 (25)
12–36 months	23 (35.4)	11 (55)
37–60 months	18 (27.7)	4 (20)
Residency		
Rural	48 (73.8)	16 (80)
Urban	17 (26.2)	4 (20)
Socioeconomic status		
Lower	2 (3.1)	0 (0)
Middle-lower	2 (3.1)	0 (0)
Upper-lower	61 (93.8)	20 (100)

Table 2: Comparison of median serum Vitamin D and calcium levels between the study groups (N=85)

Parameter median (interquartile range)	Vitamin D (mg/dl)		Mann–Whitney U-test
	Cases (n=65)	Control (n=20)	
Vitamin D (ng/ml)	17.70 (13.40–24.97)	32.70 (30.18–37.15)	<0.001
Calcium (ng/ml)	8.90 (7.35–9.26)	9.27 (8.91–9.88)	<0.001

Table 3: Serum 25 (OH) Vitamin D level in study groups (N=85)

Study group	Vitamin D levels (ng/ml) (%)			
	Severe deficiency (<10)	Deficiency (10–20.99)	Insufficiency (21–29.99)	Sufficiency (>30)
Cases (n=65)	6 (9.2)	35 (53.8)	17 (26.2)	7 (10.8)
Control (n=20)	0 (0)	2 (10)	2 (10)	16 (80)

DISCUSSION

Vitamin D has a significant role in skeletal and extraskeletal functions. In the present study, 56.9% of participants were male and 43.1% were female, and similar gender distribution was found by Nabeta *et al.* [11] in their study where 57.6% of participants were male and 42.4% were female. In this study, majority of 48 (73.8%) cases were residing in rural area and only 17 (26.2%) lived in urban places. A study by Garg *et al.* [12] reported no significant difference in rural or urban children regarding serum Vitamin D status. In the present study, majority of the cases, 61 (93.8%) were from upper socioeconomic status. A study by Léger-Guist'hau *et al.* [13] found that low socioeconomic status appears to be a major risk factor for severe Vitamin D deficiency.

According to the present study, the median Vitamin D level was 17.70 mg/dl in cases, whereas a study by Mehta [14] reported the median Vitamin D level to be 68.8 nmol/L. In the present study, the calcium deficiency significantly associated with Vitamin D deficiency. Ayulo *et al.* [15] reported that ionized calcium levels did not significantly correlate with Vitamin D deficiency. McNally *et al.* [16] reported that lower levels of Vitamin D were associated with hypocalcemia.

In our study, 61.5% of participants were normal or healthy, 20% had moderate acute malnutrition, and 18.5% had severe acute malnutrition, whereas a study by Nabeta *et al.* [11] reported that 43.6% of participants were malnourished with suboptimal level of Vitamin D and 36.6% was not suffering from malnutrition. The prevalence of malnutrition was high in a study conducted by Ejaz and Latif [17] as he reported 79% of subjects to be severely malnourished and 20% were moderately malnourished. In the present study, the prevalence of Vitamin D deficiency was not age related, whereas in a study by Ebenezer *et al.* [18], higher age was associated with low Vitamin D levels. According to this study, a high prevalence (63%) of Vitamin D deficiency was found. Similar results were found by Sankar *et al.* [19], as he reported 74% prevalence.

Vitamin D deficiency is usually associated with various factors such as duration and timing of sun exposure, amount of skin exposed, skin pigmentation, and dietary and genetic factors [20]. Majority of these cases are asymptomatic; thus, the deficiency may not be clinically relevant. It is associated with increase morbidity and mortality due to its

Table 4: Serum 25 (OH) Vitamin D level in cases as per age, gender, (N=65)

Parameters	Vitamin D levels (ng/ml) (%)			
	Severe deficiency (<10)	Deficiency (10–20.99)	Insufficiency (21–29.99)	Sufficiency (>30)
Age group				
6–12 months (n=24)	3 (12.5)	12 (50)	8 (33.3)	1 (4.2)
13–36 months (n=23)	1 (4.3)	15 (65.2)	4 (17.4)	3 (13)
37–60 months (n=18)	2 (11.1)	8 (44.4)	5 (27.8)	3 (16.7)
Gender				
Male	3 (8.1)	19 (51.4)	12 (32.4)	3 (8.1)
Female	3 (10.7)	16 (57.1)	5 (17.9)	4 (14.3)
Nutritional status				
Normal or healthy (n=40)	5 (12.5)	20 (50)	10 (25)	5 (12.5)
Moderate acute malnutrition (n=13)	1 (7.7)	8 (61.5)	3 (23.1)	1 (7.7)
Severe acute malnutrition (n=12)	0 (0)	7 (58.3)	4 (33.3)	1 (8.3)
Socioeconomic status				
Lower (n=2)	0 (0)	1 (50)	1 (50)	0 (0)
Middle lower (n=2)	1 (50)	0 (0)	0 (0)	1 (50)
Upper lower (n=61)	5 (8.2)	34 (55.7)	16 (26.2)	6 (9.8)

halo effects on various organs and innate and adaptive immunity [21]. Therefore, we carried out this study to conclude Vitamin D level with clinical outcome that always help in treatment planning. Short sample size was one of the major limitations of the study. Another limitation was the smaller size of the control group.

CONCLUSION

This study concluded that the incidence of Vitamin D deficiency was higher in critically ill children, as compared to healthy children, but no statistically significant association was found between Vitamin D deficiency and outcome among critically ill children. Future studies with larger sample size are required to establish the relationship.

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