Original Research Article

Vitamin D status among critical children below five years in a tertiary care hospital

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Abstract

Background: Vitamin D deficiency/insufficiency is increasing in frequency. Studies have reported reduced Vitamin D concentrations in patients with previous and prevalent cardiovascular or cerebrovascular diseases. Vitamin D deficiency is commonly noticed during admission to intensive care units. Although it is not an independently decisive factor for mortality, it might be related to the worse clinical status at ICU admission. **Objective:** To assess the Vitamin D level among children admitted to the ICU. **Methodology:** A prospective observational hospital-based study was conducted at a government tertiary care hospital in Chennai, Tamil Nadu from January 2018 to Dec 2018. Eligible children below 5 years admitted to the ICU with Glasgow coma scale <_8 or shock from any origin were included in the study as cases and children admitted to ICU without the above critical presentations were included in the study as controls. **Results:** 90.4% of the admitted children presented with one of the categories of vitamin D deficiency. 50.5% of the cases were admitted with symptoms of the respiratory system. 44.7% of the admissions presented with CNS infection symptoms. Severe vitamin D deficiency was seen in 10.6% of the study group. Death was the outcome among 84.1% of the study group. Vitamin D levels were not statistically significant to systems involved on admission, nutritional status and outcome of the admitted children. Statistical significance was noted in the levels of vitamin D between cases and controls. The cases presented with significantly lower serum vitamin D levels compared to the controls.
Key Word: Vitamin D.

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INTRODUCTION

Vitamin D deficiency is prevalent in the developed and developing worlds.[1,2] Vitamin D deficiency/insufficiency is increasing in frequency.[3] Studies have reported reduced Vitamin D concentrations in patients with previous and prevalent cardiovascular or cerebrovascular diseases.[4,5] Vitamin D deficiency is commonly noticed during admission to intensive care units. Although it is not an independently decisive factor for mortality, it might be related to the worse clinical status at ICU admission. The effect of vitamin D replacement on mortality is controversial.[6] Prevalence of vitamin D deficiency in India Vitamin D deficiency is on the rise as a major public health problem in India. Skin complexion, poor sun exposure, vegetarian food habits and lower intake of vitamin d fortified foods could be attributed to the high prevalence of Vitamin D deficiency in India. A study conducted amongst apparently healthy subjects to measure their serum Vitamin D level documented that significant Vitamin D deficiency was present in up to 90% of the subjects.[7] Subsequently, studies conducted in different parts of the country have documented a widespread prevalence of Vitamin D deficiency in all age groups including toddlers, school children residing in rural or urban areas.[8]

OBJECTIVE

To assess the Vitamin D level among children admitted to the ICU.

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REVIEW OF LITERATURE

Mehrotra et al [9] reported the prevalence of Vitamin D deficiency among infants with hypocalcemic seizures (90%), and controls (41.7%). Mean serum Vitamin D values of study infants (6.54 ng/ml) were significantly lower than those of healthy breastfed infants (9.06 ng/ml). A high prevalence of vitamin D deficiency (86%) in healthy term-born infants at the age of 3 months was attributed to the Vitamin D status of mothers[10]. Wayse et al[11] documented the prevalence of Vitamin D deficiency (levels below 14ng/ml) amongst children as 82.9 % and 82% in two regions and 2% in the third region. The study reported the prevalence of Vitamin D deficiency as 61.4%. Atalan et al [6] reported mortality rate was 21.6%. There was no significant difference between mortality rates of septic patients with normal and low vitamin D levels (p=0.071). Ebenezer K *et al.* [12] reported Vitamin D deficiency was seen in 40.3 % of the critically ill children. Shock (30.8 %), CNS conditions (23.1 %) and respiratory illnesses (21.2 %) were the three most common reasons for admission to the ICU. Ponnarmeni S *et al.*[13] reported prevalence of Vitamin D Deficiency was higher among critically ill children with sepsis compared to healthy controls. A high prevalence of Vit D Deficiency in critically ill children with sepsis was found, but it was not associated with greater severity of illness or other clinical outcomes. Sankar J *et al.* [14] reported that the prevalence of vitamin D deficiency was 74 %. The duration of ICU stay was significantly longer in 'vitamin D deficient' children (7 days) than in those with 'no vitamin D deficiency'. Rippel C *et al.* [15] reported the prevalence of Vitamin D deficiency was 34.5 % but was not associated with longer PICU stay or increased hospital mortality. Rey C et al [16] reported that the prevalence of Vitamin D deficiency was 29.5%. Pediatric intensive care patients presented an odds ratio of 2.26. Vitamin D deficiency incidence was high in PICU patients. Vitamin D deficiency was not associated with higher risk of mortality. Ayulo M Jr *et al.* [17] reported Vitamin D deficiency in 28% of patients, and vitamin D insufficiency was found in 47% of patients. There was 3% mortality, 83% of which occurred in patients with low vitamin D levels.

METHODOLOGY

A prospective observational hospital-based study was conducted at a government tertiary care hospital in Chennai, Tamil Nadu from January 2018 to Dec 2018. Eligible children below 5 years admitted to the ICU with Glasgow coma scale <8 or shock from any origin were included in the study as cases and children admitted to ICU without the above critical presentations were included in the study as controls. Children with chronic diseases, organ failure and treatment history of Vitamin D were excluded. Vitamin D insufficiency was defined as vitamin D level lower than < 30ng/ ml. Deficiency were defined as vitamin D level lower than < 20ng/ml. Descriptive analysis was conducted for quantitative variables. Frequency and proportion analysis was conducted for categorical variables. SPSS version 20 was used for statistical analysis.

RESULTS

Table 1: Demographic and clinical profile

Study Group		Cases N (%)	Controls N (%)
Gender	Male	116 (55.8)	45 (69.2)
	Female	92 (44.2)	20 (30.8)
Age group	< 1 year	70 (33.7)	12 (18.5)
	1 – 3 years	78 (37.5)	38 (58.5)
	3 – 5 years	60 (28.8)	15 (23)
Residence	Rural	150 (72.1)	45 (69.2)
	Urban	58 (27.9)	20 (30.8)
Nutrition status	Normal	110 (52.9)	65 (100)
	Moderate malnutrition	46 (22.1)	-
	Severe malnutrition	52 (25)	-
Socioeconomic class	Lower	7 (3.3)	-
	Middle lower	11 (5.3)	-
	Upper lower	190 (91.4)	65 (100)
Vitamin D	Severe deficiency (<10)	22 (10.6)	-
	Deficiency. (10 to 20.99)	110 (52.9)	7 (10.8)
	Insufficiency (21 to 29.99)	56 (26.9)	8 (12.3)
	Normal level (>30)	20 (9.6)	50 (76.9)
Median Vitamin D (ng/ml)		18	23.3
Outcome	Discharge	33 (15.9)	-
	Death	175 (84.1)	-
TOTAL		**208**	**65**

The gender distribution among the cases was 55.8% male and remainder 44.2% female. The control group had 69.2% male and 30.8% female. Age distribution among cases was 33.7% participants aged below 1 year, 37.5% participants were aged 1-3 years and 28.8% participants aged 3-5 years. Moderate malnutrition was seen in 22.1% of the cases and 25% presented with severe malnutrition. Nutrition and Socioeconomic status did not show any significance. 10.6% of cases had severe Vitamin D deficiency, 52.9% presented with moderate Vitamin D deficiency and 26.9% cases presented with mild Vitamin D deficiency. 84.1% of the cases died undergoing treatment. The median Vitamin D level among cases compared to controls was 18 and 23.3 between the two groups, which was statistically significant (p-value <0.001).

Table 2: Comparison of vitamin D levels between age group

Age group	Serum Vitamin D level			
	Severe deficiency (<10)	Vitamin D deficiency (10 to 20.99)	Vitamin D insufficiency (21 to 29.99)	Normal level of vitamin D (>30)
>1 year (N=70)	11 (15.6%)	37 (52.9%)	20 (28.6%)	2 (2.9%)
1 – 3 years (N=78)	4 (5.2%)	48 (61.5%)	17 (21.8%)	9 (11.5%)
3 – 5 years (N=60)	7 (11.6%)	25 (41.6%)	19 (31.6%)	9 (15%)

Of the 70 children below 1-year age group, 15.6% participants had severe deficiency, 52.9% participants had vitamin D deficiency and 28.6% participants had vitamin D insufficiency. Of 23 children between 1-3 year age group, 5.2% participant had severe deficiency, 61.5% participants had vitamin D deficiency and 21.8% participants had vitamin D insufficiency. Among children between 3-5 year age group, 11.6% participants had severe deficiency, 41.6% participants had vitamin D deficiency and 31.6% participants had vitamin D insufficiency. There was no statistical significance difference in the levels of vitamin D across age groups.

Table 3: Comparison of vitamin D level in cases to involved system on admission

Diagnosis	Serum Vitamin D level			
	Severe deficiency	Vitamin D deficiency	Vitamin D insufficiency	Normal level of vitamin D
Central nervous system infections (N=93)	9 (10.75%)	46 (48.4%)	33 (34.4%)	5 (6.4%)
Central nervous system / Respiratory system (N=7)	3 (42.8%)	2 (28.6%)	2 (28.6%)	-
Dengue shock syndrome (N=3)	-	1 (33.3%)	2 (66.7%)	-
Respiratory system (N=105)	10 (9.5%)	61 (58.1%)	19 (18.1%)	15 (14.2%)

50.5% of the cases were admitted with symptoms of the respiratory system. Of those admitted with respiratory symptoms, 58.1% were categorized as Vitamin D deficient and 18.1% were vitamin D insufficient. 44.7% of the ICU admissions presented with CNS infection symptoms, of which 48.4% participants had vitamin D deficiency and 34.4% had vitamin D insufficiency.

Table 4: Comparison of vitamin D level in cases to nutritional status (N=208)

Nutrition status	Serum Vitamin D level			
	Severe deficiency	Deficiency	Insufficiency	Normal
Normal (N=110)	14 (12.7%)	55 (50%)	28 (25.5%)	13 (11.8%)
Moderate malnutrition (N=46)	8 (17.4%)	26 (56.5%)	12 (26.1%)	-
Severe malnutrition (N=52)	-	29 (55.8%)	16 (30.8%)	7 (13.4%)

Severe malnutrition was seen among 55.8% of children diagnosed with vitamin D deficiency and 30.8% of children with vitamin D insufficiency. Moderate malnutrition was seen in 56.5% of children with vitamin D deficiency. The difference in the vitamin D levels between children nutrition statuses was statistically not significant.

Table 5: Comparison of vitamin D level in cases to outcome

Outcome	Serum Vitamin D level			
	Severe deficiency	Deficiency	Insufficiency	Normal
Discharge (N=33)	2 (6.1%)	16 (48.5%)	9 (27.3%)	6 (18.1%)
Death (N=175)	20 (11.5%)	94 (53.7%)	47 (26.8%)	14 (8%)

Death was the outcome among 84.1% of the study group. The proportion of children among those who died was 53.7% belonging to the vitamin D deficient group. Among the discharged children 48.5% were diagnosed as vitamin deficient. The vitamin D level was found not to be significant to the outcome.

DISCUSSION

Recently published studies reported 40 % [12], 50 % [13] and 74% [14] Vitamin D deficiency. Various factors like duration and timing of sun exposure, amount of skin exposed, skin pigmentation, dietary and genetic factors [18], have been implicated as possible reasons for the high incidence of vitamin D deficiency observed in the subcontinent. The deficiency may not be clinically relevant. There are multiple other factors involved for the critically ill population. Vitamin D deficiency is presumed to increase morbidity and mortality by its pleiotropic effects on various organ system functions and its effects on innate and adaptive immunity[17]. 84.1% of the study subjects in the present study faced death as an outcome. We observed that children who were vitamin D deficient at admission were more likely to require mechanical ventilation, inotropes, and fluid boluses and have prolonged duration of mechanical ventilation. All these factors in combination might have contributed to the outcome in this group of children. Vitamin D deficiency in children from other countries show variable prevalence, for instance the prevalence among 12–24 month-olds in China was 65.3% [19]; non-malnourished children in Qatar was 68.8% [20], urban children aged 1–6 years in Saudi Arabia was 63% [21], in rural Ethiopia among school-aged children in the community was 49% [22] and hospitalized malnourished children in Uganda was 43%. Ejaz *et al.* [23] reported 79% severely malnourished patients, 20% moderate malnutrition. 42% of the severely malnourished children had severe stunting. Rickets was diagnosed in 36% participants. Ebenezer K *et al.* [12] reported Vitamin D deficiency was seen in 40.3 % of the critically ill children. Shock was identified as the cause for admission in 30.8 %, CNS conditions 23.1 % and respiratory illnesses in 21.2%, which were the three common reasons to the ICU. Ponnarmeni S *et al.*[13] reported prevalence of Vitamin D Deficiency was higher among critically ill children with sepsis compared to healthy controls. Madden K *et al.* [24] analysed and reported that after adjusting for factors associated with deficiency, lower Vitamin D levels were associated with higher admission day illness severity. Mehta S *et al.* [25] reported the prevalence of Vitamin D deficiency was 32%. These data indicate that Vitamin D deficiency is prevalent among malnourished children. However, Mc Nally *et al.* [26] have documented a similar observation in the study where the authors observed that children with higher weight for age were more deficient than others. The prevalence of vitamin D deficiency was high in both well-nourished and malnourished groups. 55.8% of children with severe malnutrition nutrition status had vitamin D deficiency in the present study.

CONCLUSION

90.4% of the admitted children presented with one of the categories of vitamin D deficiency. 50.5% of the cases were admitted with symptoms of the respiratory system. 44.7% of the admissions presented with CNS infection symptoms. Severe vitamin D deficiency was seen in 10.6% of the study group. Death was the outcome among 84.1% of the study group. Vitamin D levels were not statistically significant to systems involved on admission, nutritional status and outcome of the admitted children. Statistical significance was noted in the levels of vitamin D between cases and controls. The cases presented with significantly lower serum vitamin D levels compared to the controls.

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