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Assessment Of Vitamin D Levels In Children With Severe Acute Malnutrition With Medical Complications: A Cross-Sectional Study

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ABSTRACT

Severe acute malnutrition (SAM) remains a major pediatric health challenge in India, frequently complicated by infections, electrolyte imbalance, and micronutrient deficiencies. Vitamin D plays a pivotal role in bone health and immune regulation, yet its status among children with complicated SAM has been underexplored. To evaluate serum vitamin D levels in children admitted with SAM and associated medical complications, and to explore correlations with clinical and biochemical parameters. This hospital-based cross-sectional study included children aged 6–59 months admitted with WHO-defined SAM and concurrent complications. Clinical details, anthropometry, and relevant laboratory investigations were recorded. Serum 25-hydroxyvitamin D was measured using standardized immunoassay methods. Vitamin D deficiency was defined as <20 ng/mL, insufficiency as 20–30 ng/mL, and sufficiency as >30 ng/mL. Among 120 children with SAM, the mean serum vitamin D level was 18.4 ± 6.2 ng/mL. Deficiency was observed in 62.5%, insufficiency in 24.2%, and sufficiency in only 13.3%. Deficient children had significantly higher rates of respiratory infections and hypocalcemia compared with those who were vitamin D sufficient. Mortality was more common in the deficiency group, though not statistically significant. Vitamin D deficiency is highly prevalent among children with complicated SAM and is associated with greater infectious morbidity and metabolic instability. Screening and correction of vitamin D levels may serve as an important adjunct in the management of SAM.

Keywords: severe acute malnutrition, vitamin D deficiency, pediatric nutrition, medical complications, cross-sectional study

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INTRODUCTION

Children admitted with severe acute malnutrition are often critically ill, presenting with infections, dehydration, or electrolyte problems that make treatment difficult. The condition continues to account for a large share of preventable childhood deaths, especially in poorer regions of South Asia and Africa [1]. In India, despite efforts through government nutrition schemes and hospital-based care units, the numbers remain high, and many of the children who survive struggle with prolonged weakness and repeated hospital visits [2].

Alongside the immediate challenges of feeding and stabilisation, deficiencies of vitamins and minerals play a major role in recovery. Vitamin D is particularly important because it not only supports growth of bones and regulation of calcium but also helps the immune system fight infections [3]. Children with low vitamin D often show slower improvement, more frequent chest infections, and a greater risk of metabolic disturbances [4].

Although low vitamin D status has been described in malnourished children, very little work has focused specifically on those admitted with complicated SAM. In India, where malnutrition and vitamin D deficiency are both widespread, this overlap has direct consequences for clinical care [5,6].

This study was carried out to measure vitamin D levels in children admitted with SAM and medical complications, and to examine how these levels relate to illness patterns and short-term outcomes. The results are expected to provide practical information that can guide paediatricians managing such children in resource-limited hospitals.

MATERIALS AND METHODS

Study Design and Setting

This was a cross-sectional study carried out in the paediatric ward and nutritional rehabilitation unit of a tertiary care , Government Medical College Hospital, Ramanathapuram, India.In the year February 2024 to April 2025. The hospital serves a mixed catchment area, with referrals coming from both rural primary health centres and nearby urban clinics. Children admitted with malnutrition are managed under national guidelines, with special focus on those presenting with medical complications.

Participants

Children aged 6–59 months, admitted with WHO-defined severe acute malnutrition and at least one medical complication, were eligible. Complications included pneumonia, persistent diarrhoea, severe dehydration, hypoglycaemia, or electrolyte imbalance. Children with congenital bone disease, chronic kidney disease, or those on vitamin D supplementation prior to admission were excluded.

A total of 120 children meeting these criteria were enrolled during the study period. The sample size was determined to allow estimation of vitamin D deficiency prevalence around 60 percent with a 95 percent confidence interval width of approximately ±9 percent, considered sufficient for prevalence estimation and group comparisons.

Data Collection

A structured proforma was used to record demographic details, feeding history, immunisation status, clinical signs, and anthropometric measurements. Weight, length/height, and mid-upper arm circumference were measured by trained staff using standardised equipment. Z-scores were calculated with WHO Anthro software.

Laboratory Investigations

Venous blood samples were collected within 48 hours of admission. Basic investigations such as complete blood counts, serum electrolytes, and calcium were performed according to routine clinical protocols. Serum 25-hydroxyvitamin D [25(OH)D] was measured by chemiluminescent immunoassay in

the hospital laboratory. Vitamin D deficiency was defined as <20 ng/mL, insufficiency as 20–30 ng/mL, and sufficiency as >30 ng/mL.

Outcomes

The primary outcome was prevalence of vitamin D deficiency among children with complicated SAM. Secondary outcomes included association of vitamin D status with type of medical complication, length of hospital stay, and short-term mortality during admission.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25. Continuous variables were expressed as mean with standard deviation or median with interquartile range, depending on distribution. Categorical variables were expressed as percentages. Group comparisons were made using chi-square test or Fisher's exact test for categorical data and t-test for continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS

Study Cohort

A total of 120 children with complicated SAM were enrolled. The mean age was 24.7 ± 11.3 months, with 56.7% boys. More than half were below two years of age, and nearly two-thirds had incomplete immunisation. Pneumonia was the leading complication at admission, followed by persistent diarrhoea, electrolyte imbalance, and severe dehydration.

Table 1: Baseline characteristics of children with complicated SAM (N = 120)

Variable	Value
Mean age (months)	24.7 ± 11.3
Age group 6–23 months	68 (56.7%)
Age group 24–59 months	52 (43.3%)
Sex: Male	68 (56.7%)
Incomplete immunisation	78 (65.0%)
Common complications at admission	
– Pneumonia	44 (36.7%)
– Persistent diarrhoea	32 (26.7%)
– Electrolyte imbalance	21 (17.5%)
– Severe dehydration	15 (12.5%)
– Hypoglycaemia	8 (6.6%)

Vitamin D Status

The mean serum vitamin D concentration was 18.4 ± 6.2 ng/mL. Deficiency was widespread, with nearly two-thirds of children falling below 20 ng/mL. Only a small minority (13.3%) had sufficient levels.

Table 2: Distribution of vitamin D status in study participants

Vitamin D category	Frequency (n)	Percentage (%)
Deficient (<20 ng/mL)	75	62.5
Insufficient (20–30 ng/mL)	29	24.2
Sufficient (>30 ng/mL)	16	13.3

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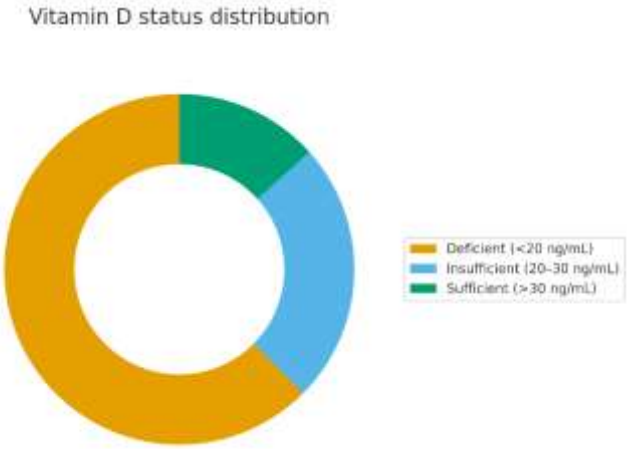
Figure 1: Vitamin D status distribution among children with complicated SAM

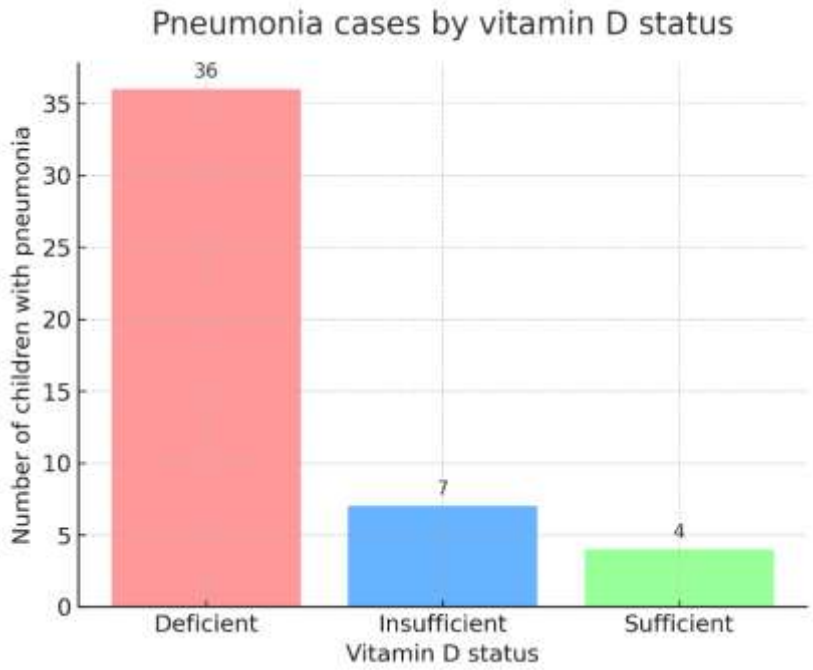


Donut chart showing proportions of deficiency, insufficiency, and sufficiency

Association with Clinical Complications

Children with vitamin D deficiency were more likely to present with respiratory infections. Pneumonia was recorded in 48.0% of deficient children, compared with 24.1% of those with insufficiency and 25.0% of those with sufficient levels.

Figure 2: Pneumonia cases across vitamin D categories



Bar chart comparing pneumonia frequency among deficient, insufficient, and sufficient groups

Hospital Stay and Outcomes

Median hospital stay was longer in children with vitamin D deficiency. A higher proportion of deficient children required more than 12 days of admission, whereas short stays (≤7 days) were most frequent in those with sufficient vitamin D.

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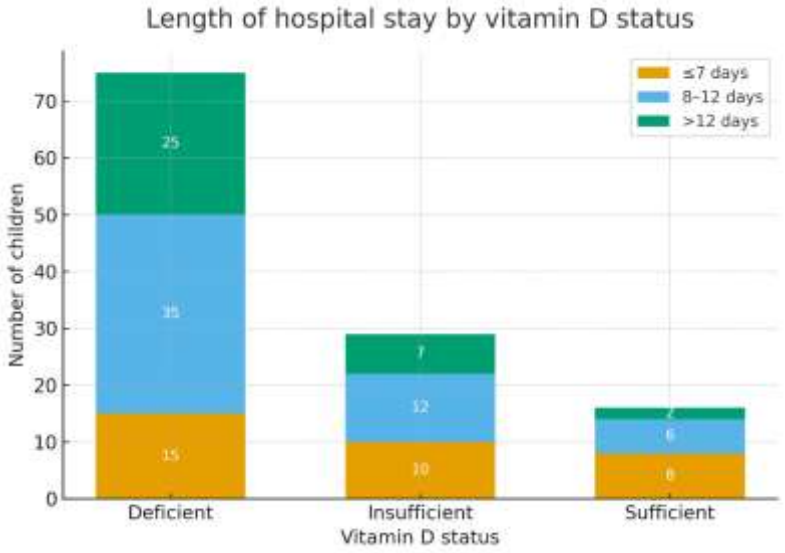
Figure 3. Length of hospital stay by vitamin D status



Stacked bar chart showing proportions of ≤7 days, 8–12 days, and >12 days across groups

Mortality was observed in 9 children (7.5%). Seven of these were from the vitamin D deficient group, two were from the insufficient group, and none were from the sufficient group. The difference was not statistically significant.

Table 3: Association between vitamin D status and clinical outcomes

Outcome	Deficient (n=75)	Insufficient (n=29)	Sufficient (n=16)	p-value
Pneumonia (%)	36 (48.0)	7 (24.1)	4 (25.0)	0.04
Hypocalcaemia (%)	22 (29.3)	4 (13.8)	1 (6.3)	0.03
Hospital stay >12 days (%)	25 (33.3)	7 (24.1)	2 (12.5)	0.02
Mortality (%)	7 (9.3)	2 (6.9)	0 (0)	0.18

DISCUSSION

In this study, most children admitted with severe acute malnutrition and medical complications were found to have low vitamin D levels. Only a small minority had values within the sufficient range. This pattern is consistent with earlier Indian and African reports, where undernourished children frequently showed poor vitamin D status [7].

Respiratory illness was particularly common in the deficient group. Vitamin D has an important role in immune defence, especially in the lungs, and deficiency is thought to reduce antimicrobial activity in the airway. Previous Indian studies have also reported higher odds of acute respiratory infections in children with low vitamin D [8,9].

Children with low vitamin D also stayed longer in hospital. This could reflect slower recovery, greater risk of metabolic imbalance, or recurrent infections during admission. Similar findings have been noted in other hospital cohorts, where deficiency was associated with delayed nutritional rehabilitation [10]. Mortality was higher in deficient children in our study, although the difference was not statistically significant. Large cohort studies from Africa have demonstrated a stronger association, suggesting that our sample may not have been large enough to detect such an effect [11,12].

We also noted a clear link between deficiency and hypocalcaemia. The physiological explanation is well established: without adequate vitamin D, intestinal calcium absorption falls, predisposing to low

serum calcium and poor bone health [13]. In the context of malnutrition, this adds another burden and may slow catch-up growth.

From a practical perspective, these results support consideration of vitamin D assessment in children with complicated SAM. Some small Indian trials have already shown benefits of supplementation, including faster weight gain and improved immune recovery [14]. Incorporating vitamin D correction into existing treatment protocols for SAM could therefore improve outcomes, though larger controlled studies are needed to confirm this [15].

This study has limitations. It was conducted in a single centre, which restricts generalisability. Being cross-sectional, it can show associations but not causation. Follow-up after discharge was not included, so long-term impact could not be measured. Even with these limitations, the findings add to current evidence by showing that vitamin D deficiency is common in hospitalised children with SAM and is linked with greater clinical instability.

CONCLUSION

Most children admitted with severe acute malnutrition and medical complications had low vitamin D levels. Deficiency was linked with more respiratory infections, higher rates of hypocalcaemia, and longer hospital stays. Mortality was also higher in the deficient group, though not statistically significant. These findings highlight the importance of considering vitamin D screening and supplementation as part of the comprehensive care of children with complicated SAM.

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