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Original Research Article

Estimation of Vitamin B 12 Levels in Children with Severe Acute Malnutrition

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Abstract

Background: Vitamin B12 remains a major public health challenge in India. It contributes to anemia, impaired growth, neurodevelopmental delay, and increased susceptibility to infections. This study aimed to estimate vitamin B12 levels among children with severe acute malnutrition and determine their association with socio-demographic and anthropometric factors.

Methods: A hospital-based observational study was conducted over 10 months (March 2024–December 2024) among 107 children aged 6–60 months admitted with SAM to the Malnutrition Treatment Centre (MNTC), J.L.N. Medical College and Hospital, Ajmer. Serum vitamin B12 levels were measured using the electrochemiluminescence (ECL) method on the COBAS e411 analyzer. Vitamin B12 levels <100 pg/mL were considered deficient, 100–200 pg/mL borderline, and >200 pg/mL sufficient. Statistical analysis was performed using SPSS version 23.0, with p<0.05 considered statistically significant.

Results: Among the 107 children, 54 (50.5%) were males and 53 (49.5%) were females. The majority (45.8%) were aged 37–60 months, 82% belonged to low or middle socioeconomic status, 32.7% were exclusively breastfed and 55.1% were completely immunized. Overall, 75 (70.1%) children had vitamin B12 levels <200 pg/mL. Vitamin B12 deficiency was significantly associated with female gender (81.1% vs. 59.3% in males; p=0.0135), lower socioeconomic status (88.9%; p<0.0001), lack of exclusive breastfeeding (86.1%; p<0.0001), and incomplete immunization (p=0.0062). No significant association was observed with age (p=0.1025). Head circumference <-3 SD (78.5% vs. 46.4%; p=0.0014) as well as weight-for-height <-3 SD (82.9% vs. 28.0%; p<0.0001) showed significant associations with vitamin B12 deficiency.

Conclusion: Vitamin B12 deficiency is highly prevalent among children with severe acute malnutrition. Female gender, low socioeconomic status, non-exclusive breastfeeding, incomplete immunization and severe anthropometric deficits were significantly associated with lower vitamin B12 levels. Routine screening and timely correction of vitamin B12 deficiency should be considered as an integral component to improve growth and developmental outcomes.

Keywords: Severe Acute Malnutrition, Vitamin B12 Deficiency, Children, Micronutrient Deficiency, Anthropometry, Socioeconomic Status.

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Introduction

People's nutritional status is widely acknowledged as a sign of a country's progress. Nutrition is a development process indication that is both an input and an outcome. Promoting people's nutritional status is crucial since a healthy, well-fed workforce is a prerequisite for effective social and economic growth [1]. One of the main problems with public health is severe acute malnutrition. In India, an estimated 8.1 million (7.5%) children under five suffer from it. This disorder is responsible for 24.6 million DALYs (Disability Adjusted Life Years) and around 0.6 million fatalities.[2] A mid-upper arm circumference of less than 11.5 cm, weight-for-height/length (Z-score below -3 SD of the median WHO child growth criteria), or the existence of nutritional edema are indicators of severe acute malnutrition.[3] For children under five, SAM dramatically raises the chance of mortality. By raising the case fatality rate in kids with common diseases including diarrhea, acute respiratory infections, malaria, and measles, it can be a direct or indirect cause of child mortality.[4] Over the past 20 years, severe acute malnutrition (SAM) among preschoolers in India has become more common. The National Family Health Survey-3 (NFHS-3) saw an increase from 6.6% in 2005–2006 to 7.5% in 2015–2016. The most recent NFHS-5 study (2019–2021), which covered 36 states and union territories (UTs), shows that the prevalence is still a concerning 7.7%.

An estimated 8.1 million (7.5%) children under the age of five in India suffer from severe acute malnutrition, which is the cause of around 0.6 million fatalities. Data from the National Family Health Survey-5 (NFHS-5,2021-2022) showed that the prevalence of underweight children was 35.8% and 63%, while the rates of malnutrition, wasting, and stunting children were 58% and 16%, respectively.[5]

Due to low socioeconomic level, insufficient intake, and poor absorption, malnutrition further raises the risk of these micronutrient deficiencies. Megaloblastic anemia, stunted development, and an increase in infections are caused by vitamin B12 and folate deficiencies. Additionally, vitamin B12 deficiency causes irreparable neurological damage to the developing brain. According to statistics from the 1999 National Nutrition Survey, 30% of people had a vitamin B12 deficiency. The National Anaemia Control Program, which provides iron and folic acid pills to mothers and children on a regular basis, may be the reason for the declining trend in iron and folate insufficiency.[6]

In severe malnutrition, deficiencies in both macronutrients and micronutrients (folic acid, vitamin B12, magnesium, zinc, fat-soluble vitamins like vitamin A, D, E, and K; selenium, copper, phosphorus, calcium, potassium, sodium, biotin, niacin, riboflavin, and thiamine) frequently coexist, and their effects on morbidity and mortality may be complicated.

Children with cobalamin deficiency may exhibit symptoms such as weakness, lethargy, failure to grow, microcephaly, pallor, glossitis, skin hyperpigmentation, vomiting, diarrhea, and icterus. Symptoms may include developmental delay and tremors. Children with poor cognitive performance, seizures, and sensory abnormalities face significant challenges as they grow. Maternal Vitamin B12 insufficiency in breast milk may increase the incidence of neural tube abnormalities.

This study determined the Estimation of vitamin b 12 levels in children with severe acute malnutrition

Methods

A 10-month observational study was conducted on 107 extremely malnourished children admitted the in the MNTC ward J.L.N Medical college & hospital, Ajmer from March 2024 to December 2024. In study include every child with severe acute malnutrition between the ages of six and sixty months whose parents gave their permission to take part in the study and excluded children who had undergone a blood transfusion in the previous six months, as well as those who had taken multivitamins or iron folic acid during that time frame. A complete socio-economic, feeding, and development history was gathered. Detailed anthropometric measurements were collected using established procedures. Standard procedures were used to obtain detailed anthropometric measurements. Children with a weight for length/height Z-score (WHZ) < -3SD were identified as having severe acute malnutrition based on WHO child growth. At admission, blood samples were taken in order to assess plasma vitamin B. A COBAS e411 analyzer was used to measure vitamin B12 levels using the electrochemiluminescence (ECL) method. A cut-off value of less than 100 pg/ml was deemed insufficient, between 100 and 200 pg/ml was deemed borderline, and more than 200 pg/ml was deemed sufficient.

Statistical Analysis: Microsoft Excel will be used to enter the data, which will then be exported into SSPS 23.0 (trial version). Chi square test, T-test, percentage, mean, and standard deviation was calculated. Tests with a p-value of less than 0.05 are deemed statistically significant.

Result

Between March 2024 and December 2024, a total of 107 severely malnourished children were admitted to the MNTC ward at J.L.N Medical College & Hospital in Ajmer. Out of these 107 children, 54 (50.5%) were male and 53 (49.5%) were female. Three age groups were identified, with the majority of children (49, or 45.8%) falling into the 37–60-month age range, followed by the 13–36-month age range. Eighty-two percent of children are from the Low and Middle socioeconomic classes. Just 35 children (32.7%) were exclusively breastfed. 59 (55.1%) children had fulfilled their vaccination status. (Table no. 1) In the study, 79 (73.8%) children had head circumference <-3SD, and 82 (76.6%) children had weight for height <-3 SD, (table no. 2)

Table 1: Association of Socio-demographic variables with Vitamin B 12 levels in Participants (N=107)

		Vitamin B12 Levels		Total	Chi sq (p Value)
		<200 pg/ml	>200 pg/ml		
Gender	Male	32(59.3%)	22(40.7%)	54	6.105 (0.0135*)
	Female	43(81.1%)	10(18.9%)	53	
Age	7-12	9(50%)	9(50%)	18	4.555 (0.1025)
	13-36	31(77.5%)	9(22.5%)	40	
	37-60	35(71.4%)	14(28.6%)	49	
SES	Upper	6(31.6%)	13(68.4%)	19	21.173 (<0.0001*)
	Middle	29(67.4%)	14(32.6%)	43	
	Lower	40(88.9%)	5(11.1%)	45	
Exclusive Breastfeed	Yes	13(37.1%)	22(62.9%)	35	26.94 (<0.0001*)
	No	62(86.1%)	10(13.9%)	72	
Immunization status	Non immunized	12(92.3%)	1(7.7%)	13	10.154 (0.0062*)
	Partially Immunized	29(82.9%)	6(17.1%)	35	
	Completely Immunized	34(57.6%)	25(42.4%)	59	

The present table describes the distribution of Vitamin B12 levels (<200 pg/ml and >200 pg/ml) across various demographic and clinical factors. A statistically significant association was observed between gender and Vitamin B12 deficiency ($p = 0.0135$), with females (81.1%) showing a higher prevalence of deficiency compared to males (59.3%).

Although different age groups exhibited varying proportions of deficiency, with the highest prevalence seen in the 13–36 years group (77.5%), the association was not statistically significant ($p = 0.1025$). Socioeconomic status demonstrated a highly significant relationship with Vitamin B12 levels ($p < 0.0001$), as deficiency was most prevalent in the lower class (88.9%), followed by the middle class (67.4%), and least in the upper class (31.6%). Exclusive breastfeeding was also significantly associated with Vitamin B12 status ($p < 0.0001$), with non-breastfed individuals showing a markedly higher prevalence of deficiency (86.1%) compared to those who were exclusively breastfed (37.1%).

Similarly, immunization status showed a significant association ($p = 0.0062$), with the highest deficiency observed among non-immunized individuals (92.3%), followed by partially immunized (82.9%), and the lowest in completely immunized individuals (57.6%). Overall, the findings indicate that Vitamin B12 deficiency is significantly influenced by gender, socioeconomic status, breastfeeding practices, and immunization status, while age does not appear to have a statistically significant impact.

Table 2: Association of Anthropometrics Measurements with Vitamin B 12 levels in Participants (N=107)

		Vitamin B12 Levels		Total	Chi sq (p Value)
		<200 pg/ml	>200 pg/ml		
Head Circumference	<-3SD	62(78.5%)	17(21.5%)	79	10.132 (0.0014*)
	>-3SD	13(46.4%)	15(53.6%)	28	
Weight for height	<-3SD for age	68(82.9%)	14(17.1%)	82	27.574 (<0.0001*)
	>-3SD for age	7(28%)	18(72%)	25	

The table demonstrates the association between Vitamin B12 levels and anthropometric indicators, namely head circumference and weight-for-height. A statistically significant association was observed between head circumference and Vitamin B12 deficiency ($p = 0.0014$). Among children with head circumference less than -3SD, 78.5% were deficient in Vitamin B12, whereas only 46.4% of those with head circumference greater than -3SD were deficient. This indicates that reduced head circumference is significantly associated with a higher prevalence of Vitamin B12 deficiency.

Similarly, weight-for-height showed a highly significant association with Vitamin B12 levels ($p < 0.0001$). A large proportion of children with weight-for-height less than -3SD (82.9%) were deficient, compared to only 28% among those with weight-for-height greater than -3SD. This suggests that severe wasting is strongly linked with Vitamin B12 deficiency.

Overall, these findings highlight that poor nutritional status, as reflected by reduced head circumference and low weight-for-height, is significantly associated with increased prevalence of Vitamin B12 deficiency.

Discussion

The present study demonstrated that vitamin B12 deficiency was significantly associated with female gender, lower socioeconomic status, lack of exclusive breastfeeding, and incomplete immunization, whereas age did not show a statistically significant association. The higher prevalence of vitamin B12 deficiency among females (81.1%) is consistent with findings from several recent studies, which have reported a greater burden of micronutrient deficiencies among girls because of poorer dietary diversity, lower intake of animal-source foods, and gender-related nutritional disparities, particularly in low- and middle-income countries [7].

The strong association between lower socioeconomic status and vitamin B12 deficiency observed in the present study. Similar findings have been reported by Melaku et al. in Ethiopia, where children from low-income families had significantly higher odds of vitamin B12 deficiency because of poor dietary diversity and food insecurity [9].

Exclusive breastfeeding showed a significant protective association against vitamin B12 deficiency in the present study. Although exclusive breastfeeding is recommended during the first six months of life, its influence on infant vitamin B12 status largely depends on maternal vitamin B12 stores. Therefore, the findings of the present study may reflect better maternal nutritional status and improved infant feeding practices among exclusively breastfed children.

A significant association was also observed between immunization status and vitamin B12 deficiency, with non-immunized and partially immunized children exhibiting a higher prevalence of deficiency. Although direct evidence linking immunization status with vitamin B12 deficiency is limited, previous studies have suggested that incomplete immunization often reflects poor healthcare utilization, inadequate caregiver awareness, and lower socioeconomic conditions, all of which are closely associated with poor nutritional status and micronutrient deficiencies [8]. Thus, immunization status may serve as an indirect indicator of overall child health and access to preventive healthcare services rather than being a direct determinant of vitamin B12 deficiency.

The present study demonstrated a significant association between vitamin B12 deficiency and anthropometric indicators, particularly head circumference and weight-for-height. Children with a below −3 SD head circumference (78.5%) and below −3 SD weight-for-height (82.9%) had a significantly higher prevalence of vitamin B12 deficiency. This finding is consistent with study conducted by Melaku et.al. Among children with severe acute malnutrition (SAM) [8].

Likewise, a hospital-based study by Sharma et al. found that nearly half of children admitted with SAM had vitamin B12 deficiency, which was associated with severe wasting, anemia, and developmental delay (10). A recent tertiary care study from central India also demonstrated that vitamin B12 deficiency was significantly more common among children with SAM than healthy controls and was associated with more severe clinical manifestations, including severe anemia and poor nutritional status [11].

Furthermore, a recent study from Tanzania has also observed that children with severe acute malnutrition frequently exhibited functional vitamin B12 deficiency [12].

Overall, the findings of the present study are in agreement with existing literature, indicating that severe anthropometric deficits, particularly severe wasting, are associated with an increased risk of vitamin B12 deficiency. The observed association between reduced head circumference and vitamin B12 deficiency further reinforces the essential role of vitamin B12 in normal brain growth and neurodevelopment. These findings emphasize the importance of routine assessment of vitamin B12 status in children with severe acute malnutrition and severe growth failure, particularly in resource-limited settings where micronutrient deficiencies frequently coexist with protein-energy malnutrition.

Limitation: The present study had certain limitations. It was a single-center observational study with a relatively small sample size, which may limit the generalizability of the findings. Vitamin B12 status was assessed using serum vitamin B12 levels only, without functional biomarkers such as methylmalonic acid or homocysteine, which may have resulted in underestimation or misclassification of deficiency. Dietary history and feeding practices were based on caregiver recall and may be subject to recall bias. Maternal vitamin B12 status and inflammatory markers were not assessed.

Conclusion

The present study demonstrated that vitamin B12 deficiency is highly prevalent among children with severe acute malnutrition (SAM), indicating that micronutrient deficiencies remain a major nutritional concern in this vulnerable population.

A significant association was observed between vitamin B12 deficiency and female gender, lower socioeconomic status, lack of exclusive breastfeeding, incomplete immunization, reduced head circumference, and severe wasting (weight-for-height < −3 SD). However, age was not significantly associated with vitamin B12 deficiency.

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