International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Vitamin B12 Deficiency and Its Association with Haemoglobin Status in Children with Severe Acute Malnutrition: A Hospital-Based Cross-Sectional Study

Dr. Aqsa Rashid[1], Dr. Ashish Verma[2], Dr. Saman Beg[3], Dr. Akanksha D Shrivastava[4]

[1,2,3,4]*Career Institute of Medical Sciences and Hospital, Atal Bihari Vajpayee Medical University, Uttar Pradesh, India*

OPEN ACCESS

Corresponding Author:

Dr. Saman Beg
Career Institute of Medical Sciences and Hospital, Atal Bihari Vajpayee Medical University, Uttar Pradesh, India

Received: 04-05-2026
Accepted: 22-06-2026
Available online: 23-07-2026

ABSTRACT

Background: Severe acute malnutrition (SAM) remains a major cause of childhood morbidity and mortality in low-resource settings. Vitamin B12 deficiency is a common but often overlooked micronutrient deficiency in children with SAM and may contribute to significant hematological abnormalities, particularly anemia and macrocytosis.

Objectives: To determine the prevalence of vitamin B12 deficiency among children with severe acute malnutrition and evaluate its association with hemoglobin levels and hematological parameters.

Methods: This hospital-based cross-sectional study was conducted in the Department of Pediatrics at a tertiary care hospital in Lucknow, India, during 2022–2023. A total of 110 children aged 6–59 months fulfilling the World Health Organization criteria for severe acute malnutrition were enrolled. Demographic and clinical details were recorded, and blood samples were analyzed for serum vitamin B12, hemoglobin, mean corpuscular volume (MCV), and platelet count. Vitamin B12 deficiency was defined as a serum level <200 pg/mL. Statistical analysis was performed using SPSS version 29.0, with $p < 0.05$ considered statistically significant.

Results: Among the 110 enrolled children, 48 (43.6%) had vitamin B12 deficiency. Anemia (hemoglobin <11 g/dL) was present in 98 (89.1%) children, with moderate-to-severe anemia observed in 74 (67.3%). Vitamin B12 deficiency was significantly associated with severe anemia (31.3% vs. 9.7%; $p = 0.003$) and macrocytic blood picture (85.4% vs. 1.6%; $p < 0.001$). Although thrombocytopenia was more frequent among vitamin B12-deficient children (20.8% vs. 11.3%), the association was not statistically significant ($p = 0.392$). No significant difference in vitamin B12 deficiency was observed between male and female children ($p = 0.216$).

Conclusion: Vitamin B12 deficiency is highly prevalent among children with severe acute malnutrition and is significantly associated with severe anemia and macrocytosis. Routine screening and timely vitamin B12 supplementation should be considered as part of comprehensive management protocols for children with severe acute malnutrition.

Keywords*: Severe acute malnutrition; Vitamin B12 deficiency; Anemia; Macrocytosis; Children.*

INTRODUCTION

Severe acute malnutrition (SAM) is the most severe form of undernutrition affecting children aged 6–59 months. It is characterized by a very low weight-for-height (below −3 standard deviations), visible severe wasting, or bilateral pitting edema, and is associated with a markedly increased risk of infections, complications, and mortality if not recognized and treated promptly.(1) SAM remains a major public health challenge, particularly in low- and middle-income countries. Globally, an estimated 45 million children under five years of age are wasted, of whom approximately 13.6 million suffer

from severe acute malnutrition.(2) Children with SAM have a five- to eight-fold higher risk of mortality than their well-nourished counterparts owing to impaired immunity, recurrent infections, and multiple metabolic derangements.(3) In addition to protein-energy deficiency, children with SAM frequently develop deficiencies of essential micronutrients, including vitamin A, vitamin D, iron, folate, and vitamin B12, because of inadequate dietary intake, impaired intestinal absorption, and increased physiological requirements. These micronutrient deficiencies adversely affect growth, immune function, neurodevelopment, and clinical recovery.(4) Vitamin B12 (cobalamin) is an essential water-soluble vitamin required for DNA synthesis, erythropoiesis, normal neurological function, and cellular metabolism. It is obtained predominantly from animal-derived foods; therefore, children consuming diets deficient in animal products or those born to vitamin B12-deficient mothers are at increased risk of deficiency. Vitamin B12 deficiency leads to ineffective erythropoiesis, megaloblastic or macrocytic anemia, and, if prolonged, irreversible neurological impairment.(5) In children with SAM, vitamin B12 deficiency is multifactorial and may result from poor dietary intake, low maternal vitamin B12 stores, inadequate breast milk concentrations, inappropriate complementary feeding practices, underlying malabsorption, and the generalized nutritional deprivation associated with severe malnutrition.(6) Recent Indian studies have reported that vitamin B12 deficiency affects approximately 41%–77% of children with severe acute malnutrition, highlighting its high prevalence in this vulnerable population.(7) Beyond hematological abnormalities, vitamin B12 deficiency has also been associated with delayed neurodevelopment, impaired cognitive function, and poor nutritional rehabilitation. Consequently, early identification and timely supplementation of vitamin B12 have become increasingly important components of comprehensive SAM management.(8) Despite the established biological importance of vitamin B12 and its potential impact on hematological and neurological outcomes, its status is not routinely evaluated in many children with severe acute malnutrition. Limited Indian data are available regarding the relationship between vitamin B12 deficiency and hemoglobin status among hospitalized children with SAM. Therefore, the present study was undertaken to determine the prevalence of vitamin B12 deficiency in children with severe acute malnutrition and to evaluate its association with hemoglobin levels and hematological abnormalities.

METHODS

Study Design and Setting - This hospital-based cross-sectional study was conducted in the Department of Pediatrics, Career Institute of Medical Sciences and Hospital, Lucknow, between 2022–2023.

Study Population - Children aged 6–59 months meeting WHO criteria for SAM were included. Exclusion criteria included chronic illnesses, recent transfusions or supplementation, and preterm birth . Sample Size and Sampling - A sample size of 110 was calculated based on a presumed prevalence of 43.5% (Verma et al., 2021) and a 5% margin of error.

Data Collection - A detailed history was obtained, including sociodemographic, dietary, and feeding practices. Anthropometric measurements were taken using standardized methods. Venous blood samples were analyzed for hemoglobin, mean corpuscular volume (MCV), and vitamin B12 using chemiluminescence immunoassay.

Definitions :

SAM: - weight-for-height <-3 SD, - MUAC <11.5 cm, - or bilateral edema

Anaemia: Hb <11 g/dL Mild (10–10.9) Moderate (7–9.9) Severe (<7)

Vitamin B12 deficiency: <200 pg/mL.

Statistical Analysis : Data were analysed using SPSS v29. Categorical variables were compared using Chi-square test; continuous variables were compared using t-test. $P<0.05$ was considered statistically significant.

RESULTS

Out of 110 children, 69 were male (62.7%) and 41 were female (37.3%). The mean age was 22.38 ± 13.93 months, and 77 children (70.0%) were younger than 24 months.

Table 1. Distribution of patients according to age and sex

Age group	Male, n (%)	Female, n (%)	Total, n (%)
6–12 months	30 (43.5)	9 (22.0)	39 (35.5)
13–24 months	17 (24.6)	21 (51.2)	38 (34.5)
25–36 months	13 (18.8)	6 (14.6)	19 (17.3)
37–48 months	6 (8.7)	4 (9.8)	10 (9.1)
49–59 months	3 (4.3)	1 (2.4)	4 (3.6)
Total	69 (100.0)	41 (100.0)	110 (100.0)
Mean age ± SD (range), months	21.83 ± 14.88 (6–59)	23.32 ± 12.29 (7–57)	22.38 ± 13.93 (6–59)

$\chi^2 = 9.175$; $p = 0.057$ for age-group distribution. Independent-samples $t = 0.541$; $p = 0.590$ for mean age.

The above table illustrates that, out of 110 study participants, 69 (62.7%) were male and 41 (37.3%) were female. The 6–12-month, 13–24-month, 25–36-month, 37–48-month and 49–59-month groups comprised 39 (35.5%), 38 (34.5%), 19 (17.3%), 10 (9.1%) and 4 (3.6%) children, respectively. The mean age was 21.83 ± 14.88 months among males, 23.32 ± 12.29 months among females and 22.38 ± 13.93 months overall. Neither age-group distribution nor mean age differed significantly by sex.

Table 2. Distribution of patients according to vitamin B12 status

Vitamin B12 status	Male, n (%)	Female, n (%)	Total, n (%)	Test statistic	p-value
Deficiency (<200 pg/mL)	27 (39.1)	21 (51.2)	48 (43.6)	$\chi^2 = 1.528$	0.216
Normal (≥200 pg/mL)	42 (60.9)	20 (48.8)	62 (56.4)	—	—
Total	69 (100.0)	41 (100.0)	110 (100.0)	—	—
Mean vitamin B12 ± SD (range), pg/mL	219.16 ± 40.67 (159.18–316.50)	216.77 ± 41.37 (168–320)	218.27 ± 40.76 (159.2–320)	t = 0.296	0.768

The above table illustrates that, out of 110 study participants, 48 (43.6%) had vitamin B12 deficiency and 62 (56.4%) had normal vitamin B12 status. Deficiency was present in 27/69 males (39.1%) and 21/41 females (51.2%), with no significant sex-wise association ($\chi^2 = 1.528$; p = 0.216). The mean vitamin B12 level was 219.16 ± 40.67 pg/mL among males, 216.77 ± 41.37 pg/mL among females and 218.27 ± 40.76 pg/mL overall, with no significant mean difference (t = 0.296; p = 0.768).

Table 3. Association of vitamin B12 deficiency with haematological status

Characteristic	Vitamin B12 deficiency (n=48), n (%)	No deficiency (n=62), n (%)	Total (n=110), n (%)	χ^2	p-value
Anemia: absent	1 (2.1)	11 (17.7)	12 (10.9)	13.77	0.003
Anemia: mild	8 (16.7)	16 (25.8)	24 (21.8)	—	—
Anemia: moderate	24 (50.0)	29 (46.8)	53 (48.2)	—	—
Anemia: severe	15 (31.3)	6 (9.7)	21 (19.1)	—	—
Platelets <0.5 lakh/mm³	3 (6.3)	2 (3.2)	5 (4.5)	2.996	0.392
Platelets 0.5–1.0 lakh/mm³	7 (14.6)	5 (8.1)	12 (10.9)	—	—
Platelets 1.0–2.0 lakh/mm³	18 (37.5)	20 (32.3)	38 (34.5)	—	—
Platelets >2.0 lakh/mm³	20 (41.7)	35 (56.5)	55 (50.0)	—	—
MCV: microcytic	1 (2.1)	21 (33.9)	22 (20.0)	80.94	<0.001
MCV: normocytic	6 (12.5)	40 (64.5)	46 (41.8)	—	—
MCV: macrocytic	41 (85.4)	1 (1.6)	42 (38.2)	—	—

The above table illustrates that, out of 110 study participants, anemia was present in 98 (89.1%): 24 (21.8%) had mild, 53 (48.2%) moderate and 21 (19.1%) severe anemia, while 12 (10.9%) were non-anemic. Severe anemia occurred in 15/48 vitamin B12-deficient children (31.3%) and 6/62 non-deficient children (9.7%), and the overall anemia distribution differed significantly ($\chi^2 = 13.77$; p = 0.003). Platelet counts below 1 lakh/mm³ occurred in 10/48 deficient children (20.8%) and 7/62 non-deficient children (11.3%), without a significant association ($\chi^2 = 2.996$; p = 0.392). Macrocytosis was present in 41/48 deficient children (85.4%) and 1/62 non-deficient child (1.6%), with a significant association between vitamin B12 status and MCV category ($\chi^2 = 80.94$; p < 0.001).

DISCUSSION

The present study demonstrated that 43.6% of children with severe acute malnutrition (SAM) had vitamin B12 deficiency. This prevalence is comparable with previous Indian studies. Vaid et al. reported a high prevalence of vitamin B12 deficiency among hospitalized children with SAM, while Atiq et al. also observed that vitamin B12 deficiency is common in children with severe acute malnutrition and adversely influences nutritional recovery and development. Similar findings were reported by Nikièma et al., who demonstrated that vitamin B12 deficiency remains highly prevalent among malnourished children undergoing nutritional rehabilitation in low-resource settings. These findings indicate that vitamin B12 deficiency is a frequent micronutrient deficiency in children with SAM and warrants routine evaluation during management (7,8,10). The demographic profile of the present study showed that most children were below 24 months of age, with males constituting 62.7% of the study population. Although vitamin B12 deficiency was more frequent among females (51.2%) than males (39.1%), the difference was not statistically significant. Similar observations have been reported by Vaid et al. and Atiq et al., suggesting that vitamin B12 deficiency in SAM is more closely related to nutritional

inadequacy than to gender (7,8). The present study further demonstrated a significant association between vitamin B12 deficiency and hematological abnormalities. Overall, 89.1% of the study population was anemic, and children with vitamin B12 deficiency had a significantly higher frequency of severe anemia compared with children having normal vitamin B12 levels. These findings are comparable with those reported by Arya et al., who described a high prevalence of anemia among children with SAM, and by Venigalla et al., who also reported severe anemia as a common hematological manifestation in severely malnourished children (9,13). A particularly important observation in the present study was the strong association between vitamin B12 deficiency and macrocytosis. Macrocytic blood picture was observed in 85.4% of vitamin B12-deficient children compared with only 1.6% of those without deficiency ($p < 0.001$). This finding is biologically plausible because vitamin B12 plays an essential role in DNA synthesis and erythrocyte maturation. Similar hematological changes have been reported by Mangshetty et al., who observed macrocytic anemia as the predominant presentation of pediatric vitamin B12 deficiency, while Halicioglu et al. demonstrated comparable hematological abnormalities among vitamin B12-deficient infants (6,14). Although thrombocytopenia was more common among vitamin B12-deficient children than those without deficiency, the difference was not statistically significant. This suggests that platelet abnormalities may accompany vitamin B12 deficiency but occur less consistently than anemia and macrocytosis. Similar observations have been reported in previous pediatric studies evaluating the hematological manifestations of vitamin B12 deficiency (6,14). Overall, the findings of the present study reinforce that vitamin B12 deficiency is highly prevalent among children with severe acute malnutrition and is closely associated with anemia and macrocytosis. Routine assessment of vitamin B12 status in children admitted with SAM may facilitate early diagnosis, timely supplementation, and improved hematological recovery, thereby strengthening existing nutritional rehabilitation protocols.

CONCLUSION

Vitamin B12 deficiency is highly prevalent among children with severe acute malnutrition and is significantly associated with severe anemia and macrocytosis. Routine screening and timely vitamin B12 supplementation should be considered as part of comprehensive management protocols for children with severe acute malnutrition.

DISCLOSURE

Conflict of interest- None
Funding- No

REFERENCES

1. Bhutta ZA, Berkley JA, Bandsma RHJ, Kerac M, Trehan I, Briend A. Severe childhood malnutrition. Nat Rev Dis Primers. 2017;3:17067. doi:10.1038/nrdp.2017.67.
2. Chama GC, Siame L, Kapoma C, Hamooya BM, Masenga SK. Severe acute malnutrition among children under the age of 5 years. PLoS One. 2024;19(8):e0309122. doi:10.1371/journal.pone.0309122.
3. Alflah YM. Severe acute malnutrition and its consequences among malnourished children. J Clin Pediatr Res. 2023. doi:10.37191/mapsci-2583-4525-2(1)-011.
4. World Health Organization. Pocket Book of Hospital Care for Children: Guidelines for the Management of Common Childhood Illnesses. 2nd ed. Geneva: WHO; 2013. Chapter 7: Severe acute malnutrition.
5. Rizzo G, Laganà AS, Rapisarda AMC, La Ferrera GM, Buscema M, Rossetti P, et al. Vitamin B12 among vegetarians: Status, assessment and supplementation. Nutrients. 2016;8(12):767. doi:10.3390/nu8120767.
6. Mangshetty S, Patil A, Mangshetty R. A study of clinical spectrum of vitamin B12 deficiency in pediatric age group in a tertiary care hospital. Int J Contemp Pediatr. 2025;12(4):602-608. doi:10.18203/2349-3291.ijcp20250765.
7. Vaid A, Sharma M, Gautam P, B J. Serum vitamin B12 levels in severe acute malnutrition hospitalized children between age group 6 months to 59 months in Kangra, India. Int J Contemp Pediatr. 2018;5(5):1997-2001. doi:10.18203/2349-3291.ijcp20183546.
8. Atiq A, Shah D, Sharma S, Meena RK, Kapoor S, Gupta P. Prevalence and predictors of vitamin B12 deficiency in children with severe acute malnutrition, and its association with development. Indian J Pediatr. 2025;92(1):15-21. doi:10.1007/s12098-023-04909-x.
9. Arya AK, Kumar P, Midha T, Singh M. Hematological profile of children with severe acute malnutrition: A tertiary care centre experience. Int J Contemp Pediatr. 2017;4(5):1577-1582. doi:10.18203/2349-3291.ijcp20173072.
10. Nikièma V, Kangas ST, Salpéteur C, Briend A, Talley L, Friis H, et al. Vitamin B12 status before and after outpatient treatment of severe acute malnutrition in children aged 6-59 months: A sub-study of a randomized controlled trial in Burkina Faso. Nutrients. 2023;15(16):3496. doi:10.3390/nu15163496.
11. Allen LH. Causes of vitamin B12 and folate deficiency. Food Nutr Bull. 2008;29(2 Suppl):S20-S34. doi:10.1177/15648265080292S105.
12. Ministry of Health and Family Welfare, Government of India; UNICEF; Population Council. Comprehensive National Nutrition Survey (CNNS): National Report. New Delhi: Ministry of Health and Family Welfare; 2019.
13. Venigalla WC, Nirmala C, Harshita C, Meghi SR. A study of the prevalence of anemia in children with severe acute malnutrition at a pediatric tertiary care hospital in South India. Cureus. 2024;16:e67657. doi:10.7759/cureus.67657.

14. Halicioglu O, Asik Akman S, Sutcuoglu S, Atabay B, Turker M, Akbay S, et al. Nutritional vitamin B12 deficiency in infants of vitamin B12-deficient mothers. Int J Vitam Nutr Res. 2011;81(5):328-334. doi:10.1024/0300-9831/a000080.