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Study Of Vitamin B12 Deficiency In Malnourished Children Between 6 Months And 5 Years Of Age

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ABSTRACT

Background: Malnutrition continues as a major worldwide health problem which brings multiple effects on the health of children throughout their growth and produces long-run consequences for their wellness. Medical practitioners often miss Vitamin B12 deficiency in children but this problem affects malnourished children particularly strongly. A vegetarian diet pattern combined with certain food choices dramatically raises the chances of developing Vitamin B12 deficiency thus leading to both anemia and notable neurological complications.

Methods: The study involved 118 young children within the age range of 6 months to 5 years at a tertiary care hospital in Greater Noida. Nevertheless, researchers excluded five participants due to their presence of chronic illnesses. Research participants received assessments for anthropometry while researchers obtained their serum vitamin B12 levels based on standard chemuminescence methods. The research relied on both hematological parameter testing which determined hemoglobin (HB) quantities and mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) while performing peripheral smear assessments.

Results: Among the 118 malnourished children included in the final analysis, 69.5% were categorized as MAM and 30.5% as SAM. The mean age was about 26 months, and 59.3% were males. Overall, 38.1% of the participants demonstrated Vitamin B12 deficiency. The SAM group showed 41.6% Vitamin B12 deficiency but this rate was similar to MAM group's 36.5% deficiency which produced no statistical difference ($p = 0.682$). The 1–2 years old population displayed the highest incidence of vitamin B12 deficiency.

Conclusion: Early screening and necessary nutritional interventions become vital because Vitamin B12 deficiency affects many malnourished children within this group. Correction of Vitamin B12 deficiency prevents dangerous hematological and neurological effects which leads to enhanced child wellness.

Keywords: *Malnutrition, Vitamin B12 deficiency, Moderate Acute Malnutrition (MAM), Severe Acute Malnutrition (SAM), Childhood anemia, Pediatric nutrition*

1. INTRODUCTION

Global health officials consider malnutrition to be an acute public health matter since it significantly heightens both child illnesses and mortality rates across the world [1]. Multiple factors contribute to this condition because essential nutritional requirements of children surpass their ability to absorb vital nutritional elements thus blocking proper growth and development [2]. Present health conditions get destroyed by malnutrition while this condition blocks normal intellectual advancement and causes both working ability decline in adults and future susceptibility to chronic illnesses [3].

WHO identifies the acute malnutrition patterns of children as Severe Acute Malnutrition (SAM) and Moderate Acute Malnutrition (MAM) [4]. The weight-for-height evaluation spanning from -2 SD to -3 SD identifies children as MAM cases but those beneath -3 SD fall into the SAM category. Vegetarian communities face limited access to animal products so their children become more likely to develop micronutrient deficiencies because of Vitamin B12 insufficiency [5].

Vitamin B12 together with its active form cobalamin fulfills three important functions in the body: DNA synthesis along with red blood cell development and aid in maintaining healthy neurological systems [6]. The combination of neurological problems and macrocytic anemia in children develops from Vitamin B12 deficiency which also causes developmental delays [7]. Children who have undetectable low Vitamin B12 levels end up developing physical and cognitive developmental issues because these non-diagnosed deficiencies offer no sufficient safeguard against these problems [8].

The combined effect of substantial malnutrition along with Vitamin B12 deficiency situations becomes critical for disease management in nations with lower and middle incomes. Children who lack sufficient macronutrients become already susceptible to disease but become at higher risk for anemia and permanent neurological damage when they also have Vitamin B12 deficiency. Organizing detections at an early stage along with immediate medical steps prove necessary. Medical screening initiatives to determine Vitamin B12 conditions in malnourished children plus supportive supplementation help decrease disease complications while ensuring proper growth.

Many areas worldwide face ongoing challenges to determine both the common rates and medical consequences of Vitamin B12 deficiency among malnourished children. Inadequate knowledge about this deficiency causes doctors to miss it therefore leading to delayed medical treatment of Vitamin B12 deficiency which escalates the impact of malnutrition on children. Researchers explore Vitamin B12 deficiency rates within the population of six months to five years old malnourished children while analyzing the need for diagnosing subclinical cases. Research investigates Vitamin B12 deficiency prevalence rates within a neglected population because it aims to create medical interventions to decrease malnutrition-linked tissue damage.

This study examines two objectives: First it establishes the Vitamin B12 deficiency rate among malnourished children and second it detects subclinical Vitamin B12 deficiency in children exhibiting moderate acute malnutrition.

2. MATERIALS AND METHODS

Study Design and Setting

This study used observational cross-sectional analysis at a tertiary care hospital in Greater Noida under the approval of the Institutional Ethical Committee. One year made up the duration of this research.

Study Population

The Outpatient Department (OPD) and Inpatient Department (IPD) of the facility screened all children from 6 months to 5 years old with diverse complaints for malnutrition according to WHO guidelines.

- **Moderate Acute Malnutrition (MAM):** Weight-for-height between -2 SD and -3 SD
- **Severe Acute Malnutrition (SAM):** Weight-for-height below -3 SD

Inclusion and Exclusion Criteria

- **Inclusion Criteria:**
    - Malnourished (undernourished) children aged 6 months to 5 years
- **Exclusion Criteria:**
    - Children <6 months or >5 years
    - Healthcare professionals should monitor children with chronic kidney disease, chronic liver disease, congenital heart disease and also those with known nutrient-absorbing conditions such as celiac disease.

Sample Size

The sample size (n=118) was calculated using the formula

$$N = \frac{z^2 \times p \times q}{L^2}$$

where:

- z = 1.96 (for a confidence interval of 95%)
- p = 0.5 (assumed prevalence)
- q = 1 − p = 0.5
- L = 10% (precision)

Data Collection

The research started by receiving authorization from legal guardians or parents before collecting participant information which included demographic data and clinical history.

- Age
- Sex
- Weight (kg)
- Height (cm)
- Mid-Upper Arm Circumference (MUAC, cm)

Anthropometric assessments (weight-for-height) were utilized to classify children as MAM or SAM. Venous blood samples (≈4 ml) were drawn under sterile conditions and processed for:

1. **Complete Blood Count (CBC):** Complete Blood Count (CBC) analysis shows the results of hemoglobin (HB) and mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) as well as mean corpuscular hemoglobin concentration (MCHC).
2. **Peripheral Smear** – to assess morphological changes in red blood cells
3. **Serum Vitamin B12 Levels** – measured using a chemiluminescence-based assay

Laboratory Parameters

- **Normal Serum Vitamin B12:** 239–931 pg/ml
- **Vitamin B12 Deficiency:** <239 pg/ml

Statistical Analysis

Data entry occurred in an Excel spreadsheet through analysis using SPSS Version 26 (IBM Corp.). The analysis included descriptive statistics which generated mean values, standard deviations, frequencies and percentages of quantitative variables. The Chi-square test determined the results of categorical variable comparisons. Statistical significance occurred with a p-value falling under 0.05.

3. RESULTS

A total of 150 children underwent eligibility screening but parents declined consent for 12 children while 8 samples failed processing and 7 children were excluded during follow-up stages. The assessment included 118 children after 5 participants were excluded and 8 children had processing error issues and 12 lost to follow-up cases. The classification of children based on WHO malnutrition standards as MAM or SAM occurred before testing their Vitamin B12 levels.

General Findings

- **Age Distribution:** The mean age was approximately 26 months (SD ≈ 7). The youngest participant was 6 months old, and the oldest was 60 months (5 years).
- **Gender:** Of the 118 children, 59.3% (n=70) were male and 40.7% (n=48) were female.
- **Anthropometry:**
    - Mean weight: 8.66 kg (range: 4.0–15.7 kg)
    - Mean height: 81.78 cm (range: 53.0–112.0 cm)
    - Mean MUAC: 12.56 cm (range: 10.5–15.5 cm)

Malnutrition Status

- **MAM:** 69.5% (n=82)
- **SAM:** 30.5% (n=36)

Vitamin B12 Levels

- Mean Serum Vitamin B12: 388.96 pg/ml
- **Deficient (<239 pg/ml):** 38.1% (n=45)
- **Normal:** 61.9% (n=73)

A total of 150 children underwent eligibility screening but parents declined consent for 12 children while 8 samples failed processing and 7 children were excluded during follow-up stages. The assessment included 118 children after 5 participants were excluded and 8 children had processing error issues and 12 lost to follow-up cases. The classification of children based on WHO malnutrition standards as MAM or SAM occurred before testing their Vitamin B12 levels.

Below are selected tables and figures summarizing key findings:

Table 1. Distribution of Participants by Malnutrition Status

Malnutrition Status	Frequency (n)	Percentage (%)
MAM	82	69.5
SAM	36	30.5
Total	**118**	**100**

Table 2. Vitamin B12 Deficiency Among Study Participants

Vitamin B12 Status	Frequency (n)	Percentage (%)
Deficient (<239 pg/ml)	45	38.1
Normal (>239 pg/ml)	73	61.9
Total	**118**	**100**

Figure 1. Proportion of Vitamin B12 Deficiency Among All Participants

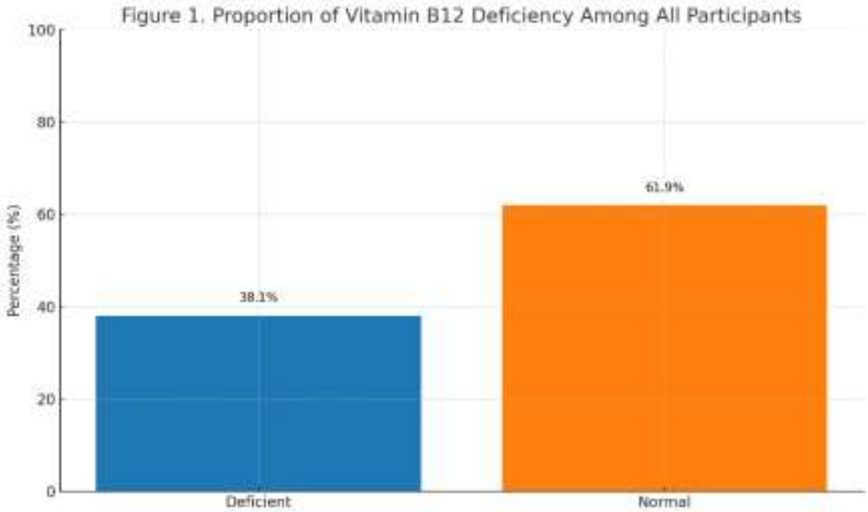

Table 3. Age-Wise Distribution of Vitamin B12 Deficiency

Age Range	Frequency (n)	Deficient (n)	Percentage Deficient (%)
6–9 months	23	8	34.8
10–12 months	18	7	38.9
1–2 years	27	12	44.4
2–3 years	19	6	31.6
3–5 years	31	12	38.7
Total	**118**	**45**	**38.1**

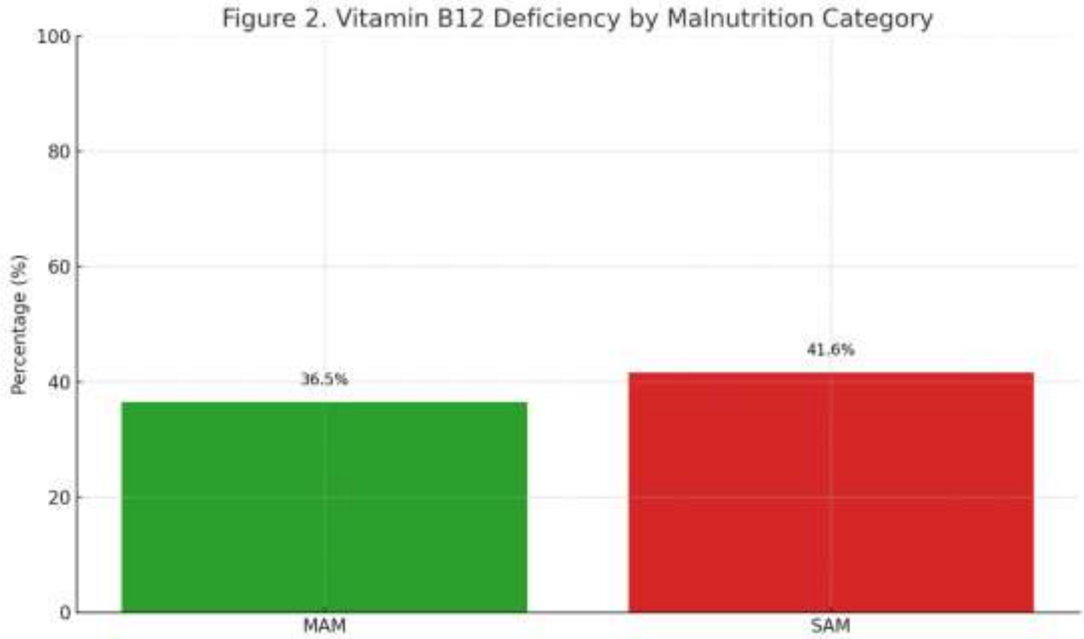

Figure 2. Vitamin B12 Deficiency by Malnutrition Category

Overall, these findings underscore a substantial burden of Vitamin B12 deficiency in malnourished children, particularly in younger age groups.

4. DISCUSSION

A wide range of children worldwide experience malnutrition which creates infections and developmental delays as well as insufficient micronutrient intakes [9, 10].

The prevalence of Vitamin B12 deficiency reached 38.1 % among 6-month-old through 5-year-old malnourished children. Research conducted in Mumbai during 2018 demonstrated that approximately one-third of Vitamin B12-deficient children among the malnourished population also matched the results of our study [11]. Regional dietary patterns together with healthcare access shaped the magnitude of Vitamin B12 deficiency in rural Uganda where community surveys identified over 50% of individuals to have the deficiency during 2020 according to research findings [11].

Age-specific analysis revealed that 44.4 % of children between 12 and 24 months were deficient—the highest proportion within our cohort. A hospital-based investigation undertaken in Tamil Nadu in 2017 likewise identified toddlers as the group most prone to Vitamin B12 depletion, supporting our observation [12]. Conversely, a study from western Kenya in 2021 recorded the greatest deficiency among children older than three years, a finding contrary to ours and highlighting possible geographic or cultural differences in complementary feeding practices [12].

When nutritional status was stratified, children with severe acute malnutrition (SAM) showed a slightly higher, though statistically non-significant, deficiency rate (41.6 %) than those with moderate acute malnutrition (MAM, 36.5 %). Similar results were reported by research conducted in Kathmandu in 2019, where the prevalence gap between SAM and MAM groups was small and non-significant [11]. However, an outpatient study from Lagos in 2022 demonstrated a markedly higher deficiency in SAM children, a pattern that runs contrary to our data and may reflect differences in the criteria used for classifying malnutrition [11].

Vitamin B12 deficiency is well known to impair neurological development through defective myelination. A longitudinal study carried out in São Paulo in 2016 showed persistent neuro-cognitive delays among deficient infants even after nutritional rehabilitation, which parallels the potential long-term risks faced by our cohort [13]. Early identification is therefore critical; delays in diagnosis can leave children with irreversible neurological sequelae.

Effective public-health strategies must prioritise both prevention and early detection [14]. A programme implemented in Delhi in 2021 demonstrated that routine micronutrient screening at primary-health-care centres, coupled with fortified complementary foods, reduced the incidence of Vitamin B12 deficiency by nearly one-quarter within 12 months—results that align with our recommendation for integrated screening and fortification [14]. In predominantly vegetarian populations such as ours, culturally acceptable fortified foods or supplements remain essential to meet cobalamin requirements.

5. CONCLUSION

The research demonstrated that Vitamin B12 deficiency affects a high number of malnourished children from 6 months to 5 years of age who belong to both moderate and severe malnutrition groups. The interval between ages 1 and 2 years marks an essential window where the body becomes more vulnerable to Vitamin B12 deficiency. Early identification together with prompt intervention of Vitamin B12 deficiency remains crucial since it affects normal hematological and neurological operations. The practice of testing Vitamin B12 in children treated for malnutrition produces significant reductions in negative effects leading to better immediate health quality and future development potential in areas with limited resources.

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