Original Research Article

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Serum vitamin B12 levels in severe acute malnutrition hospitalized children between age group 6 months to 59 months in Kangra, India

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ABSTRACT

Background: Child malnutrition is a major global health problem contributing to childhood morbidity, mortality, impaired intellectual development, suboptimal adult work capacity and increased risk of diseases in adulthood. Severe acute malnutrition, among children below five years of age remains a major embarrassment, and impediment to optimal human capital development in India.

Methods: The study was an observational study conducted in the Department of Pediatrics and Biochemistry at Dr. RPGMC Kangra at Tanda, Himachal Pradesh. All children aged between 6 to 59 months presenting in the Department of Pediatrics with SAM (Severe Acute Malnutrition) and fulfilling the inclusion and exclusion criteria were included in the study after taking the informed consent from the guardian in local language.

Results: Out of 48 children included in the study, 28 (58%) children were Males and 20 (42%) children were females with male to female Ratio 1.3:1. Out of 48 children 28 (58%) were vitamin B12 deficient and 20 (42%) were non-deficient. In the present study 53.5% (15) of males were vitamin B12 deficient. Out of 20 females 65% (13) of females were vitamin B12 deficient, showed slight preponderance of females over males. It has been observed that younger age group children mostly <2-year-old were, the most vulnerable group as far as vitamin B12 deficiency is considered (16%)

Conclusions: Micronutrients play a central part in metabolism and in maintenance of tissue functions. All severely malnourished children have vitamin and mineral deficiencies. The most common type of anemia was microcytic followed by megaloblastic anemia.

Keywords: Severe acute malnutrition, Vitamin B12, World Health Organization (WHO)

INTRODUCTION

Child malnutrition is a major global health problem contributing to childhood morbidity, mortality, impaired intellectual development, suboptimal adult work capacity and increased risk of diseases in adulthood. SAM, in children below five years of age remains a major

embarrassment, and impediment to optimal human capital development in India.² India, with a population of more than 1 billion people, faces many challenges in improving the health and nutrition of its citizens.

According to the World Health Organization (WHO), Severe acute malnutrition (SAM) is defined as weight for

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height less than -3SD and/or visible severe wasting and/or edema of both feet (excluding other causes of edema), mid arm circumference less than 11.5 cm (in infant more than 6 months of age).¹

The factors supporting the choice of weight for height below -3SD for defining SAM include:

- In a well-nourished population there are virtually no children below -3 SD (<1%);
- These children have a higher weight gain when receiving a therapeutic diet compared to other diets, which results in faster recovery;
- There are no known risks or negative effects associated with therapeutic feeding of these children, applying recommended protocols and appropriate therapeutic foods.³

In India 43% of children under the age of 5 years are malnourished or undernourished. It is estimated that 1 in every 3 malnourished children live in India. Malnutrition in children is widely prevalent in developing countries and has been responsible for 60% of the 10.9 million deaths annually among children less than 5 years. Over 2/3rd of these deaths which are often associated with inappropriate feeding practices that occurred during 1st year of life. 3-5

A study by Thakur et al in a tertiary care institution in North India on 131 cases of SAM in age group of 6-59 months documented 67.3% cases of SAM with severe anemia and 13.8% patients had moderate anemia.⁶ The most common type of anemia was microcytic (38.6%) followed by megaloblastic anemia (30.5%).

India faced the recent global fiscal crisis impressively and is relentlessly marching forward on the economic and development fronts. However, these economic gains have not translated into substantial nutritional benefits, which is acutely embarrassing and disconcerting. Protecting lives and promoting optimum development of undernourished children is a human rights issue that can no longer be swept under the carpet.

Vitamin B12 also called cobalamin is a water-soluble vitamin with a key role in the normal functioning of the nervous system and for the formation of blood. It is normally involved in the metabolism of every cell of the human body, especially affecting DNA synthesis and regulation. Dietary sources of vitamin B12 are almost exclusively from animal foods. As far as anemia in malnutrition or SAM is concerned much emphasis is laid on supplementation of iron and folic acid and not on Vitamin B12.

Moreover, supplementation of only folic acid in children having deficiency of both vitamin B12 and Folic acid can worsen the neurological status of the child. In view of these concerns and lack of data on SAM and vitamin B12 deficiency from this region, the present study was

conducted to know the prevalence of vitamin B12 deficiency in Severe Acute Malnourished children in a tertiary care institution in North India.

METHODS

The study was conducted in the Department of Pediatrics and Biochemistry at Dr. RPGMC Kangra at Tanda, Himachal Pradesh. The institutional review board approved the study. The study was a cross-sectional observational study.

Inclusion criteria

All children between the age group of 6-59 months reporting consecutively in the department of Pediatrics and fulfilling any one of the following criteria as per WHO guidelines with regard to growth parameters were included in study.

- Weight for height less than -3SD.
- Visible severe wasting.
- Edema of both feet (excluding other causes of edema),
- Mid arm circumference less than 11.5 cm (in infant more than 6 months of age).³

Exclusion criteria

Children with history of oral or parenteral supplementation of vitamin B12 in previous 6 months, folic acid supplementation, proton pump inhibitors and H2 (antihistaminic receptor 2) blockers were excluded. Children diagnosed with hemolytic anemia, liver disease, gastrointestinal disorders (inflammatory bowel disorder, celiac disease, and malabsorption), myeloproferative disorder, diabetes, heart disease, pancreatic insufficiency and AIDS were excluded as well.

Children satisfying the above criteria were enrolled to the study after a parental informed consent. Baseline clinical details including history and physical examination were recorded as per a pretested Performa/case form. Complete blood count and peripheral smear were done in all cases. Vitamin B12 levels were estimated by chemilumnisence assay using Immulite 1000 analyzer in the department of Biochemistry. Vitamin B12 level <200 pg/ml was considered deficient.

Statistical analysis

The statistical analysis was carried out using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 21.0 for Windows). Baseline variables were analyzed by descriptive statistics. Quantitative variables were analysed by measures of central tendency (mean and median) and dispersion (standard deviation). Comparison of proportions was performed with Fischer exact test and analysis of variance was computed. All

statistical tests were two-tailed and was performed at a significance level with probability (p) of 0.05.

RESULTS

The present study was conducted on an inpatient basis in the Department of Pediatrics and Biochemistry at Dr. RPGMC Kangra at Tanda, Himachal Pradesh from June 2014 to May 2015. A total of 48 children aged between 6 months to 59 months, presenting with SAM were included in the study.

Table 1: Distribution of Vitamin B12 level in different age groups.

Age	Total	Deficient	Not Deficient
6-20 months	29 (60.4%)	16	13
20-40 months	10 (20.8%)	5	5
40-59 months	9 (18.8%)	7	2

The cohort included 29 (60%), 10 (21%) and 9 (19%) children in age group 6-20, 20-40 and 41-59 months, respectively (Table 1). Vitamin B12 levels were deficient in 28 (58%) children (Table 2). There was higher prevalence of deficiency in female gender (65%) as compared to males (53%) (Table 3)

Table 1 shows that, there were 29 children between 6-20 month of age, and out of which 16 (55.17%) children were deficient while 13 (44.82%) were having normal level.

Similarly, out of 10 children in the age group of 20-40 months, 5 (50%) were deficient and 5 (50%) were not. In the age group of 40-59 months, out of 9 children 7 (77.77%) were having B 12 level <200 pg/ml and 2 (22.23%) children were having B12 level >200 pg/ml. Above data shows that $1/3^{\rm rd}$ of children were below 2 yrs. of age.

Table 2: Patients with serum Vitamin B12 level.

Vitamin B12 level	Total number of patients (n)	
Deficient (<200 pg/ml)	28	58
Not deficient (>200 pg/ml)	20	42

Serum vitamin B12 level (17) Table 2 gives us an insight about the level of Serum Vitamin B12 in our study population.

Out of the 48 children, 28 (58%) were found deficient (<200 pg/ml) while rest of the children i.e.20 children (42%) were having normal level (>200 pg/ml). Majority

of children with SAM were deficient in serum vitamin B12.

Table 3: Assessment of vitamin b12 level according to gender.

Gender	Total	Deficient	Not deficient
Male	28 (58 %)	15	13
Female	20 (42%)	13	7

Table 3 shows that out of 48 children in the study group, 28 (58 %) male and 20 (42%) female children. Out total of 28 children having B12 level <200 pg/ml, 15 (54%) were male children whereas 13 (46%) were female children.

DISCUSSION

Malnutrition is a serious global issue. Each year, around 24 million babies are born too small to lead healthy lives because of either illness of their mothers or presence of malnutrition in the mothers. Among children under five years of age in the developing world, 206 million are stunted, 50 million are wasted, and 167 million are underweight due to lack of food and the presence of disease. 38.4 % children in India are stunted (52.6 million) and 21% children in India are wasted (28.7 million). The worldwide malnutrition estimation rates indicate that 35.8% of preschool children in developing countries are underweight, 42.7% are stunted, and 9.2% are wasted. SAM is reported in 7.9%, 1/3 of global total population adding on the burden of the problem. 10

The prevalence of micronutrient deficiency in SAM is not well studied. The prevalence of nutritional anemia in children <5 years of age is 58.5% (80 million).⁷ Nutritional anemia is chiefly contributed by iron deficiency anemia 66% (52.8 million).¹¹ Although iron deficiency dominants the spectrum of nutritional anemia, several micronutrient deficiencies especially vitamin B12 deficiency contributes significantly etiopathogenesis of anemia. Moreover, in children with SAM, micronutrient deficiency along with protein energy malnutrition is a major impediment for growth and development. The objective of our study was to estimate the burden of Vitamin B12 deficiency in children with SAM. This study focuses on the burden of Vitamin B12 deficiency in SAM, thereby address the need to institute measures for appropriate therapeutic supplementation.

A total of 48 children with SAM were included in our study. Out of these, there were 28 (58 %) males and 20 (42%) female children. This was in contrast to a study by Choudhury KK, from Bangladesh where it was observed that out of the severely malnourished children, 54.2% were female, and 45.8% were male. ¹² Bangladesh typifies many south-eastern countries where female children experience inferior health and uncertain survival, especially after the neonatal period.

The results in our study could be due to the preference given to the health of a male child in our society, thereby getting more chance of being admitted in a tertiary care setting. There are also studies that report greater social valorization of sons at the detriment of daughters, including dietary discrimination. Other reasons could be that boys were more influenced by environmental stress than girls. ¹³

A study from an Indian hospital on cases with nutritional anemia showed B12 deficiency in 19 % cases and folate deficiency in 12%. In addition, nearly 35% cases had levels of B12 which could be classified as low. ¹⁴ Another study by Thakur et al in patients with SAM showed that nearly two-thirds (65%) of patients with megaloblastic anemia having folic acid deficiency, 8% both vitamin B12 and folic acid deficiency and 12% having vitamin B12 deficiency. ⁶

In the present study, the most common type of anemia was microcytic hypochromic (43.75%) followed by normocytic (25%) and then dimorphic (16.6%) and macrocytic (14.5%). Vitamin B 12 deficiency was seen in 66.6% of children with microcytic anemia. Though it was not statistically significant (p = 0.066). In a study by Areekul et al, vitamin B12 and vitamin B12 binding proteins were determined in 20 patients with iron deficiency anemia who showed low hemoglobin, haematocrit, serum iron levels and hypochromic microcytic red blood cells. The serum vitamin B12 levels in these patients were significantly lower than that of the normal subjects. ¹⁵

Chandelia et al did a study to assess whether addition of cobalamin (Cbl) to iron-folic acid will result in improved response in nutritional anemia. This study included 150 children aged between 05 months to 5years having nutritional anemia. Anemia was categorized for severity and red cell morphology. Serum levels of ferritin were obtained in all cases while levels of cobalamin (Cbl) and folic acid (FA) were done only in children having macrocytic or dimorphic anemia. It was concluded that children receiving cobalamin in addition to iron and FA showed an improved hematological response. ¹⁶

In our study, bulk of the children were having microcytic anemia, vitamin B12 deficiency was seen in 71% of children with macrocytic anemia, though it was statically insignificant (p=0.06).In a study done by Baker and others(16)from South India observed that in these areas, B12 levels in the blood were lower than observed in west but surprisingly megaloblastic anemia resulting from these low levels were uncommon.¹⁶

In the present study on observation of vitamin B12 deficiency in SAM patients, 28 (58%) children had deficiency of vitamin B12 (i.e. <200 pg/ml).¹⁷ In the present study, it was observed that nearly one third of children with SAM were below 20 months of age. Twenty-nine (60.4%) children were in the age group of 6-

20 months. More than half (55.17%) had vitamin B12 deficiency. These findings are in accordance with the study done by Thakur et al.⁶

Weaning is a crucial transition in childhood nutrition. The transition from breast feeds to introduction of complementary food at this point should be appropriate and optimum to meet the protein, energy and micronutrient needs of the child. The delay in introduction of complementary feeds, observed in substantial population would likely explain the B12 deficiency in the above-mentioned age group.

The maternal pre-pregnancy nutritional status plays important role in a child's health. This was seen in a randomized, placebo-controlled clinical trial done in pregnant women <14 week of gestation in Bangalore, India. 18 This study showed that pretreatment with 50µg of oral vitamin B12 in antenatal period plus routine iron and folic acid supplementation to all pregnant women had higher level of serum vitamin B12 at 3rd trimester and 6 weeks postnatal as compared to placebo group. Infants born to B12 supplemented mother also had higher concentration of vitamin B12 at 6 weeks postnatal. Hence maternal vitamin B12 levels reflect the stores in the infancy and improvement in pre-pregnancy nutritional status in mothers is essential. Evaluation of maternal hemoglobin or vitamin B12 levels was not performed a part of our study. However, as the of burden of vitamin B12 deficiency was higher (60.4%) in age group 6-20 months, maternal malnutrition could have contributed to the. Maternal health programs must be strengthened as the birth of malnutrition and anemia revolves around the mother.

CONCLUSION

The focus of our study was to estimate the burden of vitamin B12 deficiency in children with associated malnutrition. We observed a large proportion (58%) of patients to be deficient. The younger age (<2 years) is the most vulnerable age for vitamin B12 deficiency. The likely causes predisposing is delayed weaning and inappropriate complementary feeds. Maternal malnutrition contributes to poor stores of Vitamin B12 in infancy. The findings of our study support the need for a broad public health strategy for the control of anemia among Indian children beyond delivering iron supplementation alone.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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