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Original Research Article

Nutritional and hematological profile of children with severe acute malnutrition rehabilitated with or without vitamin B12

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ABSTRACT

Background: Aim of the study was to study the effect of vitamin B12 supplementation in children with severe acute malnutrition (SAM).
Methods: A total of 100 children were enrolled in the study in two different time frames. Group A consisted of 50 children with SAM enrolled from November 2016 to May 2017 and managed as per existing national protocol for facility-based SAM management while group B consisted of 50 children enrolled from June 2017 to Dec 2017 who were tested for vitamin B12 deficiency on admission and supplemented with vitamin B12 in presence of vitamin B12 deficiency hematological and anthropometric parameters of both groups were compared at 12 weeks of rehabilitation**.**
Results: At 12±1 weeks, 38% children from group A and 24% from group B were still anemic (p=0.13). No one from either group had folic acid deficiency while deficiency of vitamin B12 was present in 14% and 6% cases in group A and group B respectively (p>0.05). Mean weight gain at 12±1 weeks, in group A and non-supplemented sub-group of group B was comparable (p>0.59). However, mean weight gain in supplemented sub-group of group B was significantly higher compared to group A (p>0.05) and non-supplemented sub-group of group B (p<0.05).
Conclusions: Significant number of SAM children remain anemic when treated with current guidelines. Additional vitamin B12 supplementation in vitamin B12 deficient group showed improvement in weight gain among SAM children.

Keywords: Severe wasting, Anemia, Vitamin B12 supplementation, Micronutrients

INTRODUCTION

Malnutrition is a public health problem of immense importance worldwide especially in developing countries like India. According to national family health survey (NFHS-4), 38% of children under five years of age were stunted, 21% were wasted and 36% were underweight.[1] Anemia is a common comorbidity in children with malnutrition and is observed in 50-70% cases.[2,3] In a study in Delhi with 131 children with SAM, over 80% children had moderate or severe anemia. In another study, anemia was present in over 60% children with SAM. A study from Udaipur reported 94% prevalence of anemia in children with SAM.[4-6]

Deficiency of iron is the most common micronutrient deficiency among anemic children, but deficiency of folic acid (FA) and vitamin B12 (vit B12) is being reported in significant number of children with SAM. Goyal et al observed vit B12 and FA deficiency among 37.5% and 10% children with SAM respectively.[7] In addition to being a significant contributor to anemia among SAM children, supplementation with FA and vit B12 have been reported to have improved growth of malnourished children.[8]

Current guidelines for managing children with SAM recommend FA supplementation from the stabilization phase and iron supplementation during the rehabilitative phase along with twice the recommended dietary allowance (RDA) of other vitamins.[9] Rapid growth during recovery from SAM can lead to unmasking of vit B12 deficiency, as has been reported in field studies with lowering of vit B12 levels due to inadequate supplementation.[10] Although there are several studies describing anemia status of children with SAM at admission, not enough evidence was found on their anemia status during the rehabilitation phase.

In the present study, we have reported status of anemia and vit B12 among children with SAM at admission and after recovery from SAM.

METHODS

This observational study was conducted in a tertiary care hospital of New Delhi, India from November 2016 to March 2018. Children with SAM, defined as children aged 6 months to 5 years having weight for height/length<-3 SD (based on WHO growth standards 2006) and/or mid upper arm circumference (MUAC)<11.5 cm and/or bipedal edema of nutritional origin, were included in the study.[11] Children diagnosed with secondary causes of SAM such as HIV, TB, and chronic systemic diseases were excluded. Children who were already on hematinics before admission and those with clinical evidence of megaloblastic anemia such as knuckle hyperpigmentation, tremors etc. were also excluded as they required specific treatment including vit B12 supplementation. These children were managed with standard treatment guidelines outside this study.

A total of 100 children with SAM, who met the inclusion criteria, were enrolled in the study. The children enrolled in the study were divided equally into two groups. Group A consisting of children with SAM enrolled from November 2016 to May 2017 who were managed as per existing national facility-based SAM management protocol. They were assessed at 12±1 week for their hemoglobin (Hb), serum ferritin, FA and vit B12 status in addition to their anthropometric status such as height/length, weight, weight gain etc. Group B consisting of children enrolled from June 2017 to Dec 2017. In this group, in addition to anthropometric assessment of children with SAM, their serum ferritin, FA and vit B12 levels were also estimated at enrolment. This group were also rehabilitated as per the current facility-based SAM management protocol. However, if found deficient for vit B12, they were also administered oral methyl cobalamin (30 µg/kg/day).

Written informed consent from caregivers of all children was taken at the time of enrolment in the study. The study was approved by institutional ethics committee on human research (ECHR). At the time of enrolment, height/length, weight and MUAC were measured using standard methods. Weight for age Z score, height for age Z score and weight for length/height Z score-were calculated using WHO growth reference charts (2006). Classification of families based on the socio-economic score (SES) was done according to modified Kuppuswamy scale.[12] Families were classified as lower socioeconomic class, lower middle class, upper lower class, upper middle class and upper class based on the Kuppuswamy scale.

Hemoglobin (Hb) was estimated using Sysmex KX-21 automated blood cell counter. Serum FA, vit B12 and ferritin assay were done by Chemiluminescence immune-assay method by Automated Immune Assay System, using Unicel DxI 600 analyzer BECKMAN COULTER access vit B12 (33000), access folate (A98032) and access ferritin (33020) respectively. Anemia was defined as Hb less than 11 gm/dl and was graded as mild, moderate and severe according to WHO criteria.[13] Deficiency of vit B12, FA and iron was defined using cut-off <200 pg/ml, <5 ng/ml and <12 ng/ml respectively. Serum ferritin <30 ng/ml was considered deficient in children with acute infections.[5]

Data was entered in the proforma and was transferred to Microsoft Excel worksheet. Statistical analysis was done using SPSS Software (IBM SPSS Statistics for Windows, version 17.0. Armonk, New York, USA: IBM Corp). Unpaired and paired student’s ‘t’ test used for comparing means and Chi^2 test was used for comparing proportions.

RESULTS

Table 1 shows that the baseline characteristics of children (mean age of subjects, proportion of children under 12 months, gender ratio, SES and proportion belonging to urban areas) in group A and group B-were similar. Edematous SAM was present in 2 (4%) children in group A and 3 (6%) children in group B. In group A, 46 (92%) and in group B, 44 (88%) children were anemic (p>0.05).

Mean value of ferritin on admission in group B was 25.47 ng/ml with 32 (64%) for children with iron deficiency. Mean FA and mean vit B12 levels during admission in group B was 9.81 ng/ml and 233.74 pg/ml respectively. 10 (20%) children had FA deficiency and 19 (38%) children had vit B12 deficiency in group B. These 19 children were given methyl cobalmin supplementation in addition to supplementation of micronutrients according to facility-based SAM management protocol. At 12±1 weeks, 38% children in group A and 24% in group B were still anemic (p=0.13, Table 2). None of the case in either group had FA deficiency while deficiency of vit B 12 was present in 14% and 6% cases in group A and group B respectively, though the difference was statistically not significant (p>0.05). Importantly, in group B, 2 children who were deficient in vit B12 at enrolment remained deficient after 12±1 weeks supplementation and 1 child who was not deficient at admission became vit B12 deficient after 12±1 weeks. Deficiency of iron was also statistically not significant.

Table 3 compares growth parameters of children in group A and two subgroups of group B (those who were supplemented with oral methyl cobalamin and those who did not). At 12±1 weeks, mean weight gain among children in group A and sub-group of children in group B without B12 supplementation was comparable (p>0.05).

Mean weight gain in supplemented sub-group of children in group B was significantly higher compared to children in group A (p<0.05) and non-supplemented sub-group of children in group B (p<0.05). This was also evident from the observation that more children in supplemented sub-group of group B had higher daily mean weight gain.

Table 3 also shows that mean Hb and mean increment in Hb in vit B12 supplementation sub group of group B was significantly more compared to group A (p<0.001) and non-supplemented sub group of group B (p=0.06).

Table 1: Baseline characteristics of patients in group A and group B, (n=50).

Parameters	Group A (%)	Group B (%)	P value
Mean age (Months); mean ± SD	12.68±8.35	11.86±4.62	0.54
<12	29 (58)	28 (56)	X^2=0.040, p=0.84
Male	26 (52)	26 (52)	0.31
SES (lower middle class and below)	48 (96)	47 (94)	X^2=0.208, p=0.65
Urban residents	36 (72)	33 (66)	0.51
WHZ<-3	47 (94)	46 (92)	X^2=0.152, p=0.70
MUAC <115 mm	48 (96)	49 (98)	X^2=0.340, p=0.56
Bipedal edema	2 (4)	3 (6)	X^2=0.208, p=0.65
WAZ<3	48 (96)	49 (98)	X^2=0.340, p=0.56
HAZ<3	30 (60)	38 (76)	X^2=2.912, p=0.09
Anemic	46 (92)	44 (88)	X^2=0.440, p=0.51
Mean weight at enrolment (kg), mean ± SD	5.61±1.36 (95% CI: 5.22 to 5.99)	5.63±0.87 (95% CI: 5.38 to 5.88)	t=-0.120, p=0.91

Table 2: Anemia and micronutrient status of children in group A and group B at 12±1 weeks, (n=50).

Parameters	Group A (%)	Group B (%)	P value
Mean Hb	11.06 (95% CI 10.71 to 11.40)	11.79 (95% CI 11.49 to 12.09)	t=-3.717, p<0.001
Anemia	19 (38)	12 (24)	X^2=2.268, p=0.13
Iron deficiency	8 (16)	5 (10)	X^2=0.788, p=0.37
Vitamin B12 deficiency	7 (14)	3 (6)	X^2=1.760, p=0.18

Table 3: Difference in weight, height and Hb between children in group A, group B (with supplementation) and group B (without supplementation), (n=50).

Parameters	Group A (1)	Group B (With suppl) (2)	Group B (Without suppl) (3)	P value
Mean weight gain at 12±1 weeks	1.53 (95% CI: 0.62 to 2.44)	1.87 (95% CI: 1.15 to 2.59)	1.58 (95% CI: 0.92 to 2.24)	1 vs 2 (p<0.05) 1 vs 3 (p=0.59) 2 vs 3 (p<0.05)
Weight gain (gm/kg/day)				
<3	19 (38)	2 (10.5)	13 (41.9)	1 vs 2 (p<0.05)
3-5	25 (50)	12 (63.2)	16 (51.6)	1 vs 3 (p=0.707)
>5	06 (12)	5 (26.3)	2 (6.5)	2 vs 3 (p<0.05)
Mean increase in Hb (gm/dl) at 12±1 week	2.39	3.54	2.59	1 vs 2 (p<0.001) 1 vs 3 (p=0.48) 2 vs 3 (p=0.06)

DISCUSSION

In this study with SAM children, we have found that it B12 deficiency was present in 38% of children. Our findings are similar to earlier observations from ourhospital.[4] Goyal et al had also observed vitamine B12 deficiency in similar number of cases.[7] At 12±1 week into rehabilitation, persistence of anemia in 38% and 24% children and persistence of iron deficiency in 16% and 10% in the two groups are important findings of our study. In children with iron deficiency anemia, 3 months' treatment had resulted in correcting anemia in 32 (65%)

cases only.[14] Vit B12 deficiency was also found to be persisted after 3 months of treatment in 14% SAM children who were managed according to the facility-based SAM management protocol. Even in group B, in the sub group of children with vit B12 deficient and who received methyl cobalamin supplementation, 6% cases had low vit B12 levels after the treatment.

We postulated that supplementing vit B12 to children with SAM who were found to be deficient in vit B12 during admission would enhance their growth and result in better weight and height gains as compared to other children who were not supplemented with vit B12. In this small subset of children who received supplementation, significantly higher weight gain was observed. These results are similar to the study conducted by Strand et al in North Indian children in which 1377 children received either placebo or vitamin supplements.[8] Children who received vit B12 had a significant increase in weight for age SD score from -0.05 SD to 0.02 SD i.e., by 0.07 SD. On further sub-group analysis, it was found that children who were underweight, wasted and stunted had significant increase in both weight and height ($p<0.05$. In the study by Strand et al vit B12 supplementation over 6 months lead to significant gain in height as well.[8] Vit B12 supplementation results in better growth because it plays an important role in cell cycle by enhancing their growth and causing proliferation of cells as it is involved in deoxyribonucleic acid (DNA) metabolism.[15] Vit B12 metabolism is important in energy production as the intermediate products of tricarboxylic Acid (TCA) cycle (major energy producing cycle in our body) are derived from vit B12.[16] Also, supplementation of vitamin B12 could have improved appetite of children by correcting their anemia earlier and hence causing better increase in weight. Malnourished children are those who are also likely to be deficient in growth limiting nutrients (both micro and macronutrients). This subgroup of population is likely to have a large growth potential and if all the growth nutrients including vitamin B12, folic acid, iron, zinc and several others are provided in appropriate amount, it can enhance their growth.

The limited studies addressing anemia in children with SAM have assessed hematopoietic micronutrient deficiency in such children at the time of enrolment only. The studies reporting outcome of children with SAM have also not reported about outcome of anemia and micronutrient deficiencies.[17-19] For the first time, we have presented persistence of anemia and micronutrient deficiencies in children recovering from SAM. However, there are a few limitations of the study. The sample size of the study was very small and a larger sample size is needed to conduct more robust statistical analyses. Also, the study was conducted with SAM children from one hospital and it would be important to conduct the study taking samples from different hospitals to capture wider variations in the sampling. Additionally, multivariate analyses need to be conducted to understand association of other socio-economic and demographic factors of weight gain among children with SAM in the supplemented sub-group of group B.

These findings clearly indicate that there is a need to revisit the micronutrient supplementation strategy in SAM management protocol. The micronutrients prescribed currently are probably not adequate to reverse anemia over 12-week period and micronutrient supplementation should continue for a longer period. Further studies with larger sample size and randomized control trial design are needed to confirm the findings of this study.

CONCLUSION

Significant number of SAM children remain anemic when treated with current guidelines. Additional vitamin B12 supplementation in vitamin B12 deficient group showed improvement in weight gain among SAM children.

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REFERENCES

1. International Institute for Population Sciences (IIPS) and ICF.2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS. Available at: http://rchiips.org/NFHS/factsheet_NFHS-4.shtml. Accessed 20 February 2018.
2. Awasthi S, Das R, Verma T, Sheila. Anemia and undernutrition among preschool children in Uttar Pradesh. Indian J Pediatr. 2003;40(10):985-90.
3. Poulten J, Kapila M, Poddar R, Cameron D. A nutritional survey in Santhal Parganas, India. J trop pediatr. 1987;33:346-8.
4. Thakur N, Chandra J, Pemde H, Singh V. Anemia in severe acute malnutrition. Nutrition. 2014;30(4):440-2.
5. Ray S, Chandra J, Bhattacharjee J, Sunita S, Agarwala A. Determinants of nutritional anaemia in children less than five years age. Int J Contemp Pediatr. 2016;3:403-8.
6. Yaikhomba T, Poswal L, Goyal S. Assessment of iron, folate and vitamin B12status in severe acute malnutrition. Indian J Pediatr. 2015;82(6):511-4.
7. Goyal S, Tewari K, Meena P, Malviya S, Asif M. Cobalamin and folate status in malnourished children. Int J Contemp Pediatr. 2017;4(4):1480-4.
8. Strand TA, Taneja S, Kumar T, Manger MS, Refsum H, Yajnik CS et al. Vitamin B-12, folic acid, and growth in 6- to 30-month-old children: a randomized controlled trial. Pediatrics. 2015;135(4):e918.
9. Ministry of Health and Family Welfare, Government of India. Facilitator guide for facility-based management of severe acute malnutrition. 2013.
10. Osei AK, Rosenberg IH, Houser RF, Bulusu S, Methews M, Hamer DH. Community-level

Micronutrient Fortification of School Lunch Mealimproved vitamin A, Folate, and iron status in schoolchildren of Himalayan Villages of India. J Nutr. 2019;140:1146-54.
11. WHO Guideline: Updates on the management of severe acute malnutrition in infants and children. Geneva: World Health Organization; 2013. Available at: http://apps.who.int/iris/bitstream/handle/10665/95584/9789241506328_eng.pdf?sequence=1. Accessed 20 February 2021.
12. Khairnar MR, Wadgave U. Shimpi PV. Kuppuswamy's Socio-Economic Status Scale: A Revision of Occupation and Income Criteria for 2016. Indian J Pediatr. 2017;84:3-6.
13. World Health Organisation. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Available at https://www.who.int/vmnis/indicators/haemoglobin.pdf. Accessed 20 February 2020.
14. Yewale VN, Dewan B. Treatment of iron deficiency anemia in children: a comparative study of ferrous ascorbate and colloidal iron. Indian J Pediatr. 2013;80:385-90.
15. Ankar A, Kumar A. Vitamin B12 Deficiency. In: Stat Pearls. Treasure Island (FL): Stat Pearls Publishing; 2020. Available at: https://www.ncbi.nlm.nih.gov/books/NBK441923/. Accessed 20 February 2018.
16. Dror DK, Allen LH. Effect of vitamin B12 deficiency on neurodevelopment in infants: current knowledge and possible mechanisms. Nutr Rev. 2008;66(5):250-5.
17. Bhatnagar S, Kumar R, Dua R, Basu S, Kumar P. Outcome of children with severe acute malnutrition and diarrhea. Pedaitr Gastroentrol Hepatol Nutr. 2019;22:242-8.
18. Singh P, Kumar P, Rohatgi S, Basu S, Aneja S. Experience and outcome of children with severe acute malnutrition using locally prepared therapeutic diet. Indian J Pediatr. 2016;83:3-8.
19. Mamidi RS, Kulkarni B, Radhakrishna KV, Shatrugna V. Hospital based nutrition rehabilitation of severely undernourished children using energy dense local foods. Indian Pediatr. 2010;47:687-93.

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