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**Original Research Article**

# Neurodevelopmental outcome of children with severe acute malnutrition

**Irfan B. Bhat*, Muzafar Jan, Abdus S. Bhat**

Department of Pediatrics, GMC Srinagar, Srinagar, Jammu and Kashmir, India

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***Correspondence:**
Dr. Irfan B. Bhat,
E-mail: bhatirfan133@gmail.com



## ABSTRACT

**Background:** Severe acute malnutrition is known to be a major risk factor for impaired motor, cognitive, and socio-emotional development. Not much work has been done to study the neuro development of these patients. The aim of this study was to assess the neurodevelopment and outcome of children between 1 and 30 months with diagnosis of SAM

**Methods:** The study was an observational prospective study conducted from November 2018 to April 2020. A total of 61 patients were enrolled in our study. Patients admitted in NRC with diagnosis of SAM were assessed for neurodevelopment after stabilization. Developmental assessment scale of Indian infants was used to calculate the motor developmental quotient and mental developmental quotient. Patients were followed till 6 months and after 6 months, they were again assessed by DASII to see the improvement in neurodevelopment status. Developmental quotient of less 70 was taken as delayed.

**Results:** Mean DMeQ after stabilization and at 6 months after discharge was 53.672 and 72.591 respectively. Mean DMoQ after stabilization and at 6 months after discharge was 50.50 and 68.23 respectively. Mean DQ after stabilization and at 6 months after discharge was 52.186 and 70.4105 respectively.

**Conclusions:** Severe acute malnutrition results in neurodevelopmental impairment in children but early and effective intervention results in significant improvement in neurodevelopment status.

**Keywords:** Severe acute malnutrition, Neurodevelopment, DASII

## INTRODUCTION

Severe acute malnutrition as defined by WHO and UNICEF, includes severe wasting and nutritional edema. Severe wasting (marasmus) is defined as weight-for-height (WFH) below -3 standard deviations (SD or *Z*-scores) or mid upper arm circumference (MUAC) <115 mm.[1-3] Severe acute malnutrition is known to be a major risk factor for impaired motor, cognitive, and socio-emotional development.[4] Malnutrition is associated with both structural and functional pathology of the brain. Structurally malnutrition results in tissue damage, growth retardation, disorderly differentiation, reduction in synapses and synaptic neurotransmitters, delayed myelination and reduced overall development of dendritic arborization of the developing brain. There are deviations in the temporal sequences of brain maturation, which in turn disturb the formation of neuronal circuits.[5] A lot of work has been done to study the growth of children suffering from severe acute malnutrition (SAM) but equal efforts have not been made in assessing the developmental delay and cognitive impairment in these children. There is thus need to find out the exact incidence of deranged neurodevelopment in such children and so that proper guidelines are formulated to detect and treat this. There has been significant reduction of mortality in SAM children with improved treatment in nutritional rehabilitation centers, which mainly focuses on nutrition

supplementation. There is thus need of various measures which help in neurological rehabilitation of these children along with nutritional rehabilitation.

## METHODS

The study was a prospective observational study conducted from November 2018 to April 2020 in the NRC of post graduate department of pediatrics and neonatology, G. B. Pant pediatric hospital, an associated hospital of Govt. medical college Srinagar. Written informed consent was taken from parents. All the patients who got admitted with diagnosis of severe acute malnutrition were included in the study. Convenience sampling technique was used.

### *Inclusion and exclusion criteria*

Children in the age group of 1 month to 30 months who got admitted in GB Pant Children Hospital with diagnosis of severe acute malnutrition were included and studied. Children less than 1 month and more than 30 months were excluded.

Children were managed in nutritional rehabilitation centre (NRC) both medically and nutritionally as per WHO guidelines. Very sick children were managed in Emergency or Pediatric ICU and after stabilization were shifted to nutritional rehabilitation centre (NRC). After stabilization neurodevelopmental assessment was done by Developmental Assessment Scale for Indian Infants (DASII) by a single examiner. After discharge children were followed till 6 months. At 6 months, neuro-developmental assessment was done again by DASII to see the improvement. DASII is an Indian modification of Bayley scale of infant development containing motor and mental scales with 67 and 163 items respectively. The DASII Scale in its present form is a revision of the Baroda norms with a major modification, where indigenous test materials are used for standardization and published in 1996[6]. After assessment of children, motor development quotient (DMoQ) and mental development quotient (DMeQ) was calculated as per manual of DASII scale (DMoQ = MoA/CA x 100 and DMeQ = MeA/CA x 100). The composite DQ is derived as an average of DMoQ and DMeQ. Developmental delay was be defined as development quotient (DQ) <70 (<-2SD) in either the mental or motor scale. Samples from both groups were further classified as mild (50-70%), moderate (35-50%), and severe delay (<35%).[7]

### *Statistical analysis*

All the collected data was entered in Microsoft Excel spreadsheet and analyzed using SPSSvs23. Chi square test was used to see the association between two categorical variables. To compare a continuous variable between two groups t- test was used. Wilcoxon test was used to compare a discrete variable between two groups. A p value of 0.05 or lesser was considered to be statistically significant.

## RESULTS

Total of 61 patients were included in this study who fulfilled the inclusion criteria. Out of total 61 cases, 38 (62.3%) were males and 23 (37.7%) were females with male to female ratio of 1:1.65.

**Table 1: Distribution of study participants according to gender.**

| Gender | N | % |
|---|---|---|
| **Male** | 38 | 62.3 |
| **Female** | 23 | 37.7 |
| **Total** | 61 | 100.0 |

**Table 2: Distribution of age groups.**

| Age group (months) | N | % |
|---|---|---|
| **<6** | 18 | 29.5 |
| **6 to 12** | 14 | 23.0 |
| **12 to 24** | 19 | 31.1 |
| **>24** | 10 | 16.4 |
| **Total** | 61 | 100.0 |

**Table 3: Comparison between initial DMeQ and DMeQ at 6 months.**

| Variable | Initial DMeQ | DMeQ at 6 months |
|---|---|---|
| **N** | 61 | 22 |
| **Mean** | 53.672 | 72.591 |
| **Std. Deviation** | 12.4214 | 9.4297 |
| **Minimum** | 20.0 | 40.0 |
| **Maximum** | 68.0 | 80.0 |
| **Median** | 60 | 76 |

Z=3.98, p value <0.001; using Wilcoxon Signed Ranks Test

**Table 4: Comparison between initial DMoQ and DMoQ at 6 months.**

| Variable | Initial DMoQ | DMoQ at 6 months |
|---|---|---|
| **N** | 61 | 22 |
| **Mean** | 50.77 | 68.23 |
| **Std. Deviation** | 13.04 | 9.90 |
| **Minimum** | 18.0 | 34.0 |
| **Maximum** | 66.0 | 76.0 |
| **Median** | 56 | 71.5 |

Z=3.90, p value <0.001; using Wilcoxon Signed Ranks Test

The mean age of presentation was 12.016±7.72 months. Maximum number of children belonged to age group of 12-24 months mean DMeQ of patients after stabilization was 53.672 whereas on follow up after 6 months, it was 72.591. This was statistically significant with p value of <0.001. Mean DMoQ of patients after stabilization was 50.59 whereas on follow up after 6 months of discharge it was 68.23. This was statistically significant with p value of <0.001. Mean DQ was 52.186 and at 6 months after discharge it was 70.4105. We also studied the relation of

DMeQ and DMoQ with degree of recovery of SAM patients. We found that patients with more severe delay in neurodevelopment had partial recovery at discharge. But this was not statistically significant (p value>0.05).

## DISCUSSION

In this study, all the 61 patients had delay in both motor and mental domains. Mean DMeQ of patients in our study was 53.672. Among them, 7 patients had severe developmental delay (DMeQ <35), 11 patients had moderate developmental delay (DMeQ of 35-50) whereas 43 patients had mild developmental delay (DMeQ of 50-70). Mean DMoQ of patients in our study was 50.59. Among them 13 patients had severe developmental delay (DMoQ of <35), 5 patients had moderate developmental delay (DMoQ of 35-50) and 43 patients had mild developmental delay (DMoQ of 50-70). Thus, in our study both mean DMeQ and DMoQ were lower than normal. Maximum number of patients had only mild delay in both mental and motor domain and delay was more in motor domain as compared to mental domain. These results were close to results of the study done by Dwivedi D et al in which mean motor DQ was 59.04 (0.74) and mental DQ was 62.1 (0.57).[8] Jain et al also found in their study that SAM patients have both low Mental DQ and Motor DQ.[9] Only 22 patients came for regular follow up till 6 months and were assessed again in both domains. Mean DMeQ at 6 months was 72.591 which was higher than the initial value of 53.672. Mean DMoQ at 6 months was 68.23 which was again higher than the initial value of 50.77. Initial mean DQ was 52.186 and at 6 months after discharge it was 70.4105. Thus, there was statistically significant increase in both DMeQ and DMoQ after 6 months of discharge thus highlighting the importance of early nutritional intervention in improving neurodevelopmental status. Thus, it is clearly evident from this study that severe acute malnutrition results in delayed neurodevelopment with majority having only mild delay but if identified early and intervened timely, many children can be saved from serious neurodevelopmental disabilities.

### *Limitations*

The limitations of this study are its small sample size and lack of follow-up of all the patients.

## CONCLUSION

Severe acute malnutrition leads to delay in both motor development and mental development. Early diagnosis and effective rehabilitation of these patients can save them from serious neurodevelpomental sequlea.

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