Section: Paediatrics

Original Research Article

NEURODEVELOPMENTAL ASSESSMENT OF SAM CHILD

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Abstract

Background: The socio-demographic factors like a birth interval of fewer than two years, mother's age at birth, maternal education, neglect of the girl child, large family size, and lack of child spacing and family welfare methods are potentially associated with Severe Acute Malnutrition (SAM). **Materials and Methods:** This study assessed the neurodevelopmental status of severe acute malnutrition in children aged 6 months to 30 months at Chengalpattu Medical College using the Bayley scale of infant and toddler development-III. **Result:** Among the study population, the mean age was 18.75 ± 7.2 months, of which 50.67% were male, and 49.33% were female children. Weight for length has a statistically significant association with neurodevelopment, and children with a worse W/L ratio had a higher proportion of cognitive, language, and motor delay.No statistically significant delay in socioemotional and adaptive behaviour development was noted concerning MUAC and W/L ratio.No statistically significant relation was found between age and sex distribution with the degree of developmental delay.Among the 75 children screened, 25% had a delay in one or more developmental assessment scales. Among this, 25%, 94.7% of SAM children had a cognitive delay, 73.7% had a motor delay, and 68.4% had a language delay with no significant delay in socio-emotional and adaptive behavioural development. **Conclusion:** Treatment programs designed for severe acute malnutrition should have robust early intervention protocols to prevent neurodevelopmental disabilities in these children.

INTRODUCTION

Globally in 2020, 149 million children under 5 were estimated to be stunted, 45 million were estimated to be wasted, of which 14.3 million were severely wasted. Undernutrition is responsible for about 45% of all mortality in children under five. The global burden of malnutrition has substantial and long-term developmental, economic, social, and medical consequences for individuals and their families, communities, and countries.[1] According to the National Family and Health Survey (NFHS)-5, 30.1% of urban children, 37.3% of rural children, and 35.5% of all children under five are stunted in India. According to the NFHS-5 prevalence of severe acute malnutrition in Tamil Nadu has reduced to 5.5% from 7.9% in NFHS-4. Due to various steps made to lower the load of malnutrition in children under the age of five, there has been a considerable decrease in severe acute malnutrition in the state of Tamil Nadu.[2] Several studies have found an association between socio-demographic factors and Severe Acute Malnutrition (SAM) like a birth interval of fewer than two years, mother's age at birth, maternal education, neglect of the girl child, large family size, lack of child spacing and family welfare methods. The growth and development of children are influenced by environmental factors such as parental education, social level, sanitation, the standard of living, parental attitudes, and childrearing practices.[3,4] Nutritional factors like improper breastfeeding practices, late commencement after one hour of delivery, non-exclusive breastfeeding, improper weaning practices, and diet during illness all impact children's growth and development. Other key variables contributing to malnutrition include maternal malnutrition, low birth weight (LBW), and recurrent infections.[3] Thus, the study aimed to assess the neurodevelopmental status of SAM children aged 6 months to 30 months using the Bayley scale of infants and toddler development 3rd edition.

MATERIALS AND METHODS

A cross-sectional studywasconducted in the Department of Paediatrics, Chengalpattu Government Medical College and ICDS Centres in Chengalpattu districtfor 1 year and 6 months from 1st March 2020 to 30th September 2021. All Children of age 6 to 30 months, who satisfy the WHO diagnostic criteria of Severe Acute Malnutrition, i.e., weight for height less than -3SD or mid-arm circumference less than 11.5cm or presence of nutritional oedema, who are admitted to the paediatric ward, and attending ICDS centres in the district of Chengalpattu were included. Children with the following organic causes of malnutrition are excluded from the study, Congenital Heart Disease, Cerebral Palsy/ Global Developmental Delay, Malabsorption syndromes and Genetic syndromes, and Children who do not participate fully in the BAYLEY test. The Anthropometric data collected include weight, height, Mid Upper Arm Circumference (MUAC), which were interpreted using WHO growth charts based on standard deviation. Weight and height were calculated and plotted on a WHO chart.

Statistical Analysis

Descriptive analysis was carried out by mean and standard deviation for quantitative variables and frequency and proportion for categorical variables. Non-normally distributed quantitative variables were summarized by the median and interquartile range (IQR). Data was also represented using appropriate diagrams like bar diagramsand pie diagrams. All Quantitative variables were checked for normal distribution within each explanatory variable category by visual inspection of histograms and normality Q-Q plots. Shapiro- Wilk test was also conducted to assess normal distribution. Shapiro Wilk test p-value of >0.05 was considered as a normal distribution. The difference in proportions was tested for statistical significance using the Chi-square test. A p-value <0.05 was considered statistically significant. Data were analyzed using IBM SPSS software, V.22.

RESULTS

A total of 75 children were included in the final analysis. Among the study population, the mean age was 18.75 ± 7.2 months (6 to 30) (Figure 1).In our study population, 50.67% were male,and 49.33% were female.

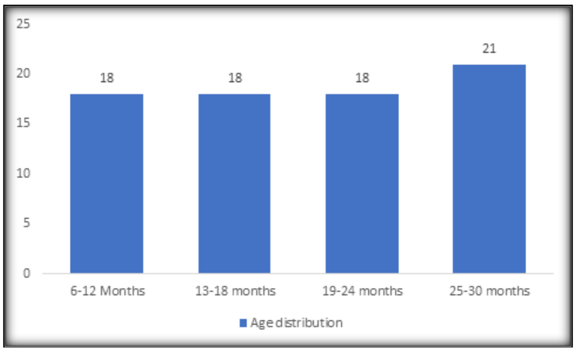

Figure 1: Distribution of age groups

Further, in our study population, the mean weight in kg was 7.85 ± 1.4, the mean Weight Z Score was -2.74 ± 1.05, the mean height was 79.74 ± 7.54, the mean Height Z Score was -0.77 ± 1.78, the mean Weight for Length was -3.41 ± 0.42, and the mean MUAC was 11.15 ± 0.21. MUAC and cognitive delay: Among the 75 children screened, 17.4% of children with MUAC 11-11.5% and 58% with MUAC <11.0 cm had a cognitive delay. A higher proportion of children with MUAC <11 cm had a cognitive developmental delay compared to those with MUAC between 11-11.5. Also, this association was found to be statistically significant (p-value -0.002). MUAC & Language delay: Among the 75 children screened, 12.7% of children with MUAC 11-11.5% and 41.7% of children with MUAC <11.0 cm had a language delay. A higher proportion of children with MUAC <11 cm had language developmental delayscompared to those with MUAC between 11-11.5. Also, this association was found to be statistically significant (p-value -0.015). MUAC & Motor delay: Among the 75 children screened, 14.3% of children with MUAC 11-11.5% and 41.7% of children with MUAC <11.0 cm had Motor delay. A higher proportion of children with MUAC <11 cm had Motor developmental delay compared to those with MUAC between 11-11.5. Also, this association was found to be statistically significant (p-value -0.026). Weight for length and cognitive delay: Among the study population, 100% of children with a weight for length <-4.0 SD and 80% of children with a weight for length between -3.5 SD and -4.0 SD had Cognitive delay. Weight for length has a statistically significant association with Cognitive development, and children with a worse W/L ratio have a significant cognitive delay. (p-value <0.05) [Figure 2].

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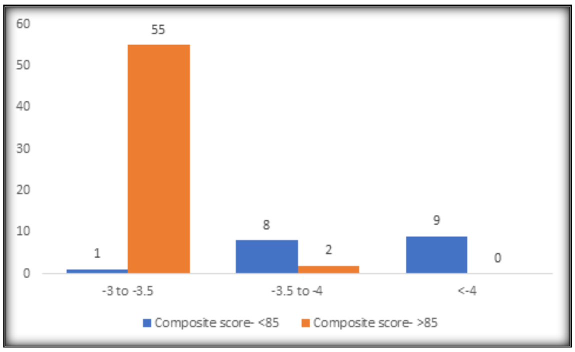

Figure 2: Distribution of Cognitive delay based on weight for length

Weight for length and language delay: Among the study population, 100% of children with a weight for length <-4.0 SD and 40% of children with a weight for length between -3.5 SD and -4.0 SD had a language delay. Weight for length has a statistically significant association with Language development, and children with a worse W/L ratio have significant Language delay. (p-value <0.05). Weight for length and motor delay: Among the study population, 100% of children with a weight for length <-4.0 SD and 50% of children with a weight for length between -3.5 SD and -4.0 SD had Motor delay. Weight for length has a statistically significant association with Motor development, and children with a worse W/L ratio have a significant Motor delay. (p-value <0.05). No statistically significant delay in socioemotional and adaptive behaviour development was noted about MUAC and W/L. No statistically significant relation was found between age and sex distribution with the degree of developmental delay [Figure 3].

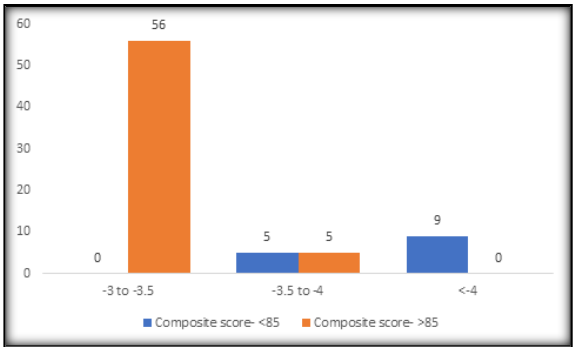

Figure 3: Weight for length and motor delay

Distribution of developmental delay among various scales: Among the study population of 75 SAM children, the developmental delay was present in all 5 wings of development at variable frequency. The cognitive delay was present in 18 (24%) of SAM children, Language delay in 13 (17%), Motor delay in 14 (18.7%), Socio-emotional 6 (8%), and adaptive behaviour in 5 (6.7%).This signifies that the scale is the most commonly affected scale among the 5 scales of cognitive development [Table 1].

Table 1: Distribution of composite scale and developmental delay scale

		Frequency	Percentage
Composite score <85	Cognitive	18	24
	Language	13	17
	Motor	14	18.7
	Socio-emotional	6	8
	Adaptive Behaviour	5	6.7
Development scale	Normal Development	56	74.7
	Developmental Delay	19	25.3

[Table 1] shows the percentage age distribution of developmental scales among children with developmental delay, indicating that 74.7% had normal development, whereas 25.3% had developmental delay. Among the 75 children tested through the Bayley scale, 19 children (25.3%) were found to have a developmental delay in one or more of the Bayley subtests.Of these 19 children with developmental delay, 18 children (94.7%) had a statistically significant delay in cognitive development, 13 children (68.4%) had a language delay, 14 children (73.7%) had a delay in motor development, 6 children (31.6%) had Socioemotional, and 5 children (26.3%) had abnormal adaptive and behavioural scores [Figure 4].

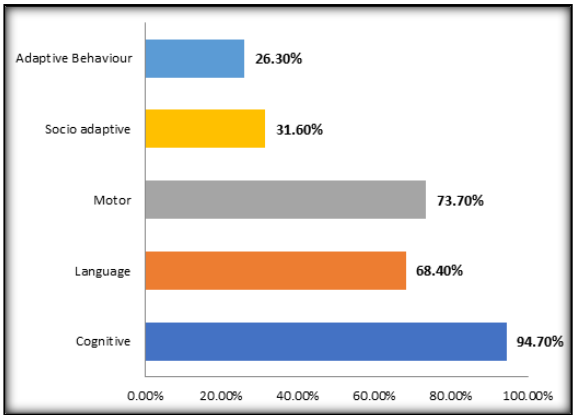

Figure 4: Chart showing the distribution of developmental delay among various scales.

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DISCUSSION

Severe acute malnutrition (SAM) is known to be a major risk factor for impaired motor, cognitive, and socio-emotional development. Survival has improved in SAM children with improved treatment in nutritional rehabilitation centres, mainly focusing on nutrition supplementation. These SAM children also require comprehensive early intervention to limit neurodevelopmental sequelae. SAMadversely affects the first 2 years of life, the most crucial period of neuronal development in children.[3,4] In this study, we have included 75 children aged 6 months to 30 months, and neurodevelopmental parameters were assessed using the Bayley scale of infant and toddler development -3rd edition. In the present study, we found a significant delay in development across 3 developmental scales, namely cognitive, motor and language, with the cognitive scale being the most affected (94.7%), followed by motor development (73.4%), followed by language development (68.4%). On the other hand, socioemotional and Adaptive behavioural scales showed no statistically significant delay in development. In the study by Dwivedi et al.[5] children with SAM had low motor and mental DQ. Most of the SAM children had a mild delay, and few had a moderate delay. Mild delay (DQ 50-70) in the motor domain was seen in 87.3% of study children and 10% of controls, whereas it was 94.1% and 12% in the mental domain. For moderate delay (DQ 35-50), these proportions were 12.7% and 1%, and 5.9% and 0% for motor and mental DQ, respectively. None of the SAM children had a severe delay in any domain. There is a significant difference in motor and mental DQ of SAM children in this study compared to controls, which shows the impact of malnutrition on child development, as in other studies in the literature. Galleret al.[6] studying childhood malnutrition and its effects on the brain and cognition, demonstrated a decline in cognitive ability over the lifespan in children with malnutrition in early life. They also studied the use of neuroimaging modalities to measure brain structure and functions as screening tools is feasible and cost-effective use in Low Resource Settings (LRS) and those populations at greatest risk for childhood malnutrition. In this study, we screened developmental parameters clinically, which showed a statistically significant delay in neurodevelopment in SAM children. Therefore, neuroimaging was not included in the study. Vaibhav Jain et al.[7] found that SAM children have both low Mental DQ and Motor DQ and that Low MUAC is associated with Low Motor DQ. In addition, stunting is associated with low Motor and Mental DQ. In this study, among the 75 children screened, there was a statistically significant association of MUAC and Weight for length with Developmental delay, with lower MUAC & W/L more the chances of delay. Kulkarni et al.[8] concluded that lower motor performance was observed in infants with PEM. Assessment of gross motor development with AIMS suggested that 74% of the infants had atypical performance, and 19% had suspected motor performance in infants aged 6 to 18 months with Protein Energy Malnutrition. In this study, 73.7% of children were found to have motor delays among the study population. Chowdhury et al.[9] concluded that well-nourished children scored significantly higher ($p < 0.05$) than undernourished children in total BOT-2 score and all individual motor subtests. Regression analysis showed that nutritional status, socioeconomic status, and height significantly impactthe total BOT-2score. Age and sex were found to be influencing factors in motor development. But this study showed no statistically significant association between age and sex with developmental delay. All the children enrolled in the study belonged to the age group of 6 months to 30months, of which 24% were 6-12 months, 24% in 13-18 months, 24% to 19-24 months, and 28% in the 25-30 months group. In a study done by Taneja.etal.[10] in Madhya Pradesh meansthe age of participants was 23.95 ± 13.68, with only 40% of children in the age group less than 24 months. Thus, the burden of SAM is more in children less than 2 years of age in most of the conducted studies. Delayed development has lifelong implications, but if identified early and intervened in a timely manner, many children can be saved from disabilities. The study had some limitations. First, this study was a cross-sectional descriptive study that screened SAM children for the neurodevelopmental delay. A follow-up study design would have helped assess the improvement of developmental parameters after nutritional rehabilitation of children with severe acute malnutrition. Second, there was no control group of children in this study to compare the Bayley scores of developmental wings of SAM children with children who are well nourished and belong to the same racial and demographic profile, which would have given a better comparison of developmental parameters. Morbidity, mortality, and other clinical parameters were not studied, which would have better understood the disease burden on the community. Finally, the Covid outbreak significantly impactedthe nutritional rehabilitation of children and the feasibility of SAM children to health care facilities due to the lockdown.

CONCLUSION

Malnourished children have the inherent potential for normal development during early infancy, but their development is delayed as they are affected by severe malnutrition in later life. As severe acute malnutrition is found to impact children's neurodevelopment and delayed development significantly has lifelong implications, many children can be saved from disabilities if identified early and intervened timely. Therefore, treatment programs for severe acute malnutrition should have robust early intervention protocols to prevent neurodevelopmental disabilities in these children.

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