



## DEVELOPMENTAL CHANGES IN SEVERELY MALNOURISHED CHILDREN.

## Paediatrics

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## ABSTRACT

**Objective:** To study the developmental changes in Severely Malnourished Children.

**Design:** Prospective Cross-sectional study

**Setting:** Severe Malnutrition Treatment Unit (SMTU), Department of Paediatrics, Shyam Shah Medical College, Rewa, Madhya Pradesh

**Participants:** Study was carried out on 52 Severely Malnourished (SAM) Children in the age group of 0-5 years admitted in Severe Malnutrition Treatment Unit(SMTU) of Department of Paediatrics. The cases with neurological disease like epilepsy, cerebral palsy, meningitis, tumour, hydrocephalus, history of perinatal asphyxia or any sign and symptom suggestive of CNS involvement were excluded to detect CNS changes attributable to malnutrition only.

**Main Outcome Measure(s):** Development assessment using DDST II was performed to assess the functional changes in SAM children. Association of developmental delay & malnutrition with various demographic & social factors was also assessed.

**Results:** Development assessment by DDST II revealed that out of 52 SAM children, 26 children (i.e. 50%) had developmental delay. Improper breast feeding practices, rural residence, low socioeconomic status and improper immunization are frequently associated with malnutrition and developmental delay.

**Conclusions:** Our study reveals that malnutrition per se has a significant effect on functions of the developing brain and also affects the intellectual development.

## KEYWORDS

Severe Acute Malnutrition, Severe Malnutrition Treatment Unit (SMTU), Development assessment, DDST II.

## INTRODUCTION

Malnutrition is a Global Health problem and one of the leading causes of death among young children of developing countries. As per NFHS-4 (1), in India out of approximately 135 million Under-5 children, 35.7% are underweight, 38.4% are stunted, 21% are wasted and 7.5% are severely wasted. According to WHO (2), malnutrition contributes to about 45% of deaths in children under -5 years age.

Growth is a unique character in children which makes them distinct from adults. The first few years of life are critical for physical and mental growth of the child. Appropriate macro-nutrient (carbohydrates, proteins, fat etc.) and micro-nutrient (vitamins, minerals) intake is essential for adequate growth of children. Thus, malnutrition causes growth retardation and impairs psycho-social and cognitive development.

Nutrition plays critical role in brain development. Thousands of neurons and neural connections develop and change as child progress in age and are involved in various neural activities. Poor nutrition can slow or limit these complex brain activities. Several neuropathological studies of the brain have shown that PEM may have adverse impact on the number of neurons and synapses, degree of myelination, and total cerebral lipid content of the developing brain (3). The brain of the child is one of the most vulnerable organs affected during growth with potential morphological and functional changes(4).

## METHODOLOGY

This prospective, cross-sectional study was carried out in Department of Paediatrics, Shyam Shah Medical College and associated Gandhi Memorial Hospital, Rewa, Madhya Pradesh over a period of 15 months from June, 2016 to August, 2017. An ethical approval for the study was obtained from the Institutional Ethics Committee. The study included 52 severely malnourished children in the age group of 0-5 years selected from the patients admitted in Severe Malnutrition Treatment Unit(SMTU) of Department of Paediatrics, SSMC and GMH, Rewa, M.P. The parent of the cases were duly informed, explained about the study and consent was taken in cases who qualified under WHO Criteria to classify children under "Severe Acute Malnutrition" mentioned here under-

- Very low weight-for-height/length (SD score below -3SD of the median for WHO Child Growth Standards), and/or
- Mid-upper arm circumference < 11.5 cm ( for >6 month age), and/or
- By the presence of bilateral pitting oedema, and/or
- Visible Severe Wasting (for <6 month age).

## Exclusion criteria

To make the study more specific and reliable only severely malnourished children without any CNS pathology were included. All children with any of the following criteria were excluded from the study:-

- Children with History of convulsions.
- Children with History of any previous disease involving CNS like Epilepsy, Cerebral Palsy, Infantile Tremor Syndrome, Tubercular Meningitis, etc.
- Children with CNS tumour or Hydrocephalus.
- Children with any sign or symptom suggestive of CNS Involvement or Pathology like seizures, posturing, raised ICT, hypertonia, etc.
- Children with history of Perinatal Asphyxia.

## Data collection

Detailed history was collected, general examination and systemic examination were carried out. All subjects were screened for developmental status using Denver Developmental Screening Test II (DDST II). All the gathered information, assessments and reports of investigations were entered in Pre-designed Performa to generate data for analysis.

## Statistical analysis

Data were analyzed using Microsoft® Excel 2007 and Graphpad Instat®. To describe nominal data, simple percentage was used. Chi-square test was applied to determine the association between different variations where ever possible.

## RESULTS

Out of 52 severely malnourished children enrolled in the study 65.3% cases were males with male to female ratio of 1.8:1. Twelve cases were under 6 months and remaining 40 cases were above 6 months of age. In our study, 82.6% of the cases were from rural areas. All 52 cases under study were from poor background, i.e. lower(13.4% cases), upper lower (77%), and lower middle (9.6%) classes as per Modified Kuppusswamy scale of social classification. (Table 1)

**Table no. 1: Demographic profile of the cases**

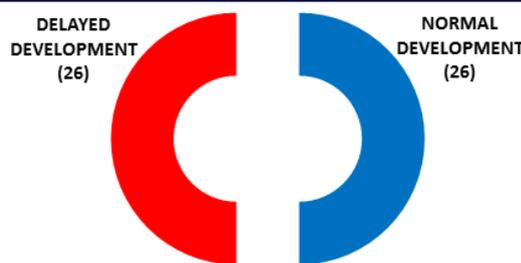
S. no.	Demographic parameter	Number of cases(n=52)	% of Total cases	
1.	Age (in months)	0-6	12	23.07%
		7-12	26	50%
		13-24	10	19.2%
		25-60	4	7.6%

2.	Sex	Male	34	65.3%
		Female	18	37.6%
3.	Residence	Rural	43	82.7%
		Urban	9	17.3%
4.	Socioeconomic status	Upper	0	0%
		Upper middle	0	0%
		Lower middle	7	13.5%
		Upper lower	40	76.9%
		Lower	5	9.6%
5.	Breast feeding	Exclusive	24	46.1%
		Top feeding	28	53.9%
6.	Immunization status	Fully immunized	24	46.2%
		Partially immunized	20	38.5%
		Unimmunized	8	15.4%
7.	Gestational age	Term	45	86.5%
		Preterm	7	13.5%
8.	Birth weight	Low birth weight (<2.5kg)	30	57.6%
		Normal birth weight	22	42.4%
9.	Birth order	<3	19	36.5%
		>3	33	63.5%
10.	Number of family members	>4	43	82.7%
		<4	9	17.3%

The development assessment of cases was done using DDST-II. Out of the 52 cases, 26 cases i.e. 50 % had developmental delay (Figure 1). Higher prevalence of developmental delay was associated with rural residence, low socio-economic status, low birth weight, high birth order and improper immunization. Developmental delay was more prevalent in children with history of top feeding during first 6 months and was found to be statistically significant (p value=0.0022). (Table 2)

**Table No. 2: Development assessment of the cases**

S. No.	Factors affecting development	Total (n=52)	Normal development (n=26)	Delayed development (n=26)	
1.	Age	< 6 month	12	5	7
		> 6 month	40	21	19
2.	Sex	Male	34	16	18
		Female	18	10	8
3.	Residence	Rural	43	20	23
		Urban	9	6	3
4.	Socio economic status	Upper	0	0	0
		Upper middle	0	0	0
		Lower middle	7	4	3
		Upper lower	40	22	18
		Lower	5	0	5
5.	Breast feeding	Exclusive	24	18	6
		Top fed	28	8	20
6.	Gestational age	Term	45	21	24
		Preterm	7	5	2
7.	Birth weight	LBW (<2.5kg)	30	13	17
		Normal (>2.5kg)	22	13	9
8.	Birth order	<3	19	12	7
		>3	33	14	19
9.	Immunization status	Fully immunized	24	16	8
		Partially immunized	20	8	12
		Un immunized	8	2	6
10.	Number of family members	>4	43	21	22
		<4	9	5	4



**FIG. 1- Development assessment of the cases (n=52)**

**DISCUSSION**

All 52 cases included in our study were also screened for developmental status using Denver Developmental Screening Test II (DDST II). Out of the 52 cases, 26 cases i.e. 50 % had Developmental Delay, which shows that severe acute malnutrition is frequently associated with Developmental Delay (Table no.2). This analysis is in support with other previous studies which state that, under nutrition in children aged 0-5 years old can impair behavioural and cognitive development, learning ability, and reproductive health (World Bank, 2011).

Developmental delay was almost equally distributed in each age group. Approximately 50% children of all age groups had developmental delay. On comparison of developmental delay in rural and urban cases, out of 43 cases with rural residence, 53.4% cases had developmental delay. This data reveals that like malnutrition, developmental delay is also more prevalent in children with rural residence. (Table no.2)

Relationship between breast feeding practices and development status was also assessed. Out of total 52 cases, 24 were exclusively breast fed while 28 were top fed. 71.4% of top fed SAM cases had delayed development while only 25% of exclusively breast fed children had delay in their developmental milestones. It is evident from above analysis that exclusive breast feeding is beneficial for both growth and development of children and top feeding during first 6 months of life promotes malnutrition and developmental delay. Even the statistical analysis of the above data had very significant association between breast feeding practices during first 6 months of life and development status of cases in future. Horwood followed children from birth to 18 years or the completion of high school. His study showed that breastfed children were found to be more cooperative and socially adept students the longer they were breastfed (5). According to Tasnim et al, 2015 breast feeding ensures proper nutrition for the baby and contributes to both cognitive and non-cognitive development of the child. Breast feeding infants show higher scores on IQ and on motor skills (6). According to Oddy et al, 2012 breastfeeding for six months or longer is preferable to shorter breastfeeding or formula feeding because it is independently and longitudinally associated with better development, cognition, educational attainment and mental health throughout childhood and into adolescence (7). Findings of our study are also in support to these previous studies.

Percentage of cases with developmental delay was more in nuclear families i.e. 56.5% which shows that the development quotient of children with joint/extended families is better than those with nuclear families. The children with higher birth order were found to have more incidence of delay in their developmental milestones. Out of 52 cases, 63.5% children had birth order of more than 3 out of which 60.6% had developmental delay. The data on relationship between immunization status and development status of the cases shows that developmental delay is more prevalent in children who are partially immunized or unimmunized. Thus we can interpret that malnutrition, improper immunization and developmental delay all are interrelated. (Table no.2)

**CONCLUSION**

The incidence of developmental delay found in our study is highly significant in comparison to normal children. So, Malnutrition per se definitely affects the development of brain. We can interpret that malnutrition is frequently associated with developmental delay that too more in cases with rural residence, low socioeconomic status and improper immunization. Top feeding or improper breast feeding practices have striking association with malnutrition and developmental delay.

This analysis confirms the concern about neuro-developmental delay in SAM and requires early diagnosis and intervention. So, the rehabilitation of children with malnutrition must include in addition to adequate nutrition, early stimulation to provide for intellectual and emotional growth. Also malnutrition affects the intellectual development of brain. Equal emphasis on nutritional and intellectual rehabilitation is essential to realize the innate potential in every child.

#### **WHAT IS ALREADY KNOWN?**

- Developmental delay is seen in severely malnourished children.

#### **WHAT THIS STUDY ADDS?**

- The incidence found in our study seems to be highly significant as compared to normal children and thus requires early diagnosis and intervention.
- Malnutrition affects the neurological and intellectual development of the child indicating need for structured developmental intervention along with nutritional rehabilitation.

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