



## ASSESSMENT OF EARLY CHILDHOOD INTERVENTION IN IMPROVING LEARNING CAPACITY AMONG DEVELOPMENTALLY DELAYED CHILDREN

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### ABSTRACT

**Background:** Developmental delays in early childhood significantly affect learning capacity, behavior, and long-term functional outcomes. Early childhood intervention (ECI) programs play a crucial role in improving developmental skills by addressing delays during the period of maximum brain plasticity.

**Methodology:** This cross-sectional, questionnaire-based study was conducted among 41 children referred for early intervention and skill development at Shrivastava Clinic, Chhindwara, Madhya Pradesh, with data analyzed in the Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaram. The study period was from March 2025 to February 2026. Developmental assessment was performed using the Denver Developmental Screening Test-II (DDST-II) and Madras Developmental Programming System (MDPS). Data were analyzed using descriptive statistics and independent t-test to compare gender differences across developmental domains.

**Results:** Developmental delays were most common in language (71%) followed by fine motor (78%), personal-social (54%), and gross motor domains (24%). Global developmental delay was observed in 30 children. Significant gender differences were noted in gross motor ( $p < 0.05$ ), language ( $p < 0.05$ ), and personal-social development ( $p < 0.05$ ), while fine motor development showed no significant difference. Post-intervention assessment demonstrated improvement in multiple developmental domains.

**Conclusion:** Early childhood intervention programs significantly improve learning capacities and developmental outcomes in children with developmental delays. Early identification and structured intervention are essential for optimal neurodevelopmental progress.

**Keywords:** Developmental Delay, Early Childhood Intervention, DDST-II, MDPS, Learning Capacity, Neurodevelopment.

### INTRODUCTION

Early childhood is a critical period for brain development, during which rapid neuronal growth, synaptic pruning, and neural network formation occur. Scientific evidence shows that the majority of brain architecture is established within the first few years of life, making this a sensitive window for cognitive, emotional, and behavioral development. Experiences during this period significantly influence lifelong learning, adaptive behavior, and intellectual potential.

Disruptions in early neurodevelopment can therefore lead to persistent deficits in cognition, communication, and social functioning [1].

Children with developmental delays or disabilities often face multiple barriers that limit their optimal growth and participation in society. These include inadequate early identification, limited access to rehabilitation services, and lack of inclusive education, negative societal attitudes, and insufficient policy support. As a result, many children with developmental challenges are not able to receive timely early intervention services, which are essential for improving functional outcomes. Without such support, developmental delays may worsen over time, leading to long-term disability, reduced educational attainment, increased dependency, and socioeconomic burden on families and communities [2].

Early childhood intervention (ECI) programs are structured, evidence-based approaches aimed at



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identifying developmental delays at the earliest possible stage and providing targeted therapeutic and educational support. These programs focus on improving cognitive, motor, language, and social skills through multidisciplinary interventions involving healthcare professionals, therapists, educators, and families. Research has consistently demonstrated that early intervention can significantly improve neurodevelopmental outcomes, particularly when initiated during the first three years of life, when brain plasticity is at its peak [3].

Despite global recognition of the importance of early intervention, implementation gaps remain significant, especially in low- and middle-income countries. Limited awareness among parents and healthcare providers, lack of trained professionals, and insufficient infrastructure contribute to delayed diagnosis and inadequate management of developmental disorders. Consequently, many children miss the critical window for optimal intervention, resulting in preventable long-term disabilities [4].

The role of early intervention is not only limited to improving developmental milestones but also extends to enhancing school readiness, social integration, and overall quality of life. Family-centered approaches have shown additional benefits by empowering caregivers, improving home-based stimulation, and strengthening parent-child interaction. Such interventions also reduce caregiver stress and improve family coping mechanisms.

In this context, early identification and structured intervention programs are essential to bridge the gap between developmental delay and functional independence. Understanding the effectiveness of early childhood intervention programs is therefore crucial for developing evidence-based strategies to improve learning capacities and developmental outcomes in affected children.

Hence, the present study aims to evaluate the role of early childhood intervention programs in improving learning capacities among children with developmental delays.

#### Aim and Objectives

**Aim:** To evaluate the effectiveness of early childhood intervention programmes in improving learning capacities among children with developmental delays.

#### Objectives

1. To assess baseline developmental and learning abilities in children with developmental delays.

2. To implement structured early childhood intervention programmes tailored to individual developmental needs.

#### METHODOLOGY

The present cross-sectional, questionnaire-based study was conducted in the Department of Paediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekharam, during the study period from March 2025 to February 2026. The study included 41 children (boys and girls) who were referred by physicians for early intervention assessment and skill development to Shrivastava Clinic, Chhindwara, Madhya Pradesh. Children were selected based on predefined inclusion criteria, considering age and gender distribution, and were enrolled through random sampling. Both male (n=20) and female (n=21) children were included in the study.

Developmental assessment was carried out using standardized tools, namely the Denver Developmental Screening Test-II (DDST-II) and the Madras Developmental Programming System (MDPS) developed by Prof. P. Jeyachandran and Prof. V. Vimala. The MDPS consists of 18 items rated on a dichotomous (yes/no) response scale and was used to evaluate developmental skill domains. Each child was individually assessed, and the evaluation process for each participant took approximately 40 minutes. Initially, a checklist of developmental tasks was administered to obtain baseline responses, followed by structured assessment using DDST-II and MDPS to determine developmental status and skill acquisition.

Data collection was performed systematically after obtaining necessary permissions, and all assessments were carried out in a standardized environment to ensure uniformity. The collected data were recorded in a predesigned proforma for further analysis.

Statistical analysis was performed using appropriate methods. Categorical variables such as gender distribution and developmental status were expressed in frequencies and percentages. Pre-intervention and post-intervention developmental scores were compared using paired t-test for normally distributed data and Wilcoxon signed-rank test for non-parametric data. Association between categorical variables was analyzed using Chi-square test. A p-value of less than 0.05 was considered statistically significant. Data analysis was performed using standard statistical software.

#### RESULT

Table No.1- Delayed Development in the Overall

Areas of Developm ent	Mean Score	SD	95% Confidence Interval of the Difference		t	Sig (2-tailed)
			Lower	Upper		

Gross Motor	Boys	7.71	2.040	1.836	3.091	7.932	.000
	Girls	5.24	1.319				
Language Development	Boys	9.59	2.324	1.710	3.070	7.102	.000
	Girls	7.20	2.015				
Fine Motor Adaptive	Boys	6.29	2.228	-0.478	1.453	1.021	.313
	Girls	5.80	1.820				
Personal - Social	Boys	8.27	.975	1.034	2.331	5.244	.000
	Girls	6.59	1.549				

**Table 1 – Gender comparison of developmental delay:** Boys had significantly higher mean scores than girls in three of the four domains assessed — Gross Motor (7.71 vs 5.24,  $t=7.932$ ,  $p<0.001$ ), Language Development (9.59 vs 7.20,  $t=7.102$ ,  $p<0.001$ ), and Personal-Social domain (8.27 vs 6.59,  $t=5.244$ ,  $p<0.001$ ) — indicating that girls in this sample showed significantly greater delay in these three areas compared to boys. In contrast, the Fine

Motor Adaptive domain showed only a marginal, statistically non-significant difference between boys and girls (6.29 vs 5.80,  $t=1.021$ ,  $p=0.313$ ), with the 95% confidence interval (-0.478 to 1.453) crossing zero, indicating that fine motor delay affected both sexes comparably. This suggests gender is significantly associated with the severity of delay in gross motor, language, and personal-social domains, but not in fine motor skills.

Table No. 2- Mother, Child, and Home Related Risk Factors of Infants.

Characteristics	Categories	Frequency	Percentage
Child's Birth weight	Less than 2 KG.	16	39%
	More than 2 KG and above	25	61%
Mother Education	SSC (Secondary School)	10	24%
	HSC(Higher Secondary School)	13	32%
	College diploma, degree	18	44%
Mother Age	20-25 Years	12	29%
	26-30 Years	22	54%
	31-35 Years	7	17%
Sex of Infants	Male	20	49%
	Female	21	51%
Illness of Children	Experience Illness	8	20%
	Did not experience Illness	33	80%
Availability of playing materials	Adequately available	18	44%
	Partly available	23	56%
History of Congenital	Parents not experienced the problem	35	85%
	Parents who experience it	6	15%
Family Size	3 or 4 members in family	26	63%
	4-5 members in family	15	37%

**Table 2 – Risk factors among infants:** Among the 41 infants studied, low birth weight (less than 2 kg) was present in 39% of cases, making it a notable contributing risk factor. Most mothers (54%) were aged 26–30 years, and educational levels were fairly distributed, with 44% having college-level education — suggesting maternal education alone may not be the primary driver of delay in this group. More than half the children (56%) had only partial availability of play materials at home, pointing to

inadequate environmental stimulation as an important and potentially modifiable risk factor. While the majority had no history of illness (80%) or congenital problems in the family (85%), the smaller subgroups who did (20% and 15% respectively) may represent children at higher vulnerability requiring closer follow-up. Most families were small (63% with 3–4 members), which could influence the degree of individual stimulation and attention the child receives.

Table No. 3. Early Intervention Programmes and Training Pre and Post Test

s.no	Areas	Pre test	Post test	p- value
1	Gross Motor	22%	10%	0.00
2	Fine Motor	38%	15%	0.00
3	Meals time activities	15%	8%	0.00

4	Dressing	12%	10%	0.00
5	Grooming	14%	8%	0.00
6	Toileting	37%	20%	0.00
7	Receptive Language	19%	10%	0.00
8	Expressive Language	25%	15%	0.00
9	Social Interaction	16%	9%	0.00
10	Reading	15%	9%	0.00
11	Writing	10%	2%	0.00
12	Numbers	19%	8%	0.00
13	Time	9%	2%	0.00
14	Money	18%	7%	0.00
15	Domestic Activities	10%	6%	0.00
16	Community Orientation	19%	14%	0.00
17	Recreation ,Leisure time activities	26%	10%	0.00
18	vocational	13%	10%	0.00

**Table 3 – Effect of early intervention training:** All 18 developmental and functional areas showed a statistically significant reduction in deficit percentage from pre-test to post-test ( $p=0.00$  throughout), confirming that the early intervention programme was effective across the board. The largest relative gains were seen in Writing (10%→2%, ~80% reduction), Time concept (9%→2%, ~78% reduction), Money handling (18%→7%, ~61% reduction), and

Recreation/Leisure activities (26%→10%, ~62% reduction), indicating that cognitive-academic and adaptive skills responded particularly well to structured training. Comparatively smaller (though still significant) gains were observed in Dressing (12%→10%), Vocational skills (13%→10%), and Community Orientation (19%→14%), suggesting these domains may need a longer or more intensive intervention period to achieve gains comparable to the other areas.

## DISCUSSION

The present study evaluated developmental delays among children assessed using DDST-II and the Madras Developmental Programming System, with a focus on gender differences and domain-wise developmental patterns. The findings revealed significant differences between boys and girls in most developmental domains, except fine motor-adaptive skills. Gross motor development showed a significantly higher mean score in boys ( $7.71 \pm 2.040$ ) compared to girls ( $5.24 \pm 1.319$ ), with a  $t$ -value of 7.932 ( $p<0.05$ ), indicating a statistically significant difference [5]. Similarly, language development was significantly better in boys ( $9.59 \pm 2.324$ ) than girls ( $7.20 \pm 2.015$ ), with a  $t$ -value of 7.102 ( $p<0.05$ ). Personal-social development also showed significant gender variation (boys: 8.27; girls: 6.59;  $t = 5.244$ ,  $p<0.05$ ), suggesting that developmental disparities exist across domains in early childhood.

However, fine motor-adaptive skills did not show a statistically significant difference between boys and girls ( $t = 1.021$ ,  $p>0.05$ ), indicating relatively uniform development in this domain. These findings suggest that certain developmental domains are more sensitive to environmental and biological influences than others.

A notable finding of the present study was that 30 out of 41 children exhibited global developmental delay involving two or more domains. Language development was the most affected domain (71%),

followed by fine motor-adaptive skills (78%), personal-social skills (54%), and gross motor skills (24%). Similar patterns of delayed language development being the most common have been reported in previous developmental screening studies, where communication delays are often the earliest and most prevalent indicator of developmental dysfunction [6].

The study also identified important risk factors associated with developmental delay. A significant proportion of children had low birth weight (39%  $\leq 2$  kg), which is a known risk factor for neurodevelopmental impairment. Maternal educational status was predominantly secondary or higher secondary level, and a substantial proportion of families lacked adequate developmental stimulation at home, particularly limited availability of play materials. These environmental factors play a crucial role in shaping early brain development and learning outcomes [7].

The effectiveness of early childhood intervention (ECI) programs was evident in the observed improvement in multiple developmental domains including gross motor, fine motor, language, social interaction, and adaptive skills. Post-intervention assessment indicated that structured training significantly enhanced learning capacities among children with developmental delays. These findings are consistent with evidence suggesting that early intervention during the critical period of brain

plasticity leads to improved cognitive and functional outcomes [8].

The theoretical framework of Shonkoff emphasizes that responsive caregiving, emotional engagement, and enriched environmental stimulation are essential for optimal brain development [9]. Similarly, Bronfenbrenner's ecological systems theory highlights that child development is influenced by multiple interacting systems including family, school, and community, reinforcing the importance of integrated intervention approaches [10].

Overall, the present study highlights that early identification and structured intervention significantly improve developmental outcomes in children with delays. Early intervention programs, when combined with parental involvement and enriched home environments, can effectively reduce the burden of long-term disability and enhance learning potential.

### CONCLUSION

The present study demonstrates that developmental delays are common among referred children, with significant impairments observed particularly in language, gross motor, and personal-social domains. A considerable proportion of children exhibited global developmental delay involving multiple domains, highlighting the need for early identification and comprehensive assessment.

Gender differences were observed in most developmental domains, with boys showing comparatively higher mean scores in gross motor, language, and personal-social development, while fine motor-adaptive skills showed no significant gender variation. The findings also indicate that environmental and perinatal risk factors such as low birth weight, inadequate home stimulation, and parental educational status play an important role in developmental outcomes.

Importantly, early childhood intervention programs demonstrated significant improvement in learning capacities and developmental performance across multiple domains. These results reinforce the effectiveness of structured early intervention in

enhancing developmental outcomes and reducing the severity of delays.

Overall, the study emphasizes the critical importance of early screening, timely referral, and implementation of structured intervention programs to optimize developmental potential and improve functional outcomes in children with developmental delays.

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