

# EFFECTIVENESS OF EARLY INTERVENTION ON NEURODEVELOPMENT IN PRETERM INFANTS

**Dr. N. MEENA**

Lecturer in Physiotherapy, Department of Physical Medicine & Rehabilitation, RMMCH, Annamalai University, Annamalai Nagar, Tamilnadu.

## ABSTRACT

The steady improvement in the quality of perinatal care has enhanced the survival of at-risk infants who are at-risk for developmental delay. The ability to identify infants with early neurodevelopmental problems has become a priority. Many of these infants have developmental disabilities that require therapeutic intervention to avoid secondary problems. A prospective, controlled trial was conducted to assess the effect of early intervention on Preterm infants. A cohort of 100 Preterm infants who got admitted in neonatal intensive care unit (NICU) and referral newborn (RNB) of Raja Muthiah Medical College and hospital (RMMCH) were included prospectively. Infants who received regular early intervention were assigned as interventional group (EI) & infants who were advised but did not turn up for early intervention and received conventional physiotherapy as control group (NEI). Early intervention consists of providing continuous multidisciplinary services to infants from birth throughout the first year of life. The Denver developmental screening test (DDST) and Amiel-Tison neurologic examination was used. The average level of the achievement in developmental domains in both groups of infants was compared. Results: The data shows significant benefit in the achievement of developmental domains in EI group. Conclusion: The study suggests a positive effect of early intervention in the neurodevelopmental outcome in EI group over NEI group of Preterm infants.

**Keywords:** Preterm infants, Early Intervention, Neurodevelopment.

## 1. Introduction

The steady improvement in the quality of perinatal care has enhanced the survival of at-risk infants who are at-risk for long-term disabilities.<sup>1,2</sup> Even though there is a substantial improvement in neonatal survival, the incidence of long-term and chronic morbidities, and adverse outcome in Preterm infants continues to be high and has not much declined.<sup>3,4</sup> The ability to identify infants with early neurodevelopmental problems has become a priority. Many of these infants have developmental disabilities that require therapeutic intervention to avoid secondary problems.<sup>5, 6</sup> Early intervention (EI) consists of providing continuous multidisciplinary services to infants from birth throughout the first year of life. It means interventional therapy specified for babies at-risk for developmental delay and periodic developmental assessment of motor, cognitive function, language/adaptive functioning.<sup>7</sup> EI promotes child health, minimizes developmental delays, prevents functional deterioration, and promotes parent-child interaction.<sup>7</sup>

The primary aim of the study is to assess the clinical effectiveness of early intervention as assessed by the developmental and neurological outcome in Preterm infants. DDST comprising of gross motor, fine motor, personal social and language domains was used prospectively to evaluate the effects of interventions. There are various longitudinal studies related to the neurodevelopmental outcome of prematurely born infants.<sup>8,9</sup> EI showed greater developmental and neurological progress in acquisition of skills, cognition, intellectual, social functioning and increased weight gain.<sup>10,11,12</sup> However, results from several studies are not conclusive. Many recommend the study of specific developmental training techniques to find positive effects of EI on neurodevelopment of infants during their first year of life.<sup>13,14,15</sup> Thus, we employed these techniques to study the effect of EI in the neurodevelopmental outcome of Preterm infants.

## 2. Materials and Methods

### Subjects

Preterm newborns from NICU and RNB of our hospital over a period of two years were recruited for the study. Inclusion criteria: infants with gestational age between 28-36 weeks<sup>16</sup>, Singleton delivery. Exclusion criteria: Congenital infections, neonates with major congenital malformations of cardiovascular, central nervous and respiratory systems or dysmorphic babies. Infants who took regular early physiotherapy intervention were assigned as interventional group (EI) & infants who were advised but did not turn up for early intervention and took conventional physiotherapy as comparison group (NEI) and was followed up till 12 months. Sixty infants constituted the EI group (31 male and 29 female) and forty infants (21 males and 19 females) in the NEI group.

### Early Intervention

EI was initiated for high risk infants right from the neonatal period after the babies became stable. Early intervention applied remarkably to Preterm infants, in order to arouse their actions and feelings, ultimately giving them a normal experience of development through interaction with the mother and environment.<sup>7</sup> The individually adjusted program was described to the parents (especially to the mother), who were trained and received written programs elaborated for their infants. These programs contain intensive schedules to develop elementary sensorimotor patterns<sup>17,18</sup>; individualized care plans centered on the infant developmental, mother-child interaction and extending to vision, hearing, feeding, and vocalization. Stimulation was given according to the infant feeding and sleep-time schedules. Infants were reviewed every month. It was emphasized that, aside from the training programs, the infant requires the affection and care of the family members.

### Denver developmental screening test (DDST)

The Denver Developmental Screening Test is a simple, clinically useful tool for early detection of infants with developmental delay.<sup>19</sup> The test comprised of four domains: gross motor, fine motor/adaptive, language and personal social. The levels of achievement were scored as Advanced, ok/pass, caution and fail depending on the age line.<sup>20</sup> The milestones assessment was done according to the corrected age, often

calculated prior to developmental assessment for a more accurate comparison of the developmental status.<sup>4</sup>The date of assessment and the infant corrected age were mentioned against each milestone.

### Neurologic Examination

The Amiel-Tison<sup>21</sup> test was performed by a pediatric therapist, with the infant in awake but quiet. Hypertonia or hypotonia were looked for by measuring the adductor angle, popliteal angle, ankle dorsiflexion, and scarf sign. Any asymmetries between the extremities were recorded.

### Data analyses

The efficacy of the intervention strategies on achievement in various developmental domains at 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> months for EI and NEI Preterm infants was evaluated using Hotellings T<sup>2</sup> test for equality of mean.<sup>22</sup> The effect of early intervention in improving the average level of achievement in all developmental domains in EI and NEI, at 4<sup>th</sup> month and after 12<sup>th</sup> month, the non-parametric test namely Kolmogorov – Smirnov test<sup>23</sup> for equality of means was carried out.

### 3. Results

The age of each infant in both groups was corrected for comparison, and the last examination for the objectives was performed at 12 month of corrected age. At the first examination, no differences in age, socioeconomic features, and examination results were observed. Significant differences between groups were observed with better performance in EI than NEI infants. In the initial assessment, infants of 86% were suspected of neurologic abnormalities, while 14% exhibited a normal result. Later at 12<sup>th</sup> month of examination, in NEI infants 12.5% present a normal result, while 87.5% had suspicion of neurologic abnormalities. In EI Group, all infants had a near normal result at 12<sup>th</sup> month of examination. Significant differences between groups were observed with better performance in EI than NEI. The efficacy of the intervention strategies on achievement in various developmental domains at 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> months for EI and NEI Preterm infants was evaluated. In order to compare the achievement in these developmental domains in both groups it was proposed to test the equality of the mean vectors using the multivariate test procedure, namely, Hotellings T<sup>2</sup> test for equality of mean. H<sub>0</sub>: The average level of achievement in various developmental domains does not significantly differ between the different durations of intervention. The results are given in table 1.

**Table 1:** The equality of mean vectors of four developmental domains in early intervention preterm (EI PT) infants and non-early intervention preterm (NEI PT) infants at 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> months

Age of infants	Hotellings T <sup>2</sup>	F statistic	Significance p
4 <sup>th</sup> month	14.376	98.633	0.000
8 <sup>th</sup> month	24.189	96.758	0.000
12 <sup>th</sup> month	23.404	93.614	0.000

The F statistics value with corresponding p value of 0 implies that the means of all the developmental domains differ significantly between the EI and NEI infants. The mean vectors of the four developmental domains differ significantly from 4<sup>th</sup> to 12<sup>th</sup> months. The values of the descriptive statistics i.e. mean and S.D for the four developmental domains in EI and NEI infants at 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> months are given in table 2.

**Table: 2 The Descriptive statistics for the four developmental domains in EI PT infants and NEI PT infants at 4<sup>th</sup>,8<sup>th</sup> and 12<sup>th</sup> months**

Domains	EI PTinfants		NEI PTinfants	
	Mean	S.D	Mean	S.D
<b>4<sup>th</sup> Month</b>				
Gross motor	1.3750	0.54006	1.3650	0.5397
Fine motor	1.3250	0.47434	1.3167	0.4691
Personal Social	1.3247	0.47389	1.1700	0.3798
Language	1.3219	0.47278	1.1750	0.3848
<b>8<sup>th</sup> Month</b>				
Gross motor	2.3000	0.64847	1.6000	0.63246
Fine motor	2.2750	0.59861	1.4500	0.59700
Personal Social	2.0000	0.59914	1.1750	0.38481
Language	1.9500	0.59700	1.3000	0.51640
<b>12<sup>th</sup> Month</b>				
Gross motor	3.1000	0.77790	1.9250	0.91672
Fine motor	2.9750	0.80024	1.5750	0.67511
Personal Social	2.6250	0.70484	1.2750	0.55412
Language	2.4500	0.67748	1.3500	0.57957

From the values of the descriptive statistics of the four developmental domains, it is observed that for infants who underwent EI, the average values of their developmental domains are greater when compared to that of NEI infants. To compare the difference between the average level of achievement initially at 4<sup>th</sup> month and at 15<sup>th</sup> month in all developmental domains in EI and NEI infants, the Kolmogorov-Smirnov test for equality of means was carried out. The results are given in table 3.

**Table 3:** Kolmogorov–Smirnov test for achievement in all developmental domains at 4<sup>th</sup> month and after 12 months in PT infants

Domains	At 4 <sup>th</sup> month		After 12 months	
	Kolmogorov Z statistic value	p (Significance)	Kolmogorov Z statistic Value	p (Significance)
Gross Motor	0.449	0.988	3.184	0.000
Fine Motor	0.408	0.996	2.817	0.000
Personal Social	0.694	0.721	3.225	0.000
Language	0.694	0.721	3.470	0.000

From the table 3, it is observed that the Kolmogorov – Smirnov Z statistic value have a corresponding P value of > 0.05 at 4<sup>th</sup> month. So there is no significant difference between the average levels of achievement in all developmental domains for the infants in both groups. After 12 months the corresponding P value of < 0.05 and there is a significant difference between the average level of achievement in all developmental domains in infants of EI and NEI groups. . It shows that the achievement in gross motor, fine motor, personal social and language domains differ between the two groups of infants.

#### 4. Discussion

We studied the effects of early intervention in selected sample of high risk infants. We found differences in developmental outcome between EI and NEI infants, with a better performance in EI infants. The study suggests a positive effect of EI on neurodevelopmental outcome in Preterm infants. “Early” can be understood in several ways, for example:1) early after birth;2) early in the first year of life; and3) early after onset of the condition. Each intervention type is associated with advantages and disadvantages. Very early treatment are intervention provided for infants who are at risk for neuromotor disorders, and treated as soon as possible to minimize future handicaps.<sup>24</sup> CDC model of ‘early stimulation therapy’ was effective. The beneficial effect also persisted at 2 years, without any additional interventions. A reduction of 40% in poor performance could be achieved by EI in PT babies in Trivandrum.<sup>25</sup> Various studies related to the developmental outcome of PT infants, EI showed greater developmental progress in acquisition of skills, cognition, intellectual, social functioning and increased weight gain.<sup>26,27</sup>

EI have been carried out in the NICU, after hospital discharge, or may initiate during the first semester of life.<sup>28,29</sup> Various studies suggested that children who were born prematurely are discharged from the NICU were still at risk for future developmental disabilities,<sup>30,31</sup> this necessitates systematic monitoring, follow-up, and early intervention services. But in our study we began EI during newborn period itself before hospital discharge and continued during the first year of life by reviewing infants every month. NEI group were also advised to take EI for their infants, but they did not turn up. A difference in developmental items was observed when comparing infants under EI group with those of NEI group. The level of achievement in all developmental domains in EI infants is greater when compared to NEI infants. There is a significant difference in the level of achievement in the chosen developmental domains as the duration of intervention increases, greater at 12<sup>th</sup> month when compared to other durations. This implies the effectiveness of the early intervention given. In our study, EI therapy helps in the process of achieving higher level of achievement in gross motor domain, similar studies<sup>29,32</sup> is in agreement with our result.

## 5. Conclusion

Early intervention improved the neurodevelopmental outcomes of high-risk infants. The study suggests a positive effect of early intervention in the level of achievement of developmental domains in Preterm infants. This method of intervention prevents disability of the child in future. Intervention is likely to be more effective and less costly when it is provided earlier in life rather than later.

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