

## Impact of Early Physiotherapy Intervention on Neurodevelopment in Preterm Low Birth Weight Infants during the First Six Months of Life

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### Abstract

A prospective, controlled trial was conducted to assess the outcome of early physical therapy intervention on preterm low birth weight infants during the first six months of life. A cohort of 100 preterm low birth weight infants who got admitted in neonatal intensive care unit (NICU) and referral newborn (RNB) of Raja Muthiah Medical College and Hospital (RMMC & H) were included prospectively. Infants who received regular early physiotherapy intervention were assigned as interventional group (EI) and infants who were advised but did not turn up for early intervention as comparison group (NEI). The Amiel-Tison neurologic examination and Denver developmental screening test (DDST) were used and results were compared. Better performance of infants was found in EI group in neurologic and developmental domains. The data suggest significant benefit of the use of EI programme over NEI in the neurodevelopmental outcome of preterm LBW infants at 6 months of corrected age.

**Key words:** Preterm low birth weight infants, Early Intervention, Developmental outcome

### Introduction:

Improving perinatal and neonatal care has led to increased survival of infants who are at-risk for long-term disabilities<sup>1,2</sup>. Survivals of preterm LBW infants have resulted in an increased incidence of physical and mental disabilities<sup>3</sup>. Preterm birth and medical complications due to LBW infants may impact later development such as neuromotor delays, intellectual and behavioural problems<sup>4-6</sup>. Early detection of infants at high-risk is of paramount importance to assess their

developmental status and for planning intervention to avoid secondary problems<sup>7,8</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>9</sup>. EI promotes child health, minimise developmental delays, cures existing disabilities, prevents functional deterioration, and promotes parent-child interaction<sup>9</sup>.

The goal of this study is to measure the effects of EI programme in a group of high-risk preterm LBW infants. The hypothesis is that high-risk infants under EI perform better than a group of high-risk infants without EI. DDST comprising gross motor, fine motor, personal social and language domains were used prospectively to evaluate the effects of EI on their neurodevelopment during follow-up in the first six months of life.

### Materials and Methods:

**Subjects** – Preterm LBW newborns in NICU and RNB of our hospital over a period of two years were recruited for the study. Inclusion criteria – infants with gestational

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age between 28 and 36 weeks<sup>10</sup>; inadequate weight for gestational age<sup>11</sup>; singleton delivery. Exclusion criteria- Maternal history of high blood pressure; diabetes or any chronic maternal disease during pregnancy; congenital infections; congenital malformations.

Infants who received regular early physiotherapy intervention were assigned as interventional group (EI) and infants who were advised but did not turn up for early intervention as comparison group (NEI). Sixty infants constituted the EI group (31 male and 29 female) and forty infants (21 males and 19 females) comprised 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 low birth weight 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>9</sup>. The individually adjusted programme was described to the parents (especially to the mother), who were trained and received written programmes elaborated for their infants. These programmes contain intensive schedules to develop elementary sensorimotor patterns<sup>12,13</sup>, individualized care plans centred on the infant behavioural organisation, mother-child interaction, and extending to vision, hearing, feeding, and vocalisation. Stimulation was given for at least one hour a day, according to the infant feeding and sleep-time schedules. Infants were reviewed every month. It was emphasised that, aside from the training programmes, the infant requires the affection and care of the family members.

*Neurologic Examination* – The Amiel-Tison<sup>14</sup> test was performed by a pediatric therapist, with the infant undressed and 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.

*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>15</sup>. The test comprised four domains: gross motor, fine motor/adaptive, language and personal social. The level of achievement was scored as advanced, ok/pass, caution and fail depending on the age line<sup>16</sup>. The 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>.

*Data Analyses* – In order to examine the effectiveness of early interventional therapy, it is proposed to apply the Chi-square test of independence to examine whether the level of achievement depends up on the early interventional therapy. Also to compare the effectiveness of the therapy over the level of achievement in the EI group and NEI, the “Z” test for the equality of proportions is applied<sup>17</sup>.

## Results:

The age of each infant in both groups was corrected for comparison, and the last examination for the objectives of this study was performed at 6 months of corrected age. No differences in age, socioeconomic features, and examination results were observed at the first examination. Significant differences between groups were observed with better outcome in EI than NEI group after 6 months.

*Neurologic examination* – In the initial assessment, infants of 86% were suspected of neurologic abnormalities, while 14% exhibited a normal result. Six months later at the second examination, in NEI infants 12.5% present a normal result, while 87.5% had suspicion of neurologic abnormalities. In EI group, almost all infants had a near normal result at sixth month. Significant differences between groups were observed with better performance in EI than NEI group.

*DDST* – With a view to examine the impact of the EI therapy for improving the level of achievement in gross motor, fine motor/adaptive, personal social and language domains of preterm LBW infants, the Chi-square test of independence is carried out. The results obtained are given in **Table 1**. The null hypothesis to be tested is H<sub>0</sub>: The level of achievement in all domains is independent of the EI and NEI preterm LBW infants.

From the results obtained the following conclusions could be drawn :

The chi-square statistic value for the gross motor domain data is =18.37 with a corresponding p=0.004. Since ‘p’ value is <0.05, the Chi-square statistic is significant and hence the null hypothesis is rejected. It implies that the level of achievement in gross motor domain is influenced by early interventional therapy. In the case of fine motor, personal social and language domains also the Chi-

**Table 1:** Level of Achievement in all Domains in Early Interventional (EI) and Non-Interventional (NEI) infants

Domains	Interventional (EI ) / Non-interventional (NEI)	Level of achievement (%)			
		Advanced	Ok	Caution	Fail
Gross motor	EI	33.3	35	23.3	8.4
	NEI	12.5	15	37.5	35
Fine motor	EI	25	41.7	20	13.3
	NEI	15	10	37.5	37.5
Personal social	EI	18.3	41.7	28.3	11.7
	NEI	12.5	10	25	52.5
Language	EI	16.7	45	23.3	15
	NEI	12.5	10	27.5	50

square value is significant, and the level of achievement in these domains is also influenced by the early interventional therapy. Therefore the interventional therapy is useful in getting higher level of achievement.

It is further proposed to examine whether there is any significant difference between the proportions of preterm LBW infants with regard to each level of achievement in all domains, the ‘Z’ test for the equality of proportions is used. The null hypothesis to be tested is the proportion with the level of achievement in all domains differs significantly between the EI and NEI. So the null hypothesis is given as  $H_0: P_1 = P_2$ , where  $P_1$  and  $P_2$  refer to the population proportions of the two groups. **Table 2** gives the ‘Z’ statistic values with their level of significance as well as the proportion of two groups of infants achieving the desired level of improvement in all four domains.

From the Table 2, following conclusions can be drawn.

There is a significant difference in the proportion of infants achieving advanced, ok and fail level of achievement in gross motor domain. But there is no significant difference in the proportion of caution level of achievement.

The % or proportion of babies with advanced level of achievement is higher in the EI group when compared to the same for the NEI group. Therefore the interventional strategy contributes to the level of achievement in gross motor domain. In the case of fine motor, personal social and language domains the difference is not significant between the proportion of the two groups with the advanced level of achievement.

So having advanced level of achievement is found to be a difficult task for even the EI group with regard to fine motor, personal social and language domains.

## Discussion:

We studied the effects of intensive EI in selected sample of high risk infants from birth to 6 months of age. We found differences in neurologic and developmental outcome between EI and NEI infants, with a better performance in EI infants. The study suggests a positive effect of EI on neurodevelopment.

“Early” can be understood in several ways, for example: 1) early after birth; 2) early in the first year of life; and 3) early after onset of the condition. Each intervention type is associated with advantages and disadvantages. Very early treatment is intervention provided for infants who are at risk for neuromotor disorders, and treated as soon as possible to minimise future handicaps<sup>18</sup>. The early intervention institute at Utah University reviewed 316 articles suggested that EI has immediate positive effect<sup>19</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 LBW babies in Trivandrum<sup>20</sup>.

There are various longitudinal studies related to the developmental outcome of infants born prematurely<sup>21-23</sup>. EI showed greater developmental progress in acquisition of skills, cognition, intellectual, social functioning and increased weight gain<sup>24-28</sup>. Many recommend the study of specific developmental training techniques to find positive effects of EI on neuro-development of infants during their first year of life<sup>29,30</sup>. Thus, we employed these techniques to study the effects of EI in the neurodevelopment of preterm LBW infants followed during their first six months of life.

EI have been carried out in the NICU, after hospital discharge, or during the first semester of life<sup>31-33</sup>. But

**Table 2:** 'Z' statistic Values with Their Level of Significance as well as The Proportion of Two Groups of Infants Achieving the Desired Level of Improvement in All Four Domains

Domains	Interventional (EI) n=60	Non-Interventional(NEI) n =40	z	P1	P2
<b>Gross motor</b>					
Advanced	20	5	2.32*	0.33	0.125
O k	21	6	2.25*	0.35	0.15
Caution	14	15	1.64	0.23	0.38
Fail	5	14	3.41*	0.08	0.35
<b>Fine motor</b>					
Advanced	15	6	1.20	0.25	0.15
O k	25	4	3.41*	0.08	0.35
Caution	12	15	1.97*	0.2	0.37
Fail	8	15	2.85*	0.13	0.37
<b>Personal social</b>					
Advanced	11	5	0.74	0.18	0.125
O k	25	4	3.4*	0.08	0.35
Caution	17	10	0.33	0.28	0.25
Fail	7	21	4.46*	0.116	0.52
<b>Language</b>					
Advanced	10	5	0.56	0.166	0.125
O k	27	4	3.72*	0.45	0.1
Caution	14	11	0.51	0.23	0.27
Fail	9	20	3.77*	0.15	0.5

\*Significant

in our study we began EI during newborn period itself before hospital discharge. Various studies<sup>34,35</sup> suggested that children who were born prematurely are discharged from NICU were still at risk for future developmental disabilities, this necessitates systematic monitoring, follow-up, and early intervention services. In our study, we initiated early intervention right from the neonatal period itself and continued during the first 6 months of life by reviewing infants every month in EI group. NEI group was also advised to take EI for their infants.

In our study in the initial assessment of neurological examination, infants of 86% were suspected of neurologic abnormalities, while 14% exhibited a normal result. Six months later at the second examination, in NEI infants 12.5% present a normal result, while 87.5% had suspicion of neurologic abnormalities. In EI group, almost all infants had a near

normal result at sixth month. So significant differences between groups were observed with better performance in EI than NEI group

A difference in developmental items was observed when comparing infants under EI group with those of NEI group. The level of achievement in gross motor, fine motor, personal social and language domains of preterm LBW infants is influenced by the early interventional therapy in EI group. It is therefore suggested that the use of early interventional therapy will help in the process of achieving higher level of achievement in different domains of preterm LBW infants.

In our study, EI therapy helps in the process of achieving higher level of achievement in gross motor domain, similar studies<sup>36-38</sup> is in agreement with our result.

The difference between the proportions of preterm LBW infants with regard to each level of achievement in all domains was examined. In the gross motor domain there is a difference in infants achieving advanced, ok and delay level of achievement. But there is no significant difference in caution level of achievement.

The advanced level of achievement is higher in gross motor domain of EI group when compared to the same for the NEI group. Therefore the interventional strategy contributes to the level of achievement in gross motor domain.

In the case of fine motor domain the difference is not significant between the two groups with the advanced level of achievement. A similar conclusion was drawn in the case of personal social and language domains. So having advanced level of achievement is found to be a difficult task for even the EI group with regard to fine motor, personal social and language domains .

We conclude the infants under the caution group both in EI and NEI groups do not show a significant improvement in all the domains except in fine motor.

Our data attributed to the most intensive EI programme. Moreover; the training facilitated the mother-infant relationship. It was emphasised that, aside from the training programmes, the infant requires the affection and care of the family members.

Although our follow-up time was short, our results hold the promise of good outcome in the neurodevelopment of high-risk infants. In **summary**, comparison between the EI and NEI premature LBW infants, the early interventional therapy helps in the process of achieving higher level of functions in different domains.

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