Original Article

Impact of Parent-Based Intensive Early Intervention on Breastfeeding Outcomes in Full-Term Neonates with Hypoxic-Ischemic Encephalopathy at Risk for Cerebral Palsy

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Abstract

Background: Hypoxic-ischemic encephalopathy represents a leading contributor to neonatal mortality and long-term neurodevelopmental disabilities, particularly cerebral palsy. Parent-based intensive early intervention offers a promising family-centered approach to optimize outcomes during the critical window of neuroplasticity in high-risk neonates. The objective is to determine the impact of parent-delivered intensive early stimulation therapy on breastfeeding performance, evaluated through LATCH scoring methodology at three months following intervention initiation in full-term neonates with HIE at risk of cerebral palsy. **Material and Methods:** A prospective interventional follow-up study was conducted among 70 full-term neonates with moderate to severe HIE (Grades 2-3) discharged from a tertiary care center. Parents received structured training in home-based developmental and feeding interventions. Breastfeeding outcomes were assessed using the LATCH scoring system at one- and three-months post-discharge. **Results:** The study cohort comprised predominantly male neonates (85.7%) with normal birth weight (77.1%) from lower middle-class families (64.3%). At baseline, all infants (100%) required breastfeeding support. Following parent-based intervention, 71.4% achieved good latch scores (≥7) at three months, compared to 0% at one month, demonstrating significant improvement in feeding outcomes. **Conclusion:** Parent-based intensive early intervention significantly enhances breastfeeding performance in full-term HIE survivors at risk for cerebral palsy. These findings support the integration of structured feeding interventions into family-centered neurodevelopmental care protocols.

Keywords: Hypoxic-ischemic encephalopathy, parent-based intervention, breastfeeding, LATCH score, cerebral palsy

Received: 10 July 2025 **Revised: 16 August 2025** **Accepted: 18 September 2025** **Published: 14 October 2025**

Introduction

Hypoxic-ischemic encephalopathy constitutes a major global health challenge, affecting approximately 2 per 1000 live births in developed nations and escalating to 36 per 1000 births in countries such as India.[1] This condition emerges from acute perinatal brain injury secondary to oxygen deprivation and compromised cerebral blood flow, potentially resulting in devastating long-term neurological sequelae including cerebral palsy, cognitive impairment, and epilepsy. Despite therapeutic advances including hypothermia treatment, over half of HIE survivors face mortality or significant neurodevelopmental disabilities by age two years.[2-6]

The developing brain's capacity for neuroplasticity reaches its peak during the initial two years of life, with maximal synaptogenesis occurring within the first 6-8 months. This critical developmental window represents an optimal period for therapeutic intervention, as neuronal networks undergo activity-dependent pruning processes that directly influence functional outcomes. Early intervention programs have demonstrated substantial efficacy in enhancing neurodevelopmental trajectories among high-risk populations, particularly when initiated during periods of heightened neuroplasticity.[7]

Traditional therapist-centred approaches encounter significant limitations in resource-constrained environments, where specialized services remain concentrated in urban centres with limited accessibility.[8] Parent-based intensive early intervention emerges as a compelling alternative, empowering caregivers to deliver evidence-based therapeutic activities within naturalistic home environments while reducing costs and enhancing treatment sustainability.[9-11] This family-centred model not only promotes neuromotor development but also strengthens caregiver-infant bonding and improves parental self-efficacy.[12-14]

Feeding difficulties represent a common manifestation among infants with HIE, arising from compromised coordination of sucking, swallowing, and breathing mechanisms regulated by

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DOI:
10.21276/amit.2025.v12.i3.126

How to cite this article: Alekya G, Bharani A, Prajapati J. Impact of Parent-Based Intensive Early Intervention on Breastfeeding Outcomes in Full-Term Neonates with Hypoxic-Ischemic Encephalopathy at Risk for Cerebral Palsy. Acta Med Int. 2025;12(3):516-520.

cranial nerves and brainstem centres. These neuromotor pathways are frequently affected in HIE, creating substantial challenges in establishing effective breastfeeding patterns. The present investigation evaluates the effectiveness of parent-delivered intensive early intervention on breastfeeding outcomes, measured through standardized LATCH scoring, in full-term neonates with HIE at elevated risk for cerebral palsy development.

Objective: To evaluate the effect of parent-based intensive early intervention strategies on breastfeeding outcomes, as assessed by LATCH scores at three months of age, in full-term neonates with hypoxic-ischemic encephalopathy at high risk for developing cerebral palsy.

Materials and Methods

This prospective interventional follow-up investigation was conducted at the Regional Early Intervention Center (REIC) Clinic, Department of Pediatrics in a tertiary care hospital in Indore, Madhya Pradesh, India, over a twelve-month period from July 2023 to July 2024.

The study cohort comprised full-term neonates discharged from the Special Newborn Care Unit (SNCU) who had been diagnoses with of moderate to severe hypoxic-ischemic encephalopathy (HIE Grade 2 or 3) at increased risk for cerebral palsy development. Sample size determination was established based on epidemiological data from Bhunia et al., which demonstrated that 20-50% of neonates affected by perinatal brain injury succumb during the newborn period, while 25-60% of survivors experience permanent neurodevelopmental disabilities, including cerebral palsy, seizures, intellectual disability, and learning disorders.[15] Utilizing an estimated incidence rate of 50% for neurodevelopmental complications in HIE survivors, the sample size calculation employed the formula: $n = DEFF[Np(1-p)]/[d^2Z^2_{1-\alpha/2}(N-1) + p(1-p)]$, where N represents sample size, Z denotes the confidence level at 95% (standard value 1.96), p indicates the proportion of HIE infants at high risk of developing cerebral palsy in the Indian population (50%), and d signifies the margin of error (10%). This calculation yielded a required sample size of 66 participants at 80% statistical power and 5% significance level. To accommodate anticipated attrition during the 12-month follow-up period, the final enrollment target was established at 70 neonates (66 plus 4 additional participants) with moderate to severe HIE (Grades 2-3) at elevated risk for cerebral palsy development, employing convenience sampling methodology for participant recruitment. Eligible participants were full-term neonates diagnosed with moderate to severe HIE (Grades 2–3) who exhibited subnormal neurological score on the Short Hammersmith Neonatal Neurological Examination at hospital discharge and whose parents provided written informed consent; infants were excluded if they had congenital malformations, chromosomal anomalies, meningitis, other neurological or neurodegenerative disorders identified during follow-up, or if parental consent was not obtained.

Intervention Protocol

At NICU discharge, enrolled neonates underwent comprehensive screening using the Short HNNE scale. Those demonstrating subnormal neurological performance received parent-based early stimulation therapy initiation. The intervention protocol was developed at REIC, adapting components from Denver Developmental Activities and Early Childhood Development guidelines published by the Government of India.

A physiotherapist trained in early intervention, under developmental pediatrician supervision, provided comprehensive parental guidance for home-based stimulation activities. Parents received recorded therapy sessions alongside detailed printed instructions encompassing developmentally supportive care and optimal breastfeeding practices. Remote monitoring occurred through weekly telephonic follow-up consultations, with pediatrician and physiotherapist assistance available as required.

Outcome Assessment Tool - LATCH Scoring System

This systematic breastfeeding evaluation tool, developed by Chiu and Ludington in 1994, assesses five fundamental breastfeeding components using numerical ratings of 0-2 for each parameter. The LATCH acronym represents: Latch (infant's breast attachment quality), Audible swallowing (milk transfer verification), Type of nipple (maternal nipple shape and condition), Comfort (maternal comfort during feeding), and Hold/positioning (maternal support and infant positioning effectiveness). Total scores range from 0-10 points, with higher values indicating superior breastfeeding performance. Normal latch scores are ≥7, moderate scores range 4-7, and poor scores are 0-3.

Statistical Analysis: Data collection and entry utilized Microsoft Excel 2016, with IBM SPSS Version 22 employed for statistical calculations. Descriptive statistics were presented as frequencies and percentages. Within-group mean comparisons utilized paired t-tests, while proportional comparisons employed Z-tests for two-sample proportions. Statistical significance was established at p-values <0.05.

Operational Definitions: Hypoxic-Ischemic Encephalopathy (HIE): A neonatal condition resulting from acute or subacute brain injury caused by oxygen deprivation and reduced cerebral blood flow during the perinatal period, classified using Sarnat staging criteria into grades 1-3 based on severity.[16]

Parent-Based Intensive Early Intervention: Therapeutic programs designed for high-risk infants wherein parents receive training and empowerment to deliver targeted developmental interventions within the home environment, integrating therapeutic activities into daily routines to promote motor and cognitive development during critical neuroplasticity periods.[9]

Neurologically Subnormal: Full-term HIE infants demonstrating subnormal score (i.e., <= 2) warning signs on the Short Hammersmith Neonatal Neurological Examination at hospital discharge, indicating increased risk for adverse neurodevelopmental outcomes.

Results

This section presents key findings from the prospective interventional study of 70 full-term neonates with HIE (Grades 2 and 3) who received parent-based intensive early intervention focusing on breastfeeding outcomes assessed using the LATCH

scoring system.

Table 1: Baseline Socio-demographic Characteristics of Study Participants (n=70)

Characteristics of Study Participants		Frequency (n)	Percentage (%)
Gender	Male	60	85.7
	Female	10	14.3
Birth weight	>2.5 kg	54	77.1
	≤2.5 kg	16	22.9
Socioeconomic status	Upper middle class	22	31.4
	Lower middle class	45	64.3
	Upper lower class	3	4.3
HIE	Grade 2	48	68.6
	Grade 3	22	31.4
Hospital Stay	≤7 days	18	25.7
	8-14 days	35	50.0
	15-21 days	3	4.2
	>21 days	14	20.0

[Table 1 and Figure 1] establishes the demographic profile of the study cohort, highlighting male predominance (85.7%), majority with normal birth weight (77.1%), and predominant representation from lower middle-class families (64.3%). The distribution demonstrates the study population's representativeness for early intervention research in resource-limited settings.

A substantial majority of neonates (68.6%) were born to mothers with documented pregnancy or delivery complications, underscoring the high-risk nature of the cohort and potential maternal health impacts on neonatal outcomes [Table 2].

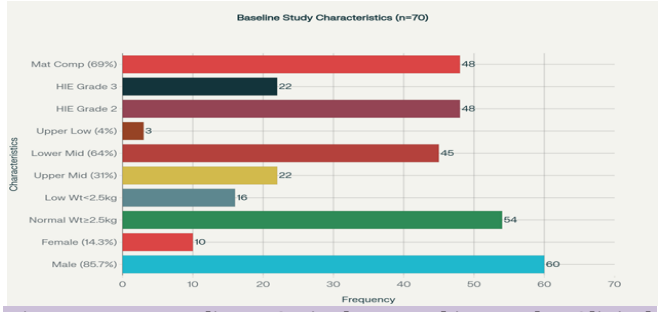

Figure 1: Baseline Socio-demographic and Clinical Characteristics of Study Participants (n=70)

Table 2: Association of lipid profile with type of stroke

LATCH Grade	At 1 Month (n)	At 3 Months (n)
Good latch (≥7)	0	50
Needs support (<7)	70	20

Figure 2: Comparison of LATCH Scores at 1 Month and 3 Months Following Parent-Based Intensive Early Intervention (n=70)

[Table 3 and Figure 2] demonstrates that at one month, all infants required breastfeeding support, but by three months, 71.4% achieved good latch scores. This demonstrates that structured parent-led interventions significantly enhance feeding success, representing a critical aspect of comprehensive neurodevelopmental care.

Discussion

The present investigation demonstrated a substantial increase in the proportion of infants achieving satisfactory breastfeeding performance—from 0% at one month to 71.4% at three months post parent-based intervention—underscoring the potential of family-delivered strategies in enhancing feeding outcomes among high-risk HIE survivors. This improvement parallels findings by Lucas et al. (2020), who observed a 65% rate of satisfactory feeding following parent-administered intervention in preterm cohorts, suggesting that caregiver-led stimulation can be effective across varied neonatal risk groups.[17] Similarly, Menici et al. (2021) reported a 78% enhancement in oro-motor function after home-based massage therapy in high-risk infants, reinforcing the premise that structured parent training yields significant feeding benefits.[18]

Demographically, our cohort's male predominance (85.7%) and normal birthweight distribution (77.1%) align with patterns described by Elvrum et al. (2020) and Benfer et al. (2020) in their respective early intervention studies, bolstering the external validity of our findings across diverse settings.[19,20] The high incidence of maternal complications (68.6%) mirrors the observations of Harniess et al. (2021), who emphasized maternal health's influence on neonatal outcomes and advocated for integrated family-centered care models to optimize both maternal and infant well-being.[21]

Our feeding outcome gains exceed those reported by Meena et al. (2014), where physiotherapist-led interventions achieved only modest improvements, indicating that the intensity and naturalistic context of parent-delivered activities may be crucial for maximizing neuroplastic adaptation.[22] The underlying neurobiological rationale is supported by Benfer et al. (2020), whose LEAP-CP trial highlighted critical-period plasticity during the first three months, a phase during which repeated oro-motor practice can promote synaptic strengthening and functional recovery in brainstem feeding circuits.[20]

In contrast, Chalak et al. (2015) documented persistent feeding difficulties in up to 60% of infants with moderate HIE managed with conventional therapy alone, underlining the limitations of standard approaches and the imperative for adjunctive caregiver-based programs.[23] The superiority of our intervention over clinic-based models is echoed in the Cochrane review by Spittle et al. (2015), which reported that early parent-involved programs yielded larger neurodevelopmental gains compared to therapist-centric regimens, particularly when delivered frequently within home environments.[24]

Furthermore, Novak et al. (2017) and Benzies et al. (2013) both underscored the importance of caregiver empowerment and high-frequency practice for motor and feeding recovery, findings that dovetail with our demonstration of significant LATCH score improvements achieved through daily parent-led stimulation.[25,26]

Overall, the study contributes to the growing body of evidence advocating for the systematic integration of parent-delivered feeding interventions into neonatal follow-up protocols, offering a scalable, cost-effective strategy to improve breastfeeding success and potentially reduce neurodevelopmental morbidity among HIE survivors.

Conclusion

Parent-based intensive early intervention, initiated at hospital discharge, significantly improves breastfeeding outcomes in full-term neonates with moderate to severe HIE at risk for cerebral palsy. The improvement from 0% to 71.4% of infants achieving good latch scores within three months demonstrates the effectiveness of structured, family-centered feeding interventions during the critical window of neuroplasticity. These findings support the integration of parent-led feeding protocols into standard neurodevelopmental care pathways for HIE survivors, particularly in resource-limited settings where specialized feeding support may be unavailable.

Recommendations

Recommendations should prioritize embedding structured feeding evaluations and interventions into HIE discharge protocols using standardized tools like LATCH, alongside the development of comprehensive caregiver training modules on oro-motor stimulation, positioning, and feeding progress recognition; concurrently, community health worker networks and telehealth platforms must be mobilized to broaden support in underserved areas, and policy advocacy should secure the integration of these feeding strategies within national early childhood development frameworks.

Strengths and Limitations

The study's prospective design employing the validated LATCH scoring system, coupled with high adherence to intervention protocols and demonstrated feasibility of parent-delivered care in resource-limited settings, ensures robust, clinically pertinent feeding outcome data, while the lack of a control group, brief three-month follow-up, reliance on parent-reported adherence, and single-center setting constrain causal attribution, long-term assessment, and broader generalizability.

Relevance of the Study

By demonstrating that structured, parent-delivered feeding interventions markedly enhance breastfeeding outcomes in high-risk HIE survivors, this work offers immediately applicable insights for neonatal follow-up care and holds significant public health implications for mitigating feeding-related complications and bolstering nutritional status among vulnerable infant populations.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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