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Original Article

The Developmental Motor Outcomes of Infants with Hypoxic Ischaemic Encephalopathy II and III between the Ages of 12-14 Months at Rural Medical College, Loni, Maharashtra

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***ABSTRACT*:**
Background: This study determined outcomes for motor developmental delay in infants, 12-14 months, diagnosed with HIE II and III, at Rural Medical College at Loni, Maharashtra during year 2009 July to 2012 January. **Materials& Methods:** Twenty nine infants diagnosed with HIE II and nine infants diagnosed with HIE III were assessed using the Peabody Development Motor Scale- 2, at their corrected age. **Results:** Demographic, antenatal and perinatal factors similar to those in other studies were found for this sample. Infants with HIE III had significantly more developmental delay (p=0.01) than infants with HIE II. Fifty two percent of infants with HIE II had no delay while a 100% of infants with HIE III presented with disability. A greater percentage of infants had delay in fine motor skills. **Conclusion:** Infants with severe and moderate disabilities were receiving intervention whereas those mild disabilities were often missed in screening clinics. It is vital to ensure these infants are assessed and followed up to remediate difficulties as soon as they arise.
Keywords: Infants, HIE II & III, Motor outcomes, PDMS.

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INTRODUCTION

Hypoxic-ischaemic encephalopathy is the abnormal behavioral state that can be seen in an infant in the early neonatal period. It is caused by severe or persistent birth asphyxia in infants. Birth asphyxia (BA) occurs when there is poor gaseous exchange during the perinatal period. It is defined as foetal or neonatal hypoxia. If asphyxia is severe or persistent it can result in death or hypoxic-ischaemic brain injury presenting as encephalopathy in the early neonatal period.[1]

During a perinatal hospitalization a study in Nepal found that 94% of infants diagnosed with HIE presented with tone abnormalities, sucking ability was poor in 32% and 19% presented with problems with consciousness.[2]

The condition is associated with long term delayed developmental outcomes and is more prevalent in developing countries.[2] Infants that survive present with different severities and the condition often leads' to severe neurological impairment resulting in cerebral palsy.[1] Previous follow up studies have shown the children with mild encephalopathy or HIE I are likely to be free of disability but those with moderate encephalopathy HIE II have a disability rate up to 25% with both neurological and developmental dysfunction. The majority of infants presenting with severe encephalopathy or HIE III usually have multiple disabilities.[2]

Developmental delay in language as well as the motor and cognitive areas has been related to the severity of the HIE as well as other perinatal and social factors. The infants that

present with cerebral palsy will require social support and health care which as well as special schooling in order to reach the potential they have for participation in their occupational performance areas.[3] Infants with HIE II and III aretherefore referred for rehabilitation and occupational therapy which provide intervention for these children.[4]

The assessment of developmental delay and parental education with regard to stimulation is provided by the allied medical services which include occupational therapy, but these programs are not structured and are subjective to each individual therapist.

Because of the socioeconomic circumstances of most of the parents of infants with HIE attending the early intervention programme the infants are usually seen at monthly appointments and are provided with a written informed consent with verbal home programme in occupational therapy. The aim of this study to determine the extent of gross and fine motor developmental delay in infants diagnosed with HIE II and III between 12-14 months, seen at Neonate Clinic and referred to occupational therapy at Pravara Institute of Medical Sciences.

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MATERIAL & METHODS:

A descriptive quantitative pre-experimental research design was used in the study. Survey and structured observation methods were used to gather information on the dependent variables, the demographics and motor function of infants with HIE. A static group comparison design was used to compare the data for the infants with HIE II and HIE III.

A cross-sectional design was used by assessing the infants at one time only as this reduced the chance of drop out from the study. Since a non - experimental design was utilized, there no randomisation and no consideration of cause and effect.

All infants between the ages of 12-14 months whose discharge report from Neonatal Ward at Rural Medical College at Loni, Maharashtra, which indicated that they were diagnosed with HIE II or III within their first few days of life were eligible for the study.

Inclusion criteria

- All infants diagnosed with HIE II and III were included.
- Infants were assessed between the age ranges of 12-14 months.
- Infants born prematurely were considered and were assessed according to their adjusted chronological age

Exclusion criteria

- Infants with other co-morbid conditions (e.g. hydrocephalus, chromosomal abnormalities) were not included in the study.

Peabody Development Motor Scale (PDMS):

This is a norm referenced standardized assessment which assesses the gross and fine motor skills of infants from birth to seven years. It is easy to administer and can be completed in a relatively 20 to 30 minute period short time. The subtests include:

- Reflexes: an 8-item subtest measures a child's ability to automatically react to environmental events. Only tested in infants less than 12 months of age.
- Stationary: This 30-item subtest measures a child's ability to sustain control of his or her body within its centre of gravity and retain equilibrium. The entry item for children at 12-14 months is kneeling in an upright position for 5 seconds.
- Locomotion: This 89-item subtest measures a child's ability to move from one place to another. The activities analyzed are crawling, walking, running, hopping, and jumping. Entry level for a child of 12 months is moving to standing from sitting on the floor.
- Object Manipulation: This 24-item subtest measures a child's ability to manipulate balls. The activities analyzed are throwing kicking and catching a ball. This subtest is given only to children ages 12 months and older. The item for 12 -13 months include catching a ball rolled along the floor, rolling a ball on the floor and throwing (flinging) a ball.
- Grasping: This 26-item subtest measures a child's ability to use his or her hands. It begins with ability to hold an object with one hand and progress to actions involving both hands. The entry level item for this subtest is picking up two cubes simultaneously.
- Visual-Motor Integration: This 72-item subtest measures a child's ability to use his or her visual perceptual skills to perform complex eye-hand coordination tasks such as reaching, grasping for objects, and building with blocks and copying design. The entry level items on the VMI subtest for 12 – 14 months includes turning pages in a book, stirring with a spoon, removing pellets from a bottle, placing cubes in a cup, placing pegs in a pegboard and tapping a spoon on the table.

These items assess infants' according to their chronological age or adjusted age if they were premature. For easy administration of PDMS-2 test, entry/start point, basal level and ceiling level are used for all the subtests. The therapist assesses the child according to the entry level item for their age which 75% of the children in the normative sample at that age passed marked on each subtest in Examiner Record Booklet.[5]

If child does not score 2 on each of the first three items administered from the entry point then the therapist should

test backward until child scores 2 on three items in a row. This will be the basal level. A basal level is established when child receives a score of 2 on three successive items in a row.

Once the basal level has been determined, the therapist administers progressively more difficult items until a ceiling is achieved by the child scoring 0 on each of the three items in a row.

As all the children in the study were over the age of 12 months the subtest of reflexes was not assessed. All subtests start at zero or one month and proceed up to 72 months.

RESULTS:

Our study showed thatthe groups were comparable for age and gender as there was no significant difference between the HIE II and HIE III groups in terms of the infant participant age or gender as the majority of the subjects in both groups were male (table 1). The 66.67% of mothers who have infants diagnosed with HIE III has caesarean sections (table 2). Of the infant participants diagnosed with CP 75% had had neonatal seizures, one had necrotizing enterocolitis and one had respiratory distress syndrome (table 3).

The specific subtests also show where the greatest deficits are noted. There was a significant difference for all subtests between infant participants' scores in the HIE II and the HIE III groups. Infant participants with HIE III had lower scores on all subtests in the PDMS -2, while all the scores for the infant participants with HIE II are below -1 z scores placing them at risk fort motor delay. The scores for the infant participant with HIE III are below -2 on the z scores meaning that their motor delay for all subtests is severe enough to require therapy (table 4). The great variation in the scores across the total sample placed the infant participants z scores between -1 and -2, thus showing the need for therapeutic intervention. The quotient standard scores all fell below the 79, the cut off point for no disability. The FMQ indicated that there was more delay in this quotient with only just over 25% of the sample having no disability for fine motor function compared to over 40% for gross motor function (table 5).

Table 1. Age and Gender of the infant participants (n=38) Total Sample

		Total Sample	HIE II Group (n=29)	HIE III Group (n=9)	P
		Percentage (n)			
Age	12 months	63.15% (24)	65.51% (19)	55.56%(5)	0.33
	12.5 and 13 months	18.43% (7)	20.69% (6)	11.12% (1)	
	13.5 and 14 months	18.43% (7)	13.80% (4)	33.34%(3)	
Gender	Male	60.52 % (23)	62.07% (18)	55.56%(5)	0.73
	Female	39.47% (15)	37.94%(11)	44.45%(4)	

Table 2: Gestation and type of delivery

		Total Sample	HIE II Group	HIE III Group	p
		Percentage (n)			
Gestation	Full term	86.85%(33)	86.21%(25)	88.89%(8)	0.84
	Premature	13.16%(5)	13.80%(4)	11.12%(1)	
Type of delivery	Normal vaginal delivery	52.64%(20)	58.62%(17)	33.34%(3)	0.19
	Caesarean section	47.37%(18)	41.38%(12)	66.67%(6)	

Table 3: Diagnosis at birth

DIAGNOSIS HIE	HIE II (n=29)	HIE III (n=9)	p
	76.31% (29)	23.68% (9)	0.00*
Birth Asphyxia and respiratory distress syndrome	17.24%(5)	11.12%(1)	0.07
Seizures	41.38%(12)	66.67%(6)	0.00*
Neonatal Jaundice	10.35% (3)	0%	‘
Sepsis	6.90%(2)	11.12% (1)	‘
Necrotisingenterocolitis	6.90%(2)	0%	‘

Table 4: Summary of standard scores and z scores for the subtests of the Peabody Development Motor Scale-2 for the HIE II and HIE III groups

Subtest	HIE II (n=29)			HIE III (n=9)			
	Standard Scores		z score	Standard Scores		z score	p
	Mean (SD)	Range	Mean	Mean (SD)	Range	Mean	
Stationary	7.31(3.74)	1-14	-0.89	3.33(3.31)	1-9	-2.22	0.007*
Locomotion	6.79(3.70)	1-12	-1.08	2.44(2.78)	1-9	-2.51	0.002*
Object Manipulation	7.65(1.23)	5-10	-0.78	6.33(1.11)	5-8	-1.22	0.006*
Grasping	6.34(3.52)	12	-1.21	1.88(1.69)	1-6	-2.70	0.0008*
Visual Motor Integration	6.10(2.71)	1-9	-1.29	2.88(2.57)	1-7	-2.37	0.003*

Table 5: Summary of standard scores for the quotients of the Peabody Development Motor Scale 2 for total sample (n=38)

	Standard Scores		z Scores
Quotient	Mean (SD)	Range	Mean
Gross Motor Quotient	75.52(17.93)	51 -102	-1.61
Fine Motor Quotient	71.44(18.45)	46 - 101	-1.71
Total Motor Quotient	72.91 (19.80)	44 - 98	-1.64

DISCUSSION:

At the time the assessment was carried out for purposes of this study 64% of the infants were 12 months, 18% were between 12 and a half and 13 months old and 18% were between 13 and a half and 14 months old. This indicates that more infants are followed up during their first year of life and that follow up visits are not commonly scheduled after the age of one year, unless a disability or delay is detected. Hospital follow ups in infants over the age of one year decreases and therefore those with developmental problems may not be identified and referred for early intervention if evaluation is only scheduled for infants over 18 months old.

Literature indicates that the evaluation of long-term sequalae of HIE should be done at 18 months.[4] However the reason this age group was chosen for this study was because infants between the ages of 12 and 14 months are developing the motor skills required to explore their environment independently and the hand function required for fine motor skills. It was felt that evidence of motor disabilities at the age of one year also means that follow up of mild disability or therapy for those not yet identified with moderate to severe disability can be commenced at an earlier age.[6] Often these infants present at a much later stage when they have learning difficulties thus the critical early intervention period has been missed out.[4]

Studies from other countries indicated that more males have been diagnosed with HIE in comparison to females[2,7]. In this study 60% of the sample was male. Literature reports these gender differences are directly related to responses of infants to brain injury. This is related to both hormonal modulation and genetically determined mechanisms which provide perinatal females with a level of protection against HIE.[2,7]

Research in Australia by Badawi et al showed that the type of delivery was highly correlated to HIE. They reported that emergency caesarean sections in particular were associated with neonatal encephalopathy.[8] The results of this type of delivery in this research were highly indicative of associated risks as 47.37 % of maternal total population underwent caesarean sections. It may indicate that there were extenuating circumstances requiring this type of intervention. Although not statistically significant, it was noted that up to 25% more of the infants diagnosed with HIE III were born via caesarean sections.[1]

Infant participants in this study with severe neurological deficits and developmental delay were receiving intensive therapy. All 12 infants that were diagnosed with CP were attending neuro rehabilitation clinic where they were receiving a specialized intervention program from the multi- disciplinary team. One of the other infants' with a severe deficit was receiving individual occupational therapy, speech therapy and nutritional advice. No other infant participants with HIE II had been referred to the speech therapist and dietician for specific deficits. It is clear that infants presenting with CP and severe deficits are receiving intervention but those with moderate and mild disability may not have been identified as needing more than a review at clinic NNFU. Therefore a more formal screening for motor function at 12 months may be advisable in view of the findings of this study.

In this study 23.65% of the participants were diagnosed with HIE III while 76.31% were diagnosed with HIE II. The results of the PDMS-2 indicate that the actual distribution mild, moderate and severe disability does not conform to these percentages even though the infants with HIE II had less disability overall.

Infant participants with HIE II had mean PDMS-2 z scores between -1 to -1.5 thus placing them all at risk for developmental delay. The mean PDMS-2 z scores of the infant participants with HIE III all were below -2. The results for the participants with HIE III was significantly lower with the scores all falling below -2 SD. This was true even for the three of the nine participants not diagnosed with CP. Research in the West Indies showed similar findings as larger proportions of infants with HIE III were developmentally delayed in comparison to infants with HIE II.[9] There is evidence to suggest that infants with HIE II and

HIE III could possibly be on a continuum with regards to their developmental outcome depending on the severity oftheir diagnosis.[10] It was therefore important to look at the frequency of the z scores to determine the percentage of infants presenting with no, mild, moderate and severe motor disability.

van Schie et al as with this study only had one participant that was found to have moderate disability but the 32% of their sample presenting with severe disability was higher than the 24.13% found in this study.[11] Overall it appears that the use of the PDMS-2 identifies less disability as only the motor skills of the infants are being considered even though there is a good concurrent validity for the PMDS-2 and BIDS II.[12] These results may also reflect the fact that the PMDS- 2 is not sensitive to tone abnormalities, these were not noted but should be recorded in future research.[4]

Mwakyusa et al. showed that the one infant diagnosed with HIE III in his study had major neurological impairments[13], in keeping with this research where all nine infants with HIE III had some degree of disability on the TMQ. In this study it was noted that 66.66% of the infants with HIE III were diagnosed with severe disability and developmental delay.

The results in this study for the GMQ were similar to those for the TMQ with nearly 40% of participants having no disability for gross motor function and just over 31.5 % having severe disability. Robertson et al reported that 26.2% of infants with HIE II had delayed gross motor skills whereas all children with HIE III had gross motor delays.[4]In this research it was found that 20. 68% of infants with HIE II and 66.66% of infants with HIE III had severe disability with regards to their gross motor functions. Tanzanian research showed that in the area of locomotion; 36% of HIE II infants were found to have delay and severe delays were found in HIE III infants.[13]This is in keeping with other research conducted in developing countries. The children with gross motor difficulties are equivalent to the children diagnosed with CP and this is expected as literature shows that CP can be seen in the first 12 to 18 months and is often noticed when children fail to reach their motor milestones e.g. sitting and walking.[14]

A lower mean score for the fine motor quotient (71.44%) compared to the score for the gross motor quotient (75.52%) is recorded in the study. This must be considered in light of the scores obtained for the object manipulation subtest in the GMQ. This may have meant that the gross motor score on the PDMS-2 is a slight misrepresentation of the severity of the gross skills of infants in this age group.

CONCLUSION:

We concluded that infants with severe disability are receiving appropriate intervention before the age of 12 months but infants that are mildly delayed often only attending screening clinics like NNFUC.

As literature states early intervention is key in improving motor and cognitive functioning in infants thus more structured programmes should be put in place to improve outcomes of infants with HIE. This study reinforces the importance of early intervention and the key role rehabilitation professionals play in the management of infants with HIE.

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