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Abstract

Hypothermia treatment via systemic head cooling (HT) serves as a viable treatment option for infants diagnosed with hypoxic-ischemic encephalopathy (HIE), although the range of developmental outcomes varies among survivors of HIE. In addition, a family's risk and protective factors may have a negative or positive impact on the child's development, as well as, the amount and type of interactions between the child and his caregivers. Research has shown that familial protective factors can offset any negative effect that may exist with a family's risk factors. Increased language stimulation has also shown similar results of counteracting any risk factors associated with developmental delays. The purpose of this study is to describe the language and home environment of three children who are survivors of HIE and HT. Descriptive case studies were compiled outlining the complexity of the child's vocalizations as well as identifying potential risk factors and familial strengths. Based on the results, only one child exhibited age appropriate language skills while the other two participants exhibited language more typical of a 9-month old. All families exhibited possible risks in the areas of family discipline and caregiver mental health and possible strength in the area of promoting school readiness. Future research is needed before developmental profiles of children who are survivors of HIE and HT can be constructed.

Introduction

HT has been determined to show positive results in regards to increased developmental outcomes and reduced neurological injury. In addition to medical treatment, research has suggested that increased language stimulation and language exposure directly relate to an increase in children's vocabulary and level of intelligence. When parents use more sophisticated language, children's IQ scores later in life were positively impacted. This outcome is particularly true for all levels of socio-economic status, in that children from low income families can show gains in language and cognitive development through increased experiences early on with language. Further research has determined that a child's developmental outcome can also be positively impacted when familial resiliency and protective factors are in place. When a child lives in a family with multiple risk factors (e.g. low socio-economic status, low maternal education, single parenthood), he can encounter greater challenges in overall development, including cognition and language. The more resiliency and protective factors that are in place, the better the likelihood a child can overcome the circumstances of their environmental and familial risk factors.

Participant 1

- born at 36 weeks by emergency C-section
- limp, cyanotic, intubated and mechanical ventilator
- HT protocol for 72 hours
- EEG showed brief subclinical seizures in the left parietal regions
- MRI on DOL 4 showed ischemia in bilateral periventricular and subcortical white matter in frontal and parietal regions
- MRI at 11 months corrected age showed a gliosis in the periventricular white matter at site of previous infarcts
- 12 months, *Mullen Scales of Early Learning* 10 month gross motor skills, 16 month fine motor skills, 13 month visual perceptual skills
- IT-FM risk factors include meeting basic needs, discipline, and caregiver mental health
- IT-FM strengths include home and car safety, nurturing family routines, and promoting school readiness



Participant 2

- born at 39 weeks by C-section
- Meconium stained amniotic fluid
- decompensated, floppy, cyanotic, bradycardic, intubated, and mechanical ventilator
- seizure activity was confirmed via an aEEG
- HT protocol for 72 hours
- video EEG multifocal sharp waves in right temporal and left frontal area, but no seizure activity
- MRI DOL 8 and at 12 months of age were both normal
- 6.5 months of age, *Mullen Scales of Early Learning* 7 month for gross and fine motor skills and visual perceptual skills
- IT-FM risk factors include home and car safety, nurturing family routines, discipline and caregiver mental health
- IT-FM strengths include meeting basic needs and promoting school readiness

Participant 3

- born at 41-week gestation vaginally with vacuum assistance
- Meconium stained amniotic fluid, tight nuchal cord
- limp, pale with poor respiratory effort
- oxygen therapy via nasal cannula
- aEEG was suspicious for seizure activity
- HT protocol for 72 hours
- Video EEG possible seizure left parietal region, no subsequent seizures detected
- MRI DOL 7 was normal
- 8 months of age, *Mullen Scales of Early Learning* 9 month level for gross and fine motor skills and visual perceptual skills
- IT-FM risk factors include meeting basic needs, nurturing family routines, discipline, and caregiver mental health
- IT-FM strengths include home and car safety and promoting school readiness

Methods

Individual profiles of the three participants were developed using medical history, language environment analyses, and family risk and resiliency factors. Using a LENA DLP and accompanying software, an extensive language sample was obtained as well as analysis regarding conversational turns, amount of child and adult speech, and environmental input (e.g. radio, television). From the DLP recording, a traditional language sample consisting of 150 utterances was collected. The sample allowed for the analysis of the child's vocalization complexity. This analysis included counts of cooing, babbling, and words. The Infant Toddler Family Map (IT-FM) was employed to assess the family's current risk factors and available resiliency factors. The IT-FM provided detailed information regarding family needs and strengths, evaluating the child's overall home environment as well as parental characteristics.

	Child Vocalizations		Adult Word Count		Conversational Turns	
	Total	Percentile Rank	Total	Percentile Rank	Total	Percentile Rank
Participant 1	825	19	14,537	72	279	38
Participant 2	1,056	37	7,989	13	248	33
Participant 3	1,523	NA	12,758	NA	413	NA

	Cooing	Babbling				Jargon	Words	
		CV	VC	CVC	VCV			Reduplicated
Participant 1	11	38	3	1	16	57	25	0
Participant 2	23	35	1	1	21	49	20	0
Participant 3	18	23	5	4	13	43	42	2

Limitations

- Participant recruitment
- LENA coding
- Data collection

Recommendations

- Further research is needed in the areas of language development and impact of home environment for children who are survivors of HIE and HT.
- Future studies protocols should include a standard cognitive and language assessment battery.