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Impact of Early Multimodal Sensory Stimulation on Gross Motor Skills of Preterm Infants

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ABSTRACT: As preterm infants are exposed to extra uterine environment early, their developing brain may undergo injury and also undergo sensory overload. This may result in delayed gross motor skills in preterm infants. Very preterm and moderate to late preterm infants were included in this study. In experimental group, infants underwent early multimodal sensory stimulation, whereas infants in control group underwent conventional therapy. Alberta infant motor assessment scale was used to evaluate gross motor skills in prone and supine positions before and after the multi-modal stimulation program.
Between group analysis for AIMS was done using Mann Whitney test. Within group analysis was done using Wilcox an signed rank test. This study concludes that the early multimodal sensory stimulation for the preterm infants is effective in improving the gross motor skills of these infants at 4 months of corrected age.

Keywords: Multimodal sensory stimulation, Preterm infants, gross motor skills.

INTRODUCTION

Infants who are born before completion of 37 weeks of gestation are termed as preterm infants. Preterm births approximately occurs around 15 million per year, which also shows an increasing trend especially in developing countries like India (Blencowe *et al.,* 2013).

In term infants, intra-uterine environment provides an optimal support for brain development like gyrification, formation and maturation of synapses, myelination etc. These processes of normal brain development is disturbed in preterm infants, as they are exposed to extra-uterine environment very early (Pickler *et al.,* 2010).

Early change in environment in preterm infants can result in brain injury as the developing brain is forced to process all the information from the new extra-uterine environment before it is ready to do so. Additionally, in preterm infants to make things even more complicated, babies may be really sick in other ways, which can also impacts brain development (Hasegawa *et al.,* 1992).

Early exposure to extra-uterine environment can also result in sensory overload to developing brain i.e., it receives inappropriate sensory stimulations from the environment which affects how neuronal organization. The preterm infant's brain is made to process information coming in from the ears, eyes, nose, mouth and skin (i.e., sound, light. smell. taste and touch respectively before the preterm infant's brain is ready to integrate those sensory information (Rajagopalan *et al.,* 2011; Thornton, 2008; Bonnier, 2008).

Studies emphasize that this early exposure to sensory stimuli may alter local tissue growth patterns of brain (Rajagopalan *et al.,* 2011).

This type of sensory overload may result in abnormal brain connections and structure in preterm infants. This may subsequently contribute to brain injury and abnormal development in preterm infants, which predisposes the infant to impaired gross motor skills (Thornton, 2008).

Intervention strategies are large in number, all the studies have shown to improve cognitive function but the motor outcome like gross motor skills was not well established. Also, the effective component for a successful intervention to improve motor outcome with appropriate dosage of intervention were not established (Spittle *et al.,* 2015).

Hence, many studies recommend early multimodal sensory stimulation techniques to provide optimal environment for these infants to develop in. This may reduce the worsening of brain injuries. Most of these therapy techniques try to mimic what the touches, sounds and lights etc., similar to intrauterine environment, which may facilitate gross motor skills in preterm infants (Spittle *et al.,* 2015).

Aim of the study. To find out the impact of early multimodal sensory stimulation on gross motor skills of preterm infants.

METHODOLOGY

This study was conducted in Sri Ramachandra Medical center and Hospital, Chennai. This study was approved by Institutional ethics committee of Sri Ramachandra University. Informed consent was obtained from mothers of preterm infants.

Around 69 very preterm (28 to less than 32 weeks) and moderate to late preterm (32 to less than 37 weeks) infants were included (both in experimental and control group) in this study for a period of 1- 4 months of corrected age. Extremely preterm and preterm infants with genetic disorders and congenital malformations diagnosed clinically were excluded from the study.

Preterm infants in experimental group underwent early multimodal sensory stimulations like tactile, auditory, gustatory, visual, vestibular stimulations administered by mothers under supervision. Infants in control group underwent conventional physiotherapy.

Forms of stimulation and administration. The stimulation were usually presented on a regular schedule for specific amounts of time. Initially used stimulations for infants in NICU environment were tactile, vestibular, and auditory; each were administered to approximate the stimulation that the infant received in the womb. As the infant gets older and healthier, other forms of stimulations were added, and the program were modified to approximate the typical sensory environment of the home.

An important element of the intervention was to enhance parent–infant interactions. At home, after discharge, parents were taught to wait for the infant's responses and to modify the support according to the infant's reactions to handling to ensure that the infants were actively participating during the treatment. Alberta Infant Motor Scale (AIMS) was used to evaluate gross infant motor skills from 0-18 months of age. It evaluates weight bearing, posture, and antigravity movements of infants in supine, prone, sitting & standing. In this study, supine & prone components were used for evaluating gross motor skills as infants were followed up only till 4 months of corrected age.

Table 1: Baseline characteristics of both groups.

Characteristics		Experimental Numbers (%)	Control Numbers (%)
Gender	Male	29 (42)	36 (51.4)
	Female	40 (57.9)	33 (47)
Type of Preterm	Very preterm	40 (57.9)	38 (54.2)
	Moderate to late preterm	29 (42)	31 (44.3)
		(mean days, SD)	**(mean days, SD)**
Age	Very preterm	14.49 (15.49)	11.3 (9.11))
	Moderate to late preterm	10.3 (8.83)	13.55 (14.92)
		(mean grams, SD)	**(mean grams, SD)**
Birth Weight	Very preterm	1105 (263.59)	1100 (251.22)
	Moderate to late preterm	1722.77 (502.56)	1621 (498.13)

Table 2: Between group analysis for aims (Prone) – (Mann whitney test).

Months	Group	Mean Rank	Z	Significance
BL	Experimental	68.00	-.843	.399
	Control	73.00		
1	Experimental	67.50	-1.012	.311
	Control	73.50		
2	Experimental	69.29	-.403	.687
	Control	71.71		
3	Experimental	68.86	-.544	.303
	Control	72.14		
4	Experimental	69.02	-.789	.050
	Control	71.00		

Table 3: Between group analysis for aims (Supine) – (Mann whitney test).

Months	Group	Mean Rank	Z	Significance
BL	Experimental	71.00	-.174	.862
	Control	70.00		
1	Experimental	70.50	-.000	1.000
	Control	70.50		
2	Experimental	73.00	-.857	.391
	Control	68.00		
3	Experimental	74.70	-1.416	.157
	Control	66.30		
4	Experimental	97.07	-8.098	.000
	Control	43.93		

The between group analysis show significant difference in the values at 4 months of age, both for supine and prone components (p value<0 .05).

Table 4: Within group analysis for aims (Prone) – (Wilcoxan signed rank test).

Experimental group (62)				Control group (64)			
Age (Months)	**Mean Rank**	**Z**	**Significance**	**Age (Months)**	**Mean Rank**	**Z**	**Significance**
BL-1	.00 1.00	-1.000	.317	BL-1	.00 .00	.000	1.000
BL-2	4.00 4.00	-1.890	.059	BL-2	2.50 2.50	.000	1.000
BL-3	4.50 4.50	-2.121	-2.121	BL-3	3.50 3.50	-.816	.414
BL-4	31.10 13.00	-6.698	-6.698	BL-4	6.00 6.00	-1.508	.132

Table 5: Within group analysis for aims (Supine) – (Wilcoxan signed rank test).

Experimental group (62)				Control group (64)			
Age (Months)	**Mean Rank**	**Z**	**Significance**	**Age (Months)**	**Mean Rank**	**Z**	**Significance**
BL-1	.00 1.00	-1.000	.317	BL-1	.00 .00	.000	1.000
BL-2	3.50 3.50	-1.633	.102	BL-2	.00 .00	.000	1.000
BL-3	6.05 5.50	-2.673	.008	BL-3	1.50 .00	-1.414	.157
BL-4	32.03 15.50	-6.752	.000	BL-4	3.50 3.50	-1.633	.102

RESULTS AND DISCUSSION

In within group analysis for supine and prone component of Alberta infant motor assessment scale, experimental group showed significant improvement, whereas control group did not show improvement.

This significance may be due to early initiation of multimodal sensory stimulation from birth till 4 months of corrected age in a critical period, were the developing brain undergo extensive transition from intra-uterine environment to the extra-uterine environment. Furthermore, from gestational age of 34-40 weeks synaptogenesis and myelination is at its maximum, during which around 40,000 synapses are formed every second and myelination of precentral, post central, optic radiation and acoustic radiation occurs during this stage (Dudink *et al.*, 2008; White *et al.*, 2010; Baroncelli *et al.*, 2009). So, early multimodal sensory stimulation with its all components of touch, proprioceptive, kinesthetic, vision, auditory stimulations applied in proper dosage at this critical period of GA could have contributed to the improvement of gross motor skills in preterm infants (Tau and Peterson 2010; Spittle *et al.*, 2015; Anderson *et al.*, 2006).

This study involves active participation of the mother in performing the therapy. These factors could have contributed to the significant development of gross motor skills in this study.

These findings suggest that the multimodal stimulations used in this study which involved tactile, vision, kinesthetic, proprioception and vestibular stimulation administered by the parent under the guidance of the therapists and initiated from neonatal period and continued till 4 months of corrected age is an effective program in improving the gross motor skills of the preterm infants at 4 months (Guzzettaa *et al.*, 2011; Llldazzitelli *et al.*, 2008; Bos & Roje 2011).

Further analysis may be required to find the effect of this multimodal stimulation program on gross motor skills in later stages.

CONCLUSIONS

This study concludes that the early multimodal sensory stimulation of the preterm infants is effective in improving the gross motor skills of these infants at 4 months of corrected age.

REFERENCES

Anderson, N. G., Laurent, I., Woodward, L. J. & Inder, T. E. (2006). Detection of impaired growth of the corpus callosum in premature infants. *Pediatrics, 118*(3), 951–960.

Baroncelli, L., Braschi, C., Spolidoro, M., Begenisic, T., Sale, A. & Maffei, L. (2009). Nurturing brain plasticity: Impact of environmental enrichment. *Cell Death and Differentiation, 17*(7), 1092–1103.

Blencowe, H., Cousens, S., Chou, D., Oestergaard, M., Say, L. and Moller, A. B. (2013). Born Too Soon Preterm Birth Action Group (2013). Born too soon: The global epidemiology of 15 million preterm births. *Reproductive Health, 10*(Suppl. 1), S2.

Bonnier, C. (2008). Evaluation of early stimulation programs for enhancing brain development. *Acta Paediatrica, 97*(7), 853–858.

Bos, A. F. & Roze, E. (2011). Neuro developmental outcome in preterm infants. *Developmental Medicine and Child Neurology, 53*(Suppl. 4), 35–39.

Dudink, J., Kerr, J. L., Paterson, K. & Counsell, S. J. (2008). Connecting the developing preterm brain. *Early Human Development, 84*(12), 777–782.

Guzzetta, A., D'Acunto, M. G., Carotenuto, M., Berardi, N., Bancale, A. & Cioni, G. (2011). The effects of preterm infant massage on brain electrical activity. *Developmental Medicine and Child Neurology, 53* (Suppl. 4), 46–51.

Hasegawa, M., Houdou, S., Mito, T., Takashima, S., Asanuma, K. & Ohno, T. (1992). Development of

myelination in the human fetal and infant cerebrum: A myelin basic protein immunohistochemical study. *Brain and Development, 14*(1), 1–6.

Llldazzitelli, C., Costa, M., SalomSo, S., De Haro, F., Berezovsky, A., Durigon, O. (2008). Neuromotor development and visual acuity in premature infants submiued to early visuomotor stimulation. *Psychology and Neuroscience, 1*(l), 41–45.

Pickler, R. H., McGrath, J. M., Reyna, B. A., McCain, N., Lewis, M., Cone, S. & Best, A. (2010). A model of neurodevelopmental risk and protection for preterm infants. *Journal of Perinatal and Neonatal Nursing, 24*(4), 356–365.

Rajagopalan, V., Scott, J., Habas, P. A., Kim, K., Corbett-Detig, J., Rousseau, F. & Studholme, C. (2011). Local tissue growth patterns underlying normal fetal human brain gyrification quantified in utero. *Journal of Neuroscience, 31*(8), 2878–2887.

Spittle, A., Orton, J., Anderson, P. J., Boyd, R., & Doyle, L. W. (2015). Early developmental intervention programmes provided post hospital discharge to prevent motor and cognitive impairment in preterm infants. *Cochrane Database of Systematic Reviews, 2015*(11), CD005495.

Tau, G. Z., & Peterson, B. S. (2010). Normal development of brain circuits. *Neuropsychopharmacology, 35*(1), 147–168.

Thornton, S. (2008). Preterm birth: Causes, consequences and prevention. *Obstetrician and Gynaecologist, 10*(4), 280–280.

White, T., Su, S., Schmidt, M., Kao, C. Y. & Sapiro, G. (2010). The development of gyrification in childhood and adolescence. *Brain and Cognition, 72*(1), 36–45.

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