

## Original Research Article

# Effect of specific physiotherapy interventions in comparison with multisensory stimulation on neurobehavioral outcome and weight gain in preterm infants: a randomized control trial

Unis D. Nadar<sup>1</sup>, Pareshkumar A. Thakkar<sup>2\*</sup>, Chaitali Shah<sup>1</sup>

<sup>1</sup>Department of Physiotherapy, Medical College and S.S.G. Hospital, Vadodara, Gujarat, India

<sup>2</sup>Department of Paediatrics, Medical College and S.S.G. Hospital, Vadodara, Gujarat, India

**Received:** 15 November 2017

**Accepted:** 09 December 2017

### \*Correspondence:

Dr. Pareshkumar A. Thakkar,

E-mail: [drpareshthakkar123@gmail.com](mailto:drpareshthakkar123@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** A premature infant is deprived of in-utero sensory experiences which are essential for normal brain development and rather is exposed to unusual sensory stimuli in the Neonatal Intensive Care Units (NICU) that pose risk to the developing brain in terms of adverse neurodevelopmental outcomes. The objective of this study was to study and compare the effect of specific physiotherapy intervention with multisensory stimulation on neurobehavioral outcome and weight gain in preterm infants. Inclusion criteria was preterm infants appropriate for gestational age more than 32 weeks, babies who were hemodynamically stable and babies receiving full enteral feeds. Exclusion criteria were major congenital anomalies, inability to undergo intervention (any fracture) or perinatal asphyxia.

**Methods:** Eligible infants were randomly allocated into one of the two groups. Group A was offered multisensory stimulation: Auditory, Tactile, Visual and Vestibular (ATVV). Group B received Specific Physiotherapy Intervention (SPI) in form of kinesthetic exercises, oil massage and oral stimulation. The outcome was studied before and after intervention. Appropriate statistical tests were applied.

**Results:** Both the groups had better suck co-ordination and improvement on neurobehavioral scale following intervention when compared to pre-intervention status ( $P < 0.0001$ ). When both groups were compared, SPI group had better sucking coordination than ATVV group, improvement in neurobehavioral scale was similar in either group.

**Conclusions:** In preterm infants, Specific Physiotherapy Interventions are more effective in improving suck co-ordination, has better weight gain and are equally effective in improving neurobehavioral outcome compared to multisensory stimulation.

**Keywords:** ATVV, Massage, Multisensory stimulation, Preterm

## INTRODUCTION

A premature infant is deprived of in-utero sensory experiences which are essential for normal brain development and rather is exposed to unusual sensory stimuli in the Neonatal Intensive Care Units (NICU) that pose risk to the developing brain in terms of adverse neurodevelopmental outcomes.<sup>1</sup> Organ systems are insufficiently developed to fully support extra-uterine life

resulting in increased biological risk for complications of prematurity.<sup>2</sup> In the normal human fetus, several organ systems mature between 34 and 37 weeks, and the fetus reaches adequate maturity by the end of this period.

Preterm birth causes a range of problems.<sup>3</sup> As they grow, there is an increased risk of cognitive and language delays, hyperkinetic disorders, behavioral and emotional problems, and learning disabilities.<sup>4-11</sup> These risks

increase as gestational age at birth decreases.<sup>12-14</sup> Low birth weight is one of the main determinants of neonatal and postnatal morbidity.<sup>15</sup> Preterm infants often demonstrate oromotor discoordination and are unable to suck and feed orally.<sup>16</sup> In preterm neonates, the systems are not developed fully and so are not ready to function. Therefore, the preterm infants' behaviors are generally characterized by disorganization and signs of stress.

Early intervention (EI) consists of multidisciplinary services provided to infants from birth through the first years of life to promote child health, enhance emerging competencies, minimize developmental delays, cure existing disabilities, prevent functional deterioration, and promote adaptive parenting functioning.<sup>17</sup>

Specific Physiotherapy Intervention (SPI) consists of massage, kinesthetic exercises and oral stimulation. Various studies have demonstrated that massage therapy can improve weight gain, mineralization of bones, shorten the hospital stay and result in earlier discharge.<sup>18</sup>

Multisensory stimulation consists of Auditory stimulation, Tactile stimulation, Visual stimulation and Vestibular stimulation (ATVV). White-Traut documented the positive effect of auditory, tactile, and vestibular and visual (ATVV) intervention on increased alertness, faster transition to nipple-feeding and decreased length of hospitalization.<sup>1</sup>

## METHODS

This was a Randomized Clinical Trial (RCT) carried out at Neonatal unit, Department of Pediatrics, Medical College and SSG Hospital, Vadodara, Gujarat, India from September 2014 to May 2015.

### Inclusion criteria

- Preterm infants appropriate for gestational age more than 32 weeks
- Babies who were hemodynamically stable
- Babies receiving full enteral feeds.

### Exclusion criteria

- Major congenital anomalies
- Inability to undergo intervention (any fracture) or perinatal asphyxia.

A written informed consent was obtained from all parents of patients enrolled in the study and confidentiality was maintained throughout the study. Each neonate was randomly allocated to either of the two groups: Group A and Group B by simple random sampling (envelope).

The treatment duration for both the experimental groups was 15 minutes twice a day for at least 5 days. In outcome measures we studied weigh gain, sucking stage, behavioral scale and length of hospital stay. In the

sucking stage we used 5-point sucking scale by Lau et al and for behavioral scale we used Anderson Behavior State scale (ABSS).<sup>19,20</sup>

### Group A (ATVV Group)

Received multisensory stimulation: auditory, tactile, visual and vestibular.

#### Auditory stimulation

A recorded lullaby was played for 5 minutes to all the neonates.<sup>20</sup>

#### Tactile stimulation

With warm palms the infant's body was gently stroked for five seconds, twelve times consecutively (totaling one minute). The following five regions of the infant's body were stroked. (1. From top of the forehead down the side of the face to the neck and back to the forehead, 2. From back of the neck across the shoulders and back to the neck, 3. From the upper back down to the waist and back up, 4. From the thighs down to the ankles and back to the thighs, 5. From the shoulders to the wrists and back to the shoulders). The total duration was of 5 minutes.<sup>21</sup>

#### Visual stimulation

A lighted soft ball was used.<sup>21</sup>

#### Vestibular stimulation

The infant was rocked for 5 minutes.<sup>21</sup>

### Group B (SPI Group)

Received specific physiotherapy interventions which included oil massage, kinesthetic exercises and oral stimulation.

#### Massage

Oil was used for this procedure.

The protocol consisted of application of six strokes, each lasting 10 seconds, to the following areas of the baby in prone position (1. head from crown to neck, 2. shoulders from middle of back to arms, 3. back from neck to waist, 4. legs from top of thighs to ankles 5. Arms from shoulder to wrist). Total duration was of 5 minutes.<sup>8</sup>

#### Kinesthetic exercises

Neonate were be placed in supine position. This five-minutes phase consisted of five one-minute intervals and each interval included six passive flexion/extension movements in the right and left arm, right and left leg, and two legs together. Total duration was of 5 minutes.<sup>22</sup>

**Oral stimulation<sup>23</sup>**

*Perioral Stimulation*

- Cheeks: Gently tap the cheeks with the index finger (8 × each cheek). Stroke the cheek with the index finger from the base of the nose towards the ear, then return back to the corner of the lips (8 × each cheek). Repeated on the other side.
- Lips: Place the index and the middle fingers on the middle of upper lip (lower lip) and quickly, but gently, stretch outward (8 × each lip). Gently stroke the area around the lips in a circular way, from the corner toward the center and to the other corner, then reverse (4 × each lip).

*Intraoral Stimulation*

- Gums: Rub the upper gum with gentle, but firm pressure from the center toward the back and return to the center for each side using a sterile gauze piece (4 × each side of the gum). Repeat the procedure on the lower gum.
- Tongue: Place a sterile gauze piece on the tongue and gently stroke forward, combining with downward pressure (8×) (If the infant displays tongue protrusion, only downward pressure is administered.). Total duration is of 5 minutes.

**Outcome measures**

Following outcome Measures were studied.

*Weight gain*

Weight was measured before starting the intervention and after the completion of the intervention with the help of digital weighing machine.

*Sucking stage*

The sucking coordination and maturation were assessed and documented before starting the intervention and after the completion of the intervention with the help of 5-stage sucking scale by Lau et al.<sup>19</sup>

- Stage 1: Represents an immature/disorganized sucking pattern
- Stages 2-4: Represent more mature sucking patterns
- Stage 5: Represents a mature sucking pattern

*Behavior scale*

The alert behavior of the baby was taken before and after the intervention with the help of Anderson Behavior State scale (ABSS).<sup>20</sup>

Scores from 1 to 5 indicate that the infant is sleeping. Scores 6-8 indicate that the infant is awake and calm and

in the most suitable state. Scores from 9 to 12 indicate that the infant is in a state of restless activity or fussiness.

*Length of Hospital stay*

**Sample size calculation**

Sample size of 64 in each group was decided by keeping allowable error  $\alpha$  as 5% and power of study  $\beta$  80%.

**Statistical analysis**

The data was entered in Excel sheet of Microsoft Office. Data analysis was done using SPSS\_17 and Stata\_13 software. Independent t test, Z test, Mann Whitney tests have been used for data analysis.

**RESULTS**

Total of 126 neonates were enrolled in the study. They were randomly allocated to either of the two groups, Group A and Group B each comprised of 64 neonates. Group A received multisensory stimulation (ATVV group) while group B received specific physiotherapy intervention (SPI group). Table 1 shows base line characteristics of both the groups. Both the groups were comparable in terms of birth weight, maturity, gender distribution and other initial parameters.

**Table 1: Baseline characteristics of neonates.**

|  | Group A (ATVV)<br>Mean (SD) | Group B (SPI)<br>Mean (SD) |
|--|-----------------------------|----------------------------|
| Day of life                              | 9.58 (2.27)                 | 9.59 (2.14)                |
| Birth weight (gm)                        | 1558.36 (188.74)            | 1558.16 (187.32)           |
| Gestational age (weeks)                  | 34.46 (1.76)                | 34.59 (1.77)               |
| Weight on first day of intervention (gm) | 1549.46 (166.75)            | 1549.85 (174.63)           |
| Sucking scale score before intervention  | 2.89 (0.69)                 | 2.64 (0.65)                |
| Score on neurobehavioral scale (ABSS)    | 5.78 (2.53)                 | 6.17 (2.69)                |

**Group A**

*Multisensory stimulation (ATVV group)*

This group received multisensory stimulation for five days. The average score on sucking scale before intervention was 2.89 (SD 0.69) which improved to 3.75 (SD 0.68) after intervention. The difference was statistically significant, P value <0.0001. Median score on ABSS of neurobehavioral assessment improved from 5 to 8 following intervention (Table 2). Significant number of patient moved to composite stage 2 of neurobehavioral

assessment of ABSS score, which would mean that they became alert and active following intervention (Table 4).

**Table 2: Group A: ATVV group, comparison of outcome parameters before and after intervention.**

| Outcome Measure                            | Pre-intervention | Post-intervention | p-value |
|--|------------------|-------------------|---------|
| Suck Co-ordination (Sucking scale Mean±SD) | 3.3 (0.65)       | 3.8 (0.66)        | <0.0001 |
| Score on Neurobehavioral scale (ABSS)      | 5                | 8                 | <0.0001 |

**Group B**

*Specific physiotherapy intervention (SPI group)*

This group received specific physiotherapy interventions for five days. The average score on sucking scale before intervention was 2.64 (SD 0.65) which improved to 4.17 (SD 0.63) after intervention. The difference was statistically significant, P value <0.0001.

Median score on ABSS of neurobehavioral assessment improved from 5 to 8 following intervention (Table 3). Significant number of patient moved to composite stage 2 of neurobehavioral assessment of ABSS score, which would mean that they became alert and active following intervention (Table 4).

**Table 3: Group B: SPI group: comparison of outcome parameters before and after intervention.**

| Outcome measure                            | Pre-intervention | Post intervention | p-value |
|--|------------------|-------------------|---------|
| Suck Co-ordination (Sucking scale Mean±SD) | 2.84 (0.67)      | 3.89 (0.56)       | <0.0001 |
| Neurobehavioral scale (ABSS)               | 5                | 8                 | <0.0001 |

**Table 4: Number of children in active and alert stage on ABSS in both groups.**

| Day of intervention | Group A (ATVV) | Group B (SPI) |
|---------------------|----------------|---------------|
| 1 <sup>st</sup> day | 9.30%          | 15.63%        |
| 3 <sup>rd</sup> day | 76.56%         | 76.56%        |
| 5 <sup>th</sup> day | 95.30%         | 98.40%        |

*Comparison of ATVV and SPI group*

Neonates with SPI group had significantly better improvement on sucking scale, had achieved higher weight gain and hence they could be discharged earlier

and had shorter length of hospital stay compared to ATVV group. Both the groups had similar improvement on neurobehavioral assessment scale of ABSS (Table 5).

**Table 5: Comparison of outcome in both groups.**

|                              | ATVV N=64    | SPI N=64     | p-value |
|------------------------------|--------------|--------------|---------|
| Weight gain (gm)             | 29.90 (5.73) | 56.81 (8.48) | <0.0001 |
| Suck Coordination            | 0.45 (0.51)  | 1.05 (0.58)  | <0.0001 |
| Length of hospital stay      | 17.99 (2.69) | 16.89 (2.97) | <0.0310 |
| Neurobehavioral scale (ABSS) | 8            | 8            | <0.6597 |

**DISCUSSION**

In this study the effects of two different physiotherapy interventions are compared. We did not have a control group due to ethical reasons. It is proven that Neurodevelopmental interventions improves the outcome in preterm neonates, hence it would be unethical to have a control group. In our group of specific physiotherapy intervention, in addition to kinesthetic stimulation oil massage and oral stimulation have been offered for which the ATVV group will act as a control. This study suggests that Specific physiotherapy interventions are more effective for weight gain and in improvement of sucking coordination. The babies could also be discharged little early.

Effectiveness of body massage in improvement of weight gain velocity of preterm infant has been reported in different studies. In Diego et al study, preterm newborns that received five days of massage therapy showed 25% greater increase in weight gain compared to control group.<sup>24</sup>

Increased vagal activity inducing gastric motility has been demonstrated in infants exposed to massage/kinesthetic exercises. Improved bone mineralization and skeletal growth have been also associated with daily exercise. With oral stimulation nutritive sucking skills developed faster in specific physiotherapy group.

This study had the other group where multisensory stimulation in the form of ATVV. The findings of many studies suggest that music interventions may have positive effects on preterm infants in the NICU including increased oxygen saturation levels, reduced heart rates, reduced arousal and behavioral stress responses, increased levels of quiet alert or quiet sleep states, improved parent-infant interaction, improved weight gain, and reduced length of hospitalization.<sup>25</sup> Several studies have made consistent observations on adverse effects of handling procedures in NICU. Thus,

supplemental tactile stimulation is indicated at the same time ensuring minimal and gentle handling.<sup>26</sup>

Positive effects of vestibular stimulation on arousal level, visual exploratory behavior, motor development and reflex integration have been reported in the literature. Korner hypothesized that vestibular stimulation reduces the intensity of internal needs (e.g., crying or state disorganization) which permits the infant to turn outward and attend to external events (through the promotion of quiet alertness).<sup>27</sup>

Present study shows greater weight gain in specific physiotherapy group. It could be because of the individual positive effects on weight by massage, kinesthetic exercise and indirectly by oral stimulation. Pre- to post intervention differences in sucking stage shows significant difference.

Thus, oral stimulation promises greater improvement in sucking coordination of a preterm infant. Behavior of the infants in both groups improved from first day to fifth day. The infants were active and alert post intervention. Thus, the intake volume of milk increased and also the energy consumption in stressful activity decreased.

In Specific physiotherapy intervention group, infants could be discharge little early, probably due to better weight gain. Though sleep wake pattern was not included as an outcome measure, on inquiry to mother and staff, it was found that there was increase in time the baby had quiet sleep.

Due to ethical reasons we did not have a control group in the present study. We have not studied the long-term outcome of such babies.

## CONCLUSION

In preterm infants, specific physiotherapy interventions are more effective in improving suck co-ordination, has better weight gain and is equally effective in improving Neurobehavioral outcome compared to multisensory stimulation.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

- Ramachandran S, Dutta S. Early developmental care interventions of preterm very low birth weight infants. *Indian Pediatr.* 2013;50(8):765-70.
- Benzies KM, Magill-Evans JE, Hayden KA, Ballantyne M. Key components of early intervention programs for preterm infants and their parents: a systematic review and meta-analysis. *BMC Pregnancy Childbirth.* 2013;13(1):S10.
- Jennische M, Sedin G. Spontaneous speech at 6 1/2 years of age in children who required neonatal intensive care in 1986-1989. *Acta Paediatr.* 2001;90(1):22-33.
- Abubakar II, Tillmann T, Banerjee A. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the global burden of disease study 2013. *Lancet.* 2015;385(9963):117-71.
- Cloherly, John P. Care of the extremely low birth weight infant. *Manual of neonatal care (7<sup>th</sup> ed).* Philadelphia: Wolters Kluwer Health/Lippincott Williams and Wilkins. 2012:146.
- Jarjour IT. Neurodevelopmental outcome after extreme prematurity: a review of the literature. *Pediatric Neurol.* 2012;52(2):143-52.
- Blencowe H, Cousens S, Oestergaard M, Chou D, Moller AB, Narwal R, et al. National, regional and worldwide estimates of preterm birth. *The Lancet.* 2012;9379(9832):2162-72.
- Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. *The Lancet.* 2008;371(9608):261-9.
- Arzuaga BH, Lee BH. Limits of human viability in the united states: a medicolegal review. *Pediatr.* 2011;128(6):1047-52.
- Bhutta AT, Cleves MA, Casey PH, Craddock MM, Anand KJS. Cognitive and behavioral outcomes of school-aged children who were born preterm: A meta-analysis. *J Am Med Assoc.* 2002;288:728-37.
- Berbel P, Navarro D, Ausó E, Varea E, Rodríguez AE, Ballesta JJ, et al. Role of late maternal thyroid hormones in cerebral cortex development: an experimental model for human prematurity. *Cerebral Cortex.* 2010;20(6):1462-75.
- Aizenman E, White WF, Loring RH, Rosenberg PA. A 3, 4-dihydroxyphenylalanine oxidation product is a non-N-methyl-D-aspartate glutamatergic agonist in rat cortical neurons. *Neuroscience Letters.* 1990;116(1-2):168-71.
- Frye RE, Landry SH, Swank PR, Smith KE. Executive dysfunction in poor readers born prematurely at high risk. *Developmental Neuropsychol.* 2009;34(3):254-71.
- Marlow N, Wolke D, Bracewell MA, Samara M. Neurologic and developmental disability at six years of age after extremely preterm birth. *New Eng J Med.* 2005;352(1):9-19.
- Karbasi SA, Golestan M, Fallah R, Golshan M, Dehghan Z. Effect of body massage on increase of low birth weight neonates growth parameters: a randomized clinical trial. *Iranian J Reprod Med.* 2013;11(7):583.
- Adams-Chapman, I. Neurodevelopmental outcome of the late preterm infant. *Clinical Perinatol.* 2006;33:947-64.
- Zohreh, Shiva, Pegah. Effect of massage on weight gain in premature infants. *Iranian J Neonatol.* 2012;3(2).

18. Massaro AN, Hammad TA, Jazzo B, Aly H. Massage with kinesthetic stimulation improves weight gain in preterm infants. *J Perinatol*. 2009;29:352-7.
19. Fucile S, McFarland DH, Gisel EG, Lau C. Oral and nonoral sensorimotor interventions facilitate suck-swallow-respiration functions and their coordination in preterm infants. *Early Hum Dev*. 2012;88(6):345-50.
20. Bijari BB, Iranmanesh S, Eshghi F, Baneshi MR. Gentle human touch and yakson: the effect on preterm's behavioral reactions. *ISRN nursing*. 2012;2012:750363.
21. Mohamadzadeh A, Karbandi S, Habibollah E, Mahdi B. Effect of tactile-kinesthetic stimulation on weight gaining of preterm Infants. *MJIRI*. 2009;23(3):148-53.
22. Hernandez-Reif M, Diego M, Field T. Preterm infants show reduced stress behaviors and activity after 5 days of massage therapy. *Infant Behav Dev*. 2007;30(4):557-61.
23. Hwang Y, Vergara E. Effects of prefeeding oral stimulation on feeding performance of preterm infants. *Indian J Pediatr*. 2010;77(8):869-73.
24. Diego MA, Field T, Hernandez-Reif M. Vagal activity, gastric motility, and weight gain in massaged preterm neonates. *J Pediatr*. 2005;147:50-5.
25. Hodges AL, Lynda. Preterm infants' responses to music: an integrative literature review. *Southern Online J Nurs Res*. 2010;10(3):1-6.
26. Harrison LL. Tactile stimulation of neonatal Intensive Care Unit preterm. In: Field T, editor. *Touch and massage in early child development*. Johnson and Johnson Pediatric Institute LLC, USA; 2004:139-162.
27. John NI, Dieter, Emory EK. Supplemental stimulation of premature infants: a treatment model. *J Pediatr Psychol*. 1997;22(3):281-95.

**Cite this article as:** Nadar UD, Thakkar PA, Shah C. Effect of specific physiotherapy interventions in comparison with multisensory stimulation on neurobehavioral outcome and weight gain in preterm infants: a randomized control trial. *Int J Contemp Pediatr* 2018;5:178-83.