Article published online: 2023-06-07

Original Article

Maternal Participation in Sensory Care of Preemies: A Pilot Study Examining the Effect on Neonatal Outcome in NICU

Renilda Shanthi Lobo[1] Theresa Leonilda Mendonca[2]

[1] City College of Nursing, Mangalore, Karnataka, India
[2] Laxmi Memorial College of Nursing, Mangalore, Karnataka, India

Address for correspondence Renilda Shanthi Lobo, M.Sc Nursing, City College of Nursing, City Enclave, Shaktinagar, Mangalore, Karnataka, India- 575016 (e-mail: shanthid969@gmail.com).

J Health Allied Sci[NU]

Abstract

Background Hospitalization with specialized medical care and equipment in neonatal intensive care unit (NICU) can help preterm infants survive and thrive; negatively it can lead to separation from the mother with an impact on their growth and behavior. It is critical to assess the interventions that are more beneficial for their development at this particular period. The study's objective was to examine the effectiveness of maternal-directed multisensory stimulation in premature neonates admitted to NICU on neonatal outcomes.

Methods A pilot, quasi-experimental research was designed where 31mother-preterm newborn dyads were enrolled in the intervention and control group, respectively, using a purposive sampling technique. The study included medically stable preterm neonates admitted to NICU between 30 and 36 weeks of gestation weighing 1 to 2.5kg. The preterm in the study group was given ATVV (Auditory, Tactile, Vestibular, and Visual) stimulation for 10 days by the mother, whereas the preterm in the comparison group received the standard treatment. The neonatal outcomes evaluated were weight, physiological parameters, and behavioral assessment of preterm neonates.

Results Preterm newborns who received the intervention scored significantly better than the comparison group on the parameters of heart and respiratory rate, blood oxygen levels, weight, and preterm assessment behavior between the 7th and 10th day of the intervention that suggests the effectiveness of the intervention in improving these parameters of preterm newborns.

Conclusion Maternal guidance and participation in the care of a preterm newborn have a beneficial neonatal outcome in stabilizing the physiological parameters, and improving the weight and preterm infant behavioral characteristics.

Keywords

- maternal directed
- preterm
- NICU
- physiological parameters
- outcome
- neonate
- behavior

Introduction

The most frequent cause of death in children under the age of five is prematurity. In India, prematurity is a major health concern, with an estimated 3.5 million preterm neonates born each year.[1] According to the United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME) report from 2021, the neonatal mortality rate globally is 17 per 1,000 live births aiming for a neonatal mortality rate of 12 or lower per 1,000 live births by 2030.[2] Small-for-gestational-age babies are a significant burden in low-and middle-income nations, with a concentration in south Asia.

DOI https://doi.org/10.1055/s-0043-1769579.
ISSN 2582-4287.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

To improve survival rates, and lower disability rates, it is urgently necessary to provide effective therapies for infants who are born too small or too soon.[1]

Preterm infants are subjected to stressors in the neonatal intensive care unit (NICU), such as invasive hospital procedures, intense light, and noise from medical equipment.[3] The sounds of the mother's speech or heartbeat and tactile or vestibular stimulation from her movements provide integrated multimodal stimulation to the fetus.[4] The environment's genetic and epigenetic effects, endogenous brain activity, sleep, external events that activate the sense organs, and the physical, chemical, sensory, and social/emotional settings all affect how the brain develops.[5]

The newborn's most crucial responsibility is to adapt to and settle in their new environment, which is very different from their mother's womb. Modern medical technology has improved the chances of survival for preterm infants. However, there are common long-term morbidities. In addition to denying infants the fetal sensory stimulation necessary for their proper development, premature infants are at higher risk of complications such as respiratory distress,[6] learning difficulties, cognitive, sensory, and neurological impairment.[7,8]

Early detection of premature babies with potential developmental or mental health issues is important to start interventions immediately since impairments could later emerge.[9] They could need specialized attention in the neonatal critical care unit to help them survive and thrive. Preterm newborns may exhibit positive physiologic and behavioral responses to beneficial NICU interventions.[10] Globally, preterm newborns are more likely to survive thanks to technological and scientific advances that have an impact on their nursing and medical care. Developmental care entails modifying the newborn intensive care unit to lower stress and enhance the preterm neonate's optimal brain and behavioral development. Developmental care is to help each neonate become as stable, structured, and competent as possible by carefully managing them and responding to their cues.[11]

Multisensory stimulation is a well-known strategy to address the issues related to preterm birth-related problems, such as physiological parameters and neuromotor development. The optimum developmental result for the newborn depends on early intervention. Coronavirus disease 2019 (COVID-19) guidelines have limited access to the mothers to NICU and thus limited opportunities for participation in newborn care. Encouragement of mothers in newborn care is vital to facilitate mother-newborn bonding and increase the confidence of mothers in caring for their preemies. Maternal-directed interventions such as skin-to-skin contact, initiating eye to eye contact, singing lullaby, breastfeeding, and emotional support can be beneficial for both the mother and the baby. This study aimed to involve maternal participation in sensory stimulation of their NICU preemies and evaluate its effectiveness on neonatal outcomes.

Materials and Procedures

Research Plan and Participants: A pilot, quasi-experimental study was conducted among the 31 mother preterm newborn dyads in the study and control group from 21/12/2021 to 15/04/2022. Preterm newborns admitted in the premature unit NICU of a tertiary care hospital who met the inclusion criteria after 2 days of stabilization, between 30 to 36 weeks of gestation, weighing between 1 to 2.5kg, and medically stable were selected for the study along with their mothers having no major complications associated with delivery using a purposive sampling technique. The sample size for the main study (from which the pilot sample size was obtained) was calculated by using the formula based on findings of similar research conducted previously[12] with a 0.05 level of significance for the two trials and 0.10 power. A total sample size of 68 each in the experimental and control group was obtained for the main study. However, the authors increased the sample size to 31 each in the pilot study to have a more representative sample size.

The sample in the comparison group received routine care in contrast to the mothers in the trial arm who received training to provide ATVV (Auditory, Tactile, Vestibular, and Visual) stimulation to their preterm newborn in NICU. To avoid selection bias, the sample for the experimental group was chosen last after the data collection was finished on the sample for the control group. The institutional ethical committee approved the study's conduct and informed consent from the participants was received.

The mother in the experimental group was trained to give ATVV stimulation once the mother was comfortable adhering to the stimulation process. Initially, information was given about the procedure using visual aids followed by a demonstration of the procedure using the doll and a return demonstration was taken to ensure that the mother understood the process. The mother was guided to give ATVV stimulation to their preterms in the NICU in the presence of the investigator and after ascertaining the correctness of the procedure, the mother was encouraged to independently carry out the procedure to their preterm neonates.

ATVV stimulation was given by the mothers in the experimental group to their preterm neonates for a total of 12 minutes daily for 10 days. **Auditory stimulation** included live humming of lullabies throughout the stimulation. After initiating auditory stimulation for 3 minutes, **tactile stimulation** was given for 3 minutes with warm palms; infant's body is stroked moderately in a sequence of the head, face, chest, upper limbs, abdomen, and lower limbs in a supine position. Following tactile stimulation after a gap of 30 seconds, **vestibular stimulation** is initiated with slow and steady rocking for 3 minutes. After a gap of 30 seconds, tactile stimulation is repeated for 3 minutes continuing with auditory stimulation. **Visual stimulation** including eye-to-eye contact was encouraged throughout the stimulation process. During signs of overstimulation, the mother was advised to pause the stimulation for 15 seconds and then continue. The mothers in the control group received a pamphlet explaining the process of ATVV stimulation after the baby was discharged from the NICU.

Measurement: The neonatal outcomes were measured before the intervention as well as 3, 5, 7, and 10 days afterward. Neonatal outcomes measured were (a) physiological indicators (heart, breathing rate, temperature, and oxygen levels in blood) measured using a calibrated multiparameter monitor; (b) the weight of the newborn was measured after changing the diaper using a calibrated weighing machine; (c) behavioral assessment tool for preterm infants was used to assess the behavior of preterm newborn after the mother–newborn interaction in NICU. This tool was used in the Indian setting and permission to use this tool was obtained from the author. No modifications in the tool were done. Two components make up the tool. The autonomic/visceral system has four categories including color, respiration, visceral signs, and neurophysiological responses. The maximum total score for this component is 8. A score of more than 5 to 8 for all the four domains in the subsystem is considered to show "Normal behavioral response" and the scores obtained of 2 to 4 show suspected abnormal behavioral responses and scores of less than 1 show definite abnormal behavioral responses. The component of the state and attention-interaction system consists of three domains: alertness, orientation to an auditory stimulus, and state control. It has a point system scoring, that is, from zero to two for both components. The total score is 6, and scores more than 4 to 6 are considered as "normal behavioral response," a score between 2 and 4 shows suspected abnormal behavioral response, and scores of less than 1 show "definite abnormal behavioral response."[13]

The content validity of the tools was ascertained by submitting them to 11 subject experts. The content validity index for baseline characteristics of mother and newborn is 0.98; physiological parameters are 1 as well as preterm behavioral assessment tool is also equal to 1. The intraclass correlation coefficients were used to examine the inter-rater reliability of the behavioral assessment tool for preterm infants. Two independent observers' raw scores for the two subsystems, namely the autonomic and state and attention-interaction systems and their domains in the tool, were calculated using SPSS (Ver. 15.0), South East Asia, Bangalore. The autonomic subsystem's "r" value was 0.96, while the state and attention–interaction subsystem's "r" value was 0.92, indicating good reliability for both of the tool's subsystem.

Data Analysis: SPSS version 23 package was used for data analysis. The data were analyzed using percentages, the frequency for univariate data, standard deviations, and mean in cases of continuous data. The chi-squared test was used to examine categorical variables. Parametric tests utilized the independent *t*-test. For nonparametric testing comparing independent groups, the Kendall tau-b correlation coefficient was utilized. According to the skewed distribution, one-way analysis of variance (ANOVA) with Bonferroni posthoc was adopted to compare more than two separate groups. Statistical significance was denoted by a *p*-value less than 0.05

Results

Characteristics of Mother as well as Preterm Newborn

The characteristic data of 31 mothers and preterm newborns in the groups of treatment and control are described in the below text.

According to the information presented in ►**Table 1**, there was not any scientifically significant distinction between the two groups concerning the age of the mothers, the gestational age, or the birth weight of the neonates. The majority of the mothers were primi, homemakers, were from joint families, had a male child, mode of delivery was lower segment cesarean section and were graduated. The occupation of the mother varied significantly across the groups of intervention and control.

The effectiveness of the maternal-directed intervention on neonatal outcomes is measured in terms of physiological parameters described in ►**Table 2.** Preterm infant behavioral assessment is described in ►**Tables 3** and **4**.

Table 1 Demographic characteristics of the mother and preterm newborn, $n = 31 + 31$

Variable	Intervention arm $n = 31$	Control arm	*t*-Value	*p*-Value	X2 Value
Age of mother[a]	27.52 ± 3.129	27.36 ± 4	0.177	0.86	–
Gestational age[a]	30.81 ± 1.45	30.68 ± 1.51	0.343	0.73	
Birth weight[a]	1.60 ± 0.45	1.77 ± 0.61	1.245	0.218	
No. of deliveries (%)					
1	23 (74.2)	22 (71)	–	0.6	1.022
2	8 (25.8)	8 (25.8)			
3	0	1 (3.2)			
Occupation (%)					
Homemaker	21 (67.7)	17 (54.8)	–	0.008[b]	9.684
Professional	5 (16.1)	0			
Salaried	5 (16.1)	14(45.2)			

(*Continued*)

Table 1 (*Continued*)

Variable	Intervention arm $n = 31$	Control arm	*t*-Value	*p*-Value	X2 Value
Type of family (%)					
Nuclear	9 (29)	10 (32.3)	–	0.783	0.076
Joint	22 (71)	21 (67.7)			
Gender of newborn (%)					
Male	15 (48.4)	20 (64.5)	–	0.2	1.64
Female	16 (51.6)	11 (35.5)			
Mode of delivery (%)					
Normal vaginal	18 (58.1)	11 (39.3)	–	0.15	2.07
LSCS	13 (41.9)	17 (60.7)			
Education (%)					
SSLC	7 (22.6)	4 (12.9)	–	0.35	3.285
PUC	6 (19.4)	12(38.7)			
Graduate	16 (51.6)	14(45.2)			
Postgraduate	2 (6.5)	1(3.2)			

Abbreviations: LSCS, lower segment cesarean section; PUC, preuniversity course; SSLC, secondary school leaving certificate.
[a]Mean ± standard deviation; [b]Highly significant.

Table 2 Comparison of temperature in Celsius, heart and respiratory rate per minute, and blood oxygen level in percentage of the preterm newborn, $n = 31 + 31$

Period	Physiological parameter	Intervention arm Mean ± SD	Control arm Mean ± SD	*t*-Value	*p*-Value
Pretest	Temperature	36.039 ± 0.533	36.090 ± 0.591	0.381	0.719
	Heart rate	152.850 ± 13.923	152.000 ± 14.708	0.152	0.853
	Respiratory rate	58.871 ± 10.847	57.125 ± 10.409	0.656	0.514
	Oxygen saturation	91.097 ± 4.331	92.903 ± 2.773	1.956	0.055
3rd day	Temperature	36.116 ± 0.469	36.203 ± 0.399	0.788	0.434
	Heart rate	150.380 ± 9.327	152.450 ± 8.147	0.931	0.356
	Respiratory rate	57.097 ± 10.143	56.321 ± 10.921	0.289	0.773
	Oxygen saturation	93.710 ± 2.224	93.645 ± 2.058	1.719	0.091
5th day	Temperature	36.287 ± 0.533	36.326 ± 0.565	0.278	0.782
	Heart rate	148.124 ± 7.857	151.152 ± 6.202	1.684	0.097
	Respiratory rate	54.290 ± 6.929	56.126 ± 8.089	0.594	0.555
	Oxygen saturation	95.774 ± 1.910	94.806 ± 1.778	0.069	0.945
7th day	Temperature	36.435 ± 0.376	36.339 ± 0.397	0.985	0.329
	Heart rate	146.251 ± 7.762	150.845 ± 9.299	2.117	0.039[a]
	Respiratory rate	51.287 ± 6.820	55.189 ± 6.925	2.178	0.0334[a]
	Oxygen saturation	96.161 ± 1.828	94.355 ± 2.484	1.456	0.151
10th day	Temperature	36.471 ± 0.304	36.342 ± 0.362	1.520	0.134
	Heart rate	144.615 ± 9.233	150.129 ± 8.940	2.889	0.009[b]
	Respiratory rate	50.190 ± 5.229	55.092 ± 8.520	2.619	0.01[b]
	Oxygen saturation	96.548 ± 2.158	94.484 ± 2.293	0.114	0.048[a]

Abbreviation: SD, standard deviation.
[a]Significant; [b]Highly significant.

Table 3 Grading of preterm infant behavior

Period	Normal behavioral response		Suspected abnormal behavioral response		Definite abnormal behavioral response	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Intervention group: Autonomic/ visceral system						
Pretest	15	48.4	13	41.9	3	9.7
3rd day	21	67.7	10	32.3	0	0
5th day	24	77.4	7	22.6	0	0
7th day	30	96.8	1	3.2	0	0
10th day	31	100	0	0	0	0
Control group						
Pretest	14	45.2	14	45.2	3	9.6
3rd day	16	51.6	13	41.9	2	6.5
5th day	20	64.6	10	32.2	1	3.2
7th day	22	70.9	9	29.1	0	0
10th day	24	77.4	7	22.6	0	0
State and attention interactive system						
Intervention group						
Pretest	2	6.5	14	45.2	15	48.4
3rd day	10	32.3	19	61.3	2	6.5
5th day	23	74.2	8	25.8	0	0
7th day	28	90.3	3	9.7	0	0
10th day	29	93.5	2	6.5	0	0
Control group						
Pretest	6	16.7	7	23.3	18	58.1
3rd day	8	25.8	14	45.2	9	29.0
5th day	10	32.3	13	41.9	8	25.8
7th day	12	38.7	14	45.2	5	16.1
10th day	14	45.2	14	45.2	3	6.6

Table 4 Effectiveness of ATVV stimulation on weight and physiological parameters among the preterm newborns, $n = 31 + 31$

Parameter	Intervention arm		Control arm	
	F-Value	*p*-Value	F-Value	*p*-Value
Weight	0.607	0.658	1.501	0.205
Temperature	1.684	0.097	1.112	0.361
Heart rate	3.542	0.009[a]	2.108	0.068
Respiratory rate	3.741	0.007[a]	2.112	0.062
Oxygen saturation	22.651	0.000[b]	1.894	0.078
Preterm infant behavior-autonomic/ visceral	31.674	0.000[b]	1.456	0.084
Preterm infant behavior-state regulation	49.073	0.000[b]	2.451	0.058

Abbreviation: ATVV, Auditory, Tactile, Vestibular, and Visual.
[a]Highly significant; [b]Very highly significant.

The information in ►**Table 2** shows that the differences in terms of physiological parameters are not statistically significant during the initial period. However, on the 7th and 10th day, the *t*-value for heart rate, respiratory rate, and oxygen saturation (10th day) is statistically significant (p-value <0.05) indicating that the intervention was effective to lower heart and respiratory rate and higher levels of blood oxygen in the experimental arm thereby accepting the research hypothesis at 0.05 level of significance.

The data in ►**Table 3** shows the frequency and percentage of each category of preterm infant behavior at different time points for both groups. The intervention group had an increased proportion of normal behavioral responses and decreased proportion of abnormal behavioral responses than the control group in the autonomic/visceral system and state/attention interactive system. The percentage of normal behavioral responses increased over time for the intervention group, while it remained relatively consistent for the control group. Similarly, the percentage of abnormal behavioral responses decreased over time for the intervention

Table 5 Symmetric measures to assess the correlation of the preterm assessment behavior of newborns using Kendall tau-b among intervention and control group

Variable/Areas	Kendall tau-b value		Standard error		*t*-Value		*p*-Value	
	Intervention arm	Control arm	Intervention arm	Control arm	Intervention arm	Control arm	Intervention arm	Control arm
Autonomic/visceral system								
Color	0.510	0.217	0.045	0.055	8.781	1.702	<0.001[a]	0.078
Respiration	0.436	0.242	0.057	0.055	7.200	1.308	<0.001[a]	0.125
Visceral	0.502	0.145	0.052	0.045	9.106	1.801	<0.001[a]	0.144
Neuro	0.420	0.170	0.060	0.052	6.714	1.318	0.000[b]	0.154
State and attention interactive system								
State regulation	0.624	0.145	0.042	0.057	12.617	1.194	0.000[b]	0.126
Orientation to auditory stimulus	0.578	0.104	0.050	0.051	11.111	1.456	0.000[b]	0.084
Alertness	0.586	0.193	0.048	0.054	11.383	1.766	0.000[b]	0.062

[a]Very highly significant; [b]Highly significant.

group, while it remained relatively consistent for the comparison group.

The effectiveness of maternal directed ATVV stimulation on weight, various physiological parameters, and assessment of preterm infant behavior analyzed using one-way ANOVA is described in ►**Table 4**.

The findings show that neither the intervention group nor the control group's weight or temperature differed significantly; hence, the null hypothesis was accepted. However, in the intervention group, there is a very highly significant rise in oxygen saturation values and a significant lowering of heart rate, respiratory rate, and significant improvement in the normal preterm infant behavior compared with the control group indicating that the difference between the groups is not likely to have happened by chance; hence, the null hypothesis was rejected.

The correlation between the intervention and outcome among the intervention and control group in the areas of preterm assessment behavior was assessed using Kendall tau-b symmetric measures as described in ►**Table 5** and ►**Fig. 1.**

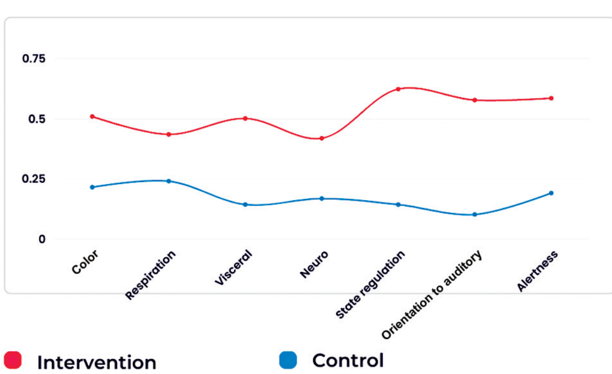

Fig. 1 Comparison of Kendall tau-b value among intervention and control group on Preterm assessment behavior using line graph.

►**Table 5** and ►**Fig. 1** show that the values of Kendall tau-b for the study group in all areas indicate a moderate positive correlation between the intervention and the outcome with a significance level of 0 to less than 0.001. Hence, the null hypothesis is rejected suggesting that the intervention had a statistically significant effect on the outcome in all areas in the intervention arm, whereas the control arm had a weak positive correlation with no statistically significant outcomes.

Discussion

COVID-19 has restricted the entry of visits in the NICU, causing superimposed stress among parents, lack of support, and opportunity to engage in parenting, which cause them to frequently misinterpret their children's behavioral indicators that can influence the neonatal outcome. Mothers lack knowledge and skill in the care to be provided to the newborn.[14] Adequate maternal guidance and motivation to provide in utero environment and appropriate stimulation can benefit the newborn admitted to NICU facing stress related to it.[15] The many components of supportive care for preterm must be actively taken into account while developing comprehensive developmental support interventions. It is necessary to perform further study to develop initiatives that directly assist families of premature infants.[16] This study aimed to guide the mother in ATVV stimulation of their preterm newborn admitted to NICU and evaluate its effect on their neonatal outcome.

There are professionally directed multisensorial stimulation research studies on preterm but very few parental-directed intervention studies in India. Mothers in this study were guided to give multisensory stimulation to their preterm in NICU. Since the brains of preterm newborns go through a crucial developmental period and maturing during 24 to 40 weeks of gestation, especially during their stay in the intensive care nursery, they are more presumably to have severe short- and long-term consequences on neurodevelopmental deficits. Of all infants, those born before 30 weeks of gestation have the lowest chances for development. These infants stay in the newborn unit of intensive care for a long period, which is not always conducive to brain development and long-term developmental requirements.[17] The newborn included in this study included stable preterm ranging between 30 and 36 weeks of gestation admitted in NICU. ATVV stimulation is a multisensory method of stimulating preterm neonates in the NICU that aims to provide neonates with a range of sensory experiences that will help to promote developmental outcomes. In stable preterm newborns, multisensory stimulation (ATVV) has been demonstrated to be safe.[18]

The results in this study indicate that there is no significant difference between the intervention and control groups in terms of mothers' age ($p = 0.73$), gestational age ($p = 0.73$), birth weight ($p = 0.218$), gender of the newborn ($p = 0.2$), educational status of the mother ($p = 0.35$), type of family ($p = 0.783$), mode of delivery ($p = 0.15$), and number of delivery ($p = 0.6$) which indicate that the groups were similar.

This study showed that maternal-directed ATVV stimulation to preterm newborns had no significant differences between the intervention and control groups for weight, temperature, heart rate, respiratory rate, and oxygen saturation at the pretest, 3rd day, and 5th day, However, on the 7th day and 10th day, there were significant differences ($p < 0.05$) between the two groups for heart rate, respiratory rate, and oxygen saturation (on 10th day) when compared with the control group that had a higher heart, respiratory rate, and lower oxygen saturation. This is thought to be due to the stimulation of the vagus nerve, which helps to regulate the body's physiological functions in preterm neonates, which is important for their overall health and development. This was consistent in study findings where multisensory stimulation led to a decrease in heart rate and respiratory rate,[19] maintenance of oxygen saturation[20] and an increase in weight considerably among the stimulation-led group when compared with standard care[21,22] Additionally, premature infants' early postnatal exposure to sounds may improve their ability to process voices.[23] One very relevant stimulation for babies is the mother's voice. In this study mothers in the intervention group were guided to stimulate their preterm newborns by singing lullabies in their own language during their interaction in NICU.

In terms of behavior, ATVV stimulation may improve alertness and attention in preterm neonates. This is thought to be due to the stimulation of the neonate's visual and auditory systems, which can help to promote the development of their cognitive and motor abilities. Additionally, ATVV stimulation may also help to improve the neonate's overall mood and reduce the risk of stress and anxiety. The effectiveness of maternal-directed ATVV stimulation on preterm behavioral assessment in the present study showed that the group receiving treatment had increased percentage of normal behavioral responses and a lower percentage of abnormal behavioral responses compared with the control group. The New Ballard score was used in one study with 80 individuals (treatment: 40; control: 40) to compare the outcomes of a multimodal intervention to standard care. Both groups saw considerable progress both before and after the intervention; however, infants in the experimental group developed their neuromuscular systems more fully than infants in the comparator group (mean difference (MD): 5.60; 95% confidence interval: 4.65–6.55; $p = 0.00001$).[24] Nurses are trained to identify the cues of stress in newborns, but the mother lacks this knowledge and there is a scarcity of such studies finding the effectiveness of maternal-directed ATVV stimulation on neonatal outcome.

Conclusion

Maternal-directed ATVV stimulation is a promising method for promoting the developmental outcomes of preterm neonates in the intensive care nursery. It can have early positive effects on the physiological parameters and behavior of preterm newborns. However, more research is needed to fully understand the long-term effects of maternal-directed ATVV stimulation on preterm neonates and to determine the most effective methods of implementation.

Conflict of Interest
None declared.

References

1 Lee AC, Katz J, Blencowe H, et al; CHERG SGA-Preterm Birth Working Group. National and regional estimates of term and preterm babies born small for gestational age in 138 low-income and middle-income countries in 2010. Lancet Glob Health 2013;1 (01):e26–e36

2 UNICEF. Levels and trends in child mortality: United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME) report. 2021. Accessed April 26, 2023 https://data.unicef.-org/resources/levels-and-trends-in-child-mortality/

3 Cong X, Wu J, Vittner D, et al. The impact of cumulative pain/stress on neurobehavioral development of preterm infants in the NICU. Early Hum Dev 2017;108:9–16

4 Lickliter R. The integrated development of sensory organization. Clin Perinatol 2011;38(04):591–603

5 Fawke J. Neurological outcomes following preterm birth. Semin Fetal Neonatal Med 2007;12(05):374–382

6 Fraser J, Walls M, McGuire W. Respiratory complications of preterm birth. BMJ 2004;329(7472):962–965

7 World Health Organization. Accessed April 26, 2023 at: https://www.who.int/ es/news-room/fact-sheets/detail/preterm-birth

8 Ward RM, Beachy JC. Neonatal complications following preterm birth. BJOG 2003;110(Suppl 20):8–16

9 Hee Chung E, Chou J, Brown KA. Neurodevelopmental outcomes of preterm infants: a recent literature review. Transl Pediatr 2020;9 (Suppl 1):S3–S8

10 Fernández Medina IM, Granero-Molina J, Fernández-Sola C, Hernández-Padilla JM, Camacho Ávila M, López Rodríguez MDM. Bonding in neonatal intensive care units: experiences of extremely preterm infants' mothers. Women Birth 2018;31(04):325–330

11 Yun EJ, Kim TI. Development and effectiveness of an educational program on developmental positioning for neonatal intensive care unit nurses in South Korea: a quasi-experimental study. Child Health Nurs Res 2022;28(01):70–81

12 Livingston M. Effectiveness of auditory and tactile stimulation on physiological parameters among Preterm Neonates. Doctoral

thesis, Sacred Heart Nursing College Madurai.2014. Accessed April 26, 2023 at: http://repository-tnmgrmu.ac.in/2712/
13 Dsouza SRB, Kumar V, Edward LL. Nurs Midwifery Res J 2014;10 (03):91–99
14 Krisnana I, Arifin H, Dwi Kurnia I. Participant Modeling Towards Mother's Knowledge and Skills About Multisensory Stimulation in Infant. In: Proceedings of the 8th International Nursing Conference on Education, Practice and Research Development in Nursing (INC 2017) [Internet]. Surabaya, Indonesia: Atlantis Press; 2017 [cited 2023 Mar 12]. Accessed April 26, 2023 at: http://www.atlantis-press.com/php/paper-details.php?id=25886889
15 Provasi J, Blanc L, Carchon I. The importance of rhythmic stimulation for preterm infants in the NICU. Children (Basel) 2021;8 (08):660
16 Lee H, Park JH, Cho H. Analysis of research on developmentally supportive care for prematurity in neonatal intensive care unit: a scoping review. Child Health Nurs Res 2022;28(01):9–22
17 Pickler RH, McGrath JM, Reyna BA, et al. A model of neurodevelopmental risk and protection for preterm infants. J Perinat Neonatal Nurs 2010;24(04):356–365
18 Burns K, Cunningham N, White-Traut R, Silvestri J, Nelson MN. Infant stimulation: modification of an intervention based on physiologic and behavioral cues. J Obstet Gynecol Neonatal Nurs 1994;23(07):581–589
19 Nasimi F, Zeraati H, Shahinfar J, Safdari M, Esmaeili A, Ghorbanzadeh M. Effect of multi-sensory stimulation on physiological parameters in preterm infants: randomized clinical trial. Tehran Univ Med J 2020;78(02):80–87
20 Abdel Mageed ASA, Olama KA, Abdel Rahman SA, El-Gazzar HE. The effect of sensory stimulation on apnea of prematurity. J Taibah Univ Med Sci 2021;17(02):311–319
21 Vesga Gualdrón LM, Durán de Villalobos MM, Bernal Camargo NM. Infant stimulation reduces weight loss and increases breastfeeding: a randomized controlled trial. invest educ enferm [Internet]. 2022 Mar 28 [cited 2023 Jan 23];40(1). Accessed April 26, 2023 at: https://revistas.udea.edu.co/index.php/iee/article/view/349218
22 Mahdieh S, Rahnama M, Ghaljaei F, et al. The effect of multisensory stimulation on weight gain in premature infants admitted to the intensive care unit: a clinical trial study. Rom J Neurol 2021;20 (01):96–102
23 Adam-Darque A, Pittet MP, Grouiller F, et al. Neural correlates of voice perception in newborns and the influence of preterm birth. Cereb Cortex 2020;30(11):5717–5730
24 Zeraati H, Nasimi F, Rezaeian A, Shahinfar J, Ghorban Zade M. Effect of multi-sensory stimulation on neuromuscular development of premature infants: a randomized clinical trial. Iran J Child Neurol 2018;12(03):32–39

