ORIGINAL ARTICLE

Nurse-Guided Maternal Interventional Package for Neonatal Stress – A Randomized Controlled Trial

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ABSTRACT

Objective: To assess the role of nurse-guided maternal interventional package for reducing stress behaviour among preterm neonates admitted in neonatal intensive care unit (NICU).

Methods: A randomized controlled trial was conducted among 100 mothers and their newborns delivered preterm and admitted consecutively in the NICU over 4 months. Mothers in the intervention group (n = 50) received education and demonstration regarding the use of maternal touch, facilitated tucking, kangaroo mother care (KMC), non-nutritive sucking (NNS), nesting and maternal voice alongwith a handout in local language for five consecutive days, while those in the control group (n = 50) received routine care including KMC and NNS for five consecutive days. Neonates were assessed before and five days after enrolment or intervention by using modified Infant Positioning Assessment Tool (IPAT), Neonatal Stress Scale and Preterm Neonate's Behaviour Assessment Scale.

Results: The mean (SD) score of positioning was significantly higher in the intervention group as compared to control group [9.62 (1.17) vs 6.58 (1.72), P < 0.001]. The median (IQR) score of stress was significantly lower in the intervention group compared to the control group [7 (7-10) vs 11(8-12.75), P = 0.004]. The mean (SD) scores for the autonomic and visceral subsystem behavioral response were significantly higher in the intervention group [5.28 (1.4) vs 3.25 (1.0), P < 0.001]. Attention interaction subsystem behavioral response score intervention group was significantly higher in the intervention group compared to the control group [2.96 (1.2) vs 1.85(0.9), P = 0.001].

Conclusion: Mothers can be guided by nurses on neonatal stress behaviour and how to handle neonates in NICU, which significantly improves positioning score, behavioral scores and reduced stress scores.

Keywords: *Behavioral response, Neonatal stress, Positioning, Preterm*

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INTRODUCTION

Around 15 million infants are born prematurely every year, with an average preterm birth rate of 11% [1]. In 2020, 3.02 million preterm babies were born in India [2]. Premature birth poses significant stress for mothers and babies as they spend several months in the Neonatal Intensive Care Unit (NICU) due to severe morbidities. Unfortunately, the environment in the NICU is very different from the intrauterine life [3]. It has been seen that premature neonates may be exposed to approximately 134 stressful procedures during their first two weeks of life [4]. Light, noise, sound, interventions, routine handling by doctors and nurses (such as weighing, radiographs, skin breaking procedures etc.) are the major stressors that cause stress reaction in the preterm neonates [5].

Preterm neonates exhibit stress behaviours alongside autonomic, motor, attention and state systems. Increased heart rate, facial grimacing, fussing, limb extension, hyperalert, arousal, covering eyes, finger splay etc. are some of the stress behaviours that occur following exposure to a stressful event [6]. Stress in the neonatal period can lead to cognitive impairments, poor motor skills, learning disabilities, psychosocial issues, lack of social control, and impulsive behaviour later in life [7].

Controlling of NICU environment, family-centred care and appropriate handling can reduce the stress and improve longterm outcomes. Developmentally Supportive Care (DSC) is one of the models for interventions that are used to promote the behavioral organization of neonates, reduce stress, protect the sleep rhythms, enhance the physiological stability and promote the growth and maturation [8].

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Nurses have an important role as main caregivers, although they cannot take the role of family, they can assist mothers by educating them in giving consistent and comforting care for their newborns. The family is seen as the sentinel entity in nurturing a preterm neonate so development care focus should be directed at the family, especially the mothers [9]. There is emerging evidence that mother-infant interaction plays a crucial role in controlling the infant stress behaviour as well as moulding the infant behaviour and physiology [10]. We planned this intervention trial wherein the impact of nurse-guided education of mothers delivering preterm neonates was assessed in terms of estimates of neonatal stress in NICU.

METHODS

A randomized controlled trial was conducted in the level III NICU of tertiary centre in North India over four months' duration, from August to November 2022. Prior approval was obtained from Institutional Ethics Committee for conduct of the study.

Preterm neonates (born before 37 weeks of gestation) and their mothers were included in the study after obtaining written informed consent from mothers. Babies on high frequency ventilation, persistent pulmonary hypertension and those born to sick mothers were excluded. Preterm neonates admitted consecutively in the NICU were randomized to either the intervention arm or the control arm. Randomization was done through computer generated random numbers and allocation concealment was guaranteed by the use of sequentially numbered, opaque and sealed envelopes. It was done by an independent person not involved in the conduct of the study.

After baseline assessment, mothers in the intervention group were trained with the nurse-guided interventional package for 5 days to reduce neonatal stress behaviours. The package included education, information and demonstrations regarding handling of the baby and the role of maternal touch, maternal voice, facilitated tucking, nesting, kangaroo mother care (KMC) and non-nutritive sucking (NNS). After the nurse gave the demonstration to the mother, a return demonstration for the same was taken from the mother and her doubts, if any, were cleared. Daily reinforcement was done and mothers were and motivated to perform the interventions. Positioning was performed 3-4 times, KMC was done at least 4 hours/day and, NNS was practiced 3-4 times/day. The preterm neonates in the control group were given routine care alongwith KMC and NNS for 5 days and reassessed. To avoid contamination, babies in the two groups were kept in separate cubicles in the NICU.

The tools used for data collection included the modified sociodemographic scale by Kuppuswamy [11], clinical profile, modified Infant Positioning Assessment Tool (IPAT) [12], Neonatal Stress Scale [13] and Preterm's Neonate Behavioral Assessment Scale [14]. The IPAT is a validated and reliable tool which is used to evaluate the posture of premature infants in six areas of the body i.e. head, neck, shoulders, hands, hips/pelvis, and knees/ankles/feet with cumulative scores ranging from 0-12. A score of 12 is the ideal cumulative score, 9-11 is an acceptable cumulative score and score of 8 indicates need for repositioning. Neonatal Stress Scale is a self-structured tool consisting of 24 components which cover four domains i.e. autonomic, motor, attention and state, to assess neonatal stress. A score of 0-8 represents mild stress, a score of 9-16 represents moderate stress and a score of 17-24 represent severe stress. Preterm's Neonate Behavioral Assessment Scale has two subsystems: autonomic/visceral subsystem and the state regulation and attention-interaction subsystem. The total score of autonomic/visceral subsystem ranges from 0-8; score of 5-8 represents normal behavioral response, 2-4 represents suspected abnormal behavioral response, and score ≤ 1 indicates definite abnormal behavioral response. The total score of state regulation and attention-interaction subsystem ranges from 0-6; score of 4-6, 2-3, and ≤1 represent normal, suspected abnormal and abnormal behavioral response, respectively. All babies were assessed for positioning, stress and behavioral response at enrolment and 5 days after intervention or enrolment in the intervention and control groups, respectively.

Sample size of 98 neonates, 49 per group, was calculated using Open Epi Menu App by considering the mean (SD) difference of Stress Behaviour Score of 5.46 [15] at 80% power and 95% CI.

Statistical analysis: Data was entered in SPSS software. Descriptive statistics were used for baseline characteristics. *Chi*-square test, Bowker's McNemar's, and was used to compare continuous data between the two groups. Unpaired *t*- test, Paired *t*-test, or Wilcoxon sign ranked test were used for intragroup comparison. Mann Whitney U test was used for skewed numerical data comparisons. $P < 0.05$ was considered statistically significant.

RESULTS

A total of 105 preterm neonates were assessed for eligibility; of these, 100 eligible neonates were enrolled and randomized to the intervention (n = 50) and control group (n = 50). See **Fig. 1**. **Table I** shows the baseline characteristics of enrolled preterm neonates. Except one, all preterm neonates had respiratory distress. At enrolment, most of the neonates were receiving orogastric feeding; 84% (n = 42), and 72% (n = 36) neonates in the

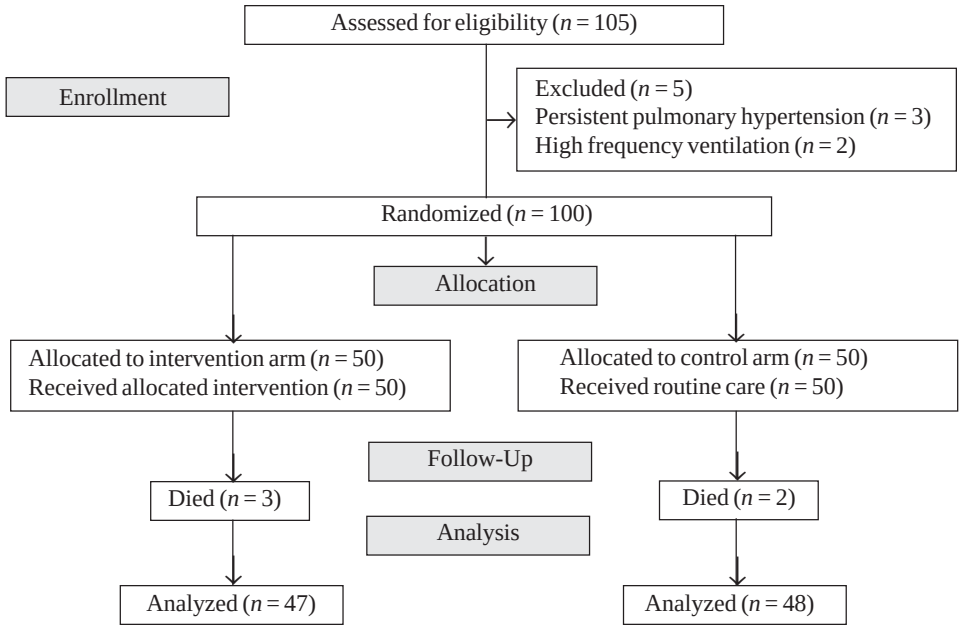

Fig. 1 Flow of study participants

Table I Baseline Characteristics of Enrolled Neonates

Variables	*Intervention group(n=50)*	*Control group(n=50)*
Gestational age[a] (wks)	30.1 (2.7)	30.7 (3.1)
Birth weight[a] (g)	1179.2 (365.1)	1339.7 (540.6)
Male	27 (54)	33 (66)
Appropriate for gestational age	29 (58)	33 (66)
Age at enrolment (d)[a]	7.1 (3.8)	6.4 (3.9)
Respiratory support (Nasal CPAP) at enrolment	33 (66)	31 (62)
Socioeconomic Class (as per Modified Kuppuswamy scale 2021)		
Upper	1 (2)	4 (8)
Upper middle	12 (24)	8 (16)
Lower middle	18 (36)	19 (38)
Upper lower	19 (38)	19 (38)
Maternal education		
No formal education	2 (4)	-
Primary	2 (4)	-
Middle	10 (20)	8 (16)
Matric	3 (6)	8 (16)
Inter/diploma	8 (16)	19 (38)
Graduate	20 (40)	11 (22)
Postgraduate	5 (10)	4 (8)

Data expressed as n (%) and [a]mean (SD), CPAP Continuous Positive Airway Pressure

interventional and control group, respectively. Of these, 64% (*n* = 32) in the interventional group and 66% (*n* = 33) in the control group were receiving exclusive expressed breastmilk.

Table II shows a significant improvement in the level of stress and in positioning and behavioral response in the intervention group as compared to the control group after the intervention.

Table III shows the intergroup and intragroup comparison of scores of positioning and behavioral response in terms of autonomic, visceral subsystem and state-regulation, attention interaction subsystem and neonatal stress scores. Scores of positioning and behavioral response in terms of autonomic, visceral subsystem and state-regulation, attention interaction subsystem in the intervention group were significantly higher than the control group following intervention. There was also a significant improvement in the scores within the intervention group but no significant change was observed in control group.

There was a significant reduction in the median scores of stress after the intervention, compared to the control group. There was also significant improvement in the median scores within the intervention group but no significant change was observed within control group.

DISCUSSION

For the optimum development of a preterm, adequate and

Table II Comparison of Positioning and Stress, Autonomic, Visceral and State Regulation Attention Interaction Subsystem

Variables	Pre intervention		P value	Post intervention		Pvalue
	Intervention group (n = 50)	Control group (n = 50)		Intervention group (n = 47)	Control group (n = 48)	
Positioning[a]						
Ideal positioning (score 12)	0	0	1.00	4 (8.5)	0	<0.001
Acceptable positioning (score 9-11)	5 (10.0)	4 (8.0)		41 (87.2)	7 (14.6)	
Need for repositioning (score < 8)	45 (90.0)	46 (92.0)		2 (4.3)	41 (85.4)	
Neonatal Stress Score[b]						
Mild (1-8)	1 (2.0)	2 (4.0)	0.78	30 (63.8)	16 (33.3)	0.004
Moderate (9-16)	45 (90.0)	43 (86.0)		17 (36.2)	30 (62.5)	
Severe (17-24)	4 (8.0)	5 (10.0)			2 (4.2)	
Domain 1: Autonomic and Visceral Subsystem[c]						
Normal behavioral response (5-8)	-	1 (2.0)	0.27	32 (68.1)	4 (8.3)	0.001
Suspected abnormal behavioral response (2-4)	38 (76.0)	32 (64.0)		13 (27.7)	36 (75.0)	
Definite abnormal behavioral response (≤ 1)	12 (24.0)	17 (34.0)		2 (4.3)	8 (16.7)	
Domain 2: State Regulation and Attention Interaction Subsystem[c]						
Normal behavioral response (4-6)	-	-		14 (29.8)	2 (4.2)	0.001
Suspected abnormal behavioral response (2-3)	29 (58.0)	25 (50.0)	0.55	24 (51.1)	24 (50.0)	
Definite abnormal behavioral response (≤ 1)	21 (42.0)	25 (50.0)		9 (19.1)	22 (45.8)	

Data expressed as n (%), [a]Modified Infant Positioning Assessment Tool, [b]Neonatal Stress Scale, [c]Preterm Neonate's Behavior Assessment Scale.

appropriate nurturing in the neonatal intensive care unit (NICU), that is attentive and responsive caregiving are necessary steps [16]. Appropriate nesting can be practiced in the NICU to achieve optimal position and is a standard developmentally supportive position which maximizes the stability of the neonate and promotes behavioral organization.

We observed a significant improvement in the positioning, neonatal stress and behavioral response in the neonates after the intervention. The improvement in positioning was reflected in the IPAT scores after the intervention which is consistent with the results of a study by Jeyabarathi et al who reported that following implementation of nesting among high risk newborns there was a significant improvement in positioning score [17].

The stress associated with the preterm birth is particularly more in the initial weeks after birth when maximum interventions are done and the neonate is sick. The preterm infants show signs of stress as reflected in the autonomic, motor and state attention subsystem. DSC interventions such as KMC, NNS, facilitated tucking, maternal touch and maternal voice help to minimize the stress and promote the growth and maturation of preterm neonates. Our study shows that the statistically significant reduction was achieved in the level of stress in preterm neonates after the implementation of intervention. The

Table III Scores of Positioning, Autonomic, Visceral Subsystem and State Regulation, Attention Subsystem and Neonatal Stress Scores

Variables	Intervention group	Control group	P value
Positioning			
Preintervention[a]	6.38 (1.67)	5.80 (1.72)	0.092
Postintervention[b]	9.62 (1.17)	6.58 (1.72)	< 0.001
P value	< 0.001	0.078	
Domain 1: Autonomic and Visceral Subsystem			
Preintervention[a]	2.68(1.13)	2.26 (1.27)	0.09
Postintervention[b]	5.28(1.49)	3.25(1.07)	< 0.001
P value	< 0.001	0.237	
Domain 2: State Regulation and Attention Interaction Subsystem			
Preintervention[a]	1.86 (0.85)	1.64 (0.77)	0.18
Postintervention[b]	2.96 (1.23)	1.85 (0.94)	< 0.001
P value	< 0.001	0.14	
Neonatal Stress Score[c]			
Preintervention[a]	12 (10-12.25)	11 (10-14)	0.73
Postintervention[b]	7 (7-10)	11 (8-12.75)	< 0.001
P value	< 0.001	0.16	

Data expressed as mean (SD) or median (IQR); I intervention group, C control group

[a]Preintervention n = 50 per group; [b]Postintervention n = 47 and n = 48 in the Intervention and Control groups respectively

WHAT THIS STUDY ADDS?

- Involvement of mother in the care of the preterm neonates admitted in NICU not only reduces the stress related behaviours but also increases the mother-infant bonding by involvement of mother in positioning, nesting, KMC and NNS.

similar findings from Shin et al and Namzoo et al showed that mother's voice and lullaby practices improved the physiological parameters in the intervention groups [18,19]. Ibrahim et al showed a significant improvement in the behavioral organization in the preterm neonates who were nursed in the NICU in nesting position as compared to the group receiving routine NICU care with traditional positions without nesting [20].

Parental involvement especially that of mother in the DSC of neonates helps to minimize the stress among the preterm neonates and promotes optimum growth and development. This is supported by the findings of our study as well as that by Byers et al wherein the infants who had received developmentally supportive family-centred care showed lesser behavioral stress signs [9].

The strength of our study includes a randomized control design. The interventional package was found to be effective and could be taught to mother by the nurses. Limitations of our study include a small sample size due to limited time period and that it could not be blinded due to nature of the study.

We conclude that mothers can be trained by nurses regarding developmentally supportive care which can reduce stress and improve behavioral response in neonates admitted in NICU.

Ethics clearance: Institutional Ethics Committee, PGIMER Chandigarh with reference number IEC-INT/2022/MSc-118, dated March 4, 2022.

Trial Registration: Clinical Trial Registry-India CTRI/2022/07/043693.

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