Modulatory Effects of Nursing-Guided Nesting Interventions on Neurobehavioral Maturation and Feeding Functionalities among Neonates: An Integrative Analytical Perspective

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Abstract: Background: *Neonatal adaptation during the early postnatal period can be critically determined by neurobehavioral maturation and effective feeding. Nesting, which is a nursing guided developmental care interventions, have shown improved behavioural regulation and feeding efficiency. This study evaluated the modulatory effects of nursing guided nesting on neurobehavioral maturation and feeding functionalities among neonates, also the maternal satisfaction and associated clinical obstetric variables.* ***Methods:*** *An experimental pre-post-test design was conducted among 60 neonates in which 30 infants were as experimental and 30 infants were as control admitted to first level new-born care units. The experimental group received nursing guided nesting for 6 hours per day over two consecutive days, while controls received routine care. Neurobehavioral activity was assessed using the Braselton Neonatal Behavioural Assessment framework and feeding functionality was measured using a standardized sucking behaviour scale. Maternal satisfaction was assessed through a structured rating scale. Data analysis included descriptive statistics, t-tests, and chi-square tests.* ***Results****- This study showed that in experimental group, mean sucking response scores increased markedly from 9.88 ± 2.26 before intervention to 12.35 ± 2.15 after nesting (p-value<0.05), whereas no meaningful improvement was observed in the control group. Significant associations were observed between neonatal variables such as age, birth weight, and gestational age with post intervention feeding outcomes. Our study also showed 76.7% of mothers reported high satisfaction with the nesting intervention, with clinical obstetric variables including mode of delivery and antenatal visit frequency showing significant associations with satisfaction levels.* ***Conclusion:*** *this study showed that nursing guided nesting significantly enhances neurobehavioral organization and feeding functionality among neonates and is a feasible, cost effective, and family cantered intervention suitable for routine neonatal nursing practice.*

Keywords*- Nesting intervention; Neurobehavioral maturation; Feeding functionality; Neonates; Nursing-guided care; Sucking behaviour; Developmental supportive care*

Introduction

Neonates exposed to the extra uterine environment during the initial postnatal period show neurobehavioral maturation which represents a critical aspect of early life adaptation. The transition from the protected intrauterine milieu to the technologically intensive neonatal care setting often disrupts normal behavioural organization, postural alignment, and functional feeding patterns[1]. Preterm and early neonates are especially vulnerable to sensory overload, altered positioning, and repeated handling and that can adversely influence central nervous system organization and behavioural regulation. Neurobehavioral organization means all essential capabilities for effective

feeding like autonomic stability, motor control, behavioural state regulation, and interactive capacities[2,3].Disruption in these capabilities can cause feeding difficulties, poor state control, and delayed neurodevelopmental trajectories. Feeding functionality or sucking behaviour is also a neurological mediated activity, which require synchronized sensory motor integration and stable behavioural states[4].

Supportive care strategies for this phase of development have therefore gained prominence in neonatal nursing practices. This aims to recreate aspects of the intrauterine environment and minimize stress-induced deregulation. In between all these strategies, nesting is one of the simple, low cost and nurse-led intervention designed to promote flexed posture, midline orientation, and containment[5,6]. Nesting involves the use of soft boundaries to provide postural support, facilitating neuromuscular stability and reducing excessive motor activity, thereby supporting neurobehavioral organization[1].Empirical evidence suggests that nesting positively influences behavioural state organization and motor regulation among neonates. There are many studies which have demonstrated significant improvements in physiological activity, autonomic stability, alertness, and state regulation following the application of nesting interventions[5,7,8]. Nesting has also been shown a enhancement in comfort behaviour and reduce stressrelated responses which indicates its role in promoting adaptive behavioural patterns[9]. These findings support the theoretical framework of Als' Synactive Developmental Model, which emphasizes the interdependence of behavioural subsystems and the importance of supportive environmental modulation[10].Nursing personnel play a pivotal role in implementing developmental care practices within neonatal units. Evidence indicates that nurse-led interventions, including nesting, contribute significantly to improved neonatal outcomes by integrating physiological stability with neurobehavioral support[11,12]. Despite growing evidence supporting nesting as a developmental intervention, variability exists in its routine application, and limited studies have comprehensively examined its combined impact on neurobehavioral maturation and feeding functionality within an integrative analytical framework.

Our study assumes significance by systematically evaluating the modulatory effects of nursing-guided nesting interventions on neurobehavioral maturation and feeding functionalities among neonates. By integrating neurobehavioral outcomes with functional feeding measures and maternal perspectives, this study addresses a critical gap in neonatal nursing research. The findings are expected to provide evidence-based support for incorporating structured nesting interventions into routine neonatal care, thereby strengthening nursing-led developmental practices and promoting holistic neonatal outcomes.

Methodology

Study Design and Setting

This controlled pre–post interventional study was conducted at St. Antony's Hospital, Chennai, a tertiarylevel maternity, and new-born care centre providing firstlevel neonatal services. The study focused on evaluating the effects of a nursing-guided nesting intervention on neurobehavioral maturation and feeding functionalities among clinically stable neonates. Total 60 neonates were enrolled and allocated into experimental group with 30 neonates and remain 30 as control groups using simple random sampling.

Inclusion and Exclusion Criteria

Our study includedhealthy, full-term neonates aged 1-8 days, admitted to first level new-born care units. Neonates born through normal vaginal delivery or caesarean section with stable clinical status were considered eligible. Mothers who were willing to participate and able to understand the study procedures were included. We included neonates which were not receiving any specialised medical or supportive therapy was enrolled.

Neonates with congenital anomalies, low birth weight, preterm status, or systemic illness were excluded. Infants requiring oxygen therapy, phototherapy, mechanical ventilation, intravenous therapy, or admission to higher-level neonatal intensive care units were not included. Neonates with unstable vital signs or on-going medical complications were also excluded to ensure sample uniformity.

Nursing-Guided Nesting Intervention and Outcome

Neonates in the experimental group received a structured nursing-guided nesting intervention and aimed at providing developmental containment and postural support. A soft, oval-shaped nest was prepared using rolled cotton sheets resembling the intrauterine environment. Nesting was administered for 6 hours per day over two consecutive days, under continuous nursing supervision. The control group continued to receive routine new-born care without nesting**.** Neurobehavioral maturation was assessed through behavioural state organization. This included maternal satisfaction and feeding functionality. This functionality was evaluated using a standardized sucking behaviour scale assessing rooting, effective latching, sucking coordination, and satiety responses. Data were analysed using descriptive statistics, paired and independent *t*-tests, and chi-square tests to examine associations between variables. Statistical significance was set at $p< 0.05$. Ethical approval was obtained prior to the study, and written informed consent was secured from all participating mothers[11,13].

Result

Our study included a total of 60 neonates in which there were two groups as control (n = 30) and experimental (n = 30), as presented in **Table 1**. In the control group, the majority of mothers belonged to the 21–30 years age group (86.66%), whereas in the experimental group 76.66% of mothers were within the same age range, indicating a comparable maternal age distribution between groups. There were a small proportion of mothers in both groups which was below 20 years or above 30 years. This study showed that more than half of the neonates in both control and experimental groups were aged 0–2 days (53.34%), followed by neonates aged 3–5 days, suggesting early postnatal inclusion. Male neonates constituted a slightly higher proportion in both groups (56.7% in control and 60% in experimental). In gestational age, the majority of neonates were full term including 96.66% in control and 93.33% in experimental, which also reflected homogeneity in maturity status. Maternal illnesses such as hypertension and gestational diabetes mellitus were reported only in a limited number of cases. The ordinal position of the child revealed that first-born neonates formed the largest group in both control (60%) and experimental (50%) groups, indicating baseline similarity between groups prior to intervention **(Table 1)**.

Table 1: Distribution of neonatal and maternal baseline characteristics in control and experimental groups (N = 60)

Sample characteristics	Control Groups		Experimental Groups	
	N	P	N	P
Age of the mother (in years)				
< 20	01	3.34	06	20
21-30	26	86.66	23	76.66
31-40	03	10	01	3.34
Age of neonates (in days)				
0-2	16	53.34	16	53.34
3-5	11	36.66	12	40
6-8	03	10	02	6.66
Gender of neonates				
Male	17	56.70	18	60
Female	13	43.30	12	40
Gestational age at birth				
Pre term	01	3.34	01	3.34
Full term	29	96.66	28	93.33
Post term	-		01	3.33
Maternal illness during antenatal period				
Hypertension	2(6.67%)	6.67	04	13.33
Gestational diabetes mellitus	01	3.34	02	6.67
Anaemia	01	3.34	-	
Ordinal position of the child				

1st Child	18	60	15	50
2nd Child	10	33.3	11	36.7
3rd Child	2	6.7	4	13.3

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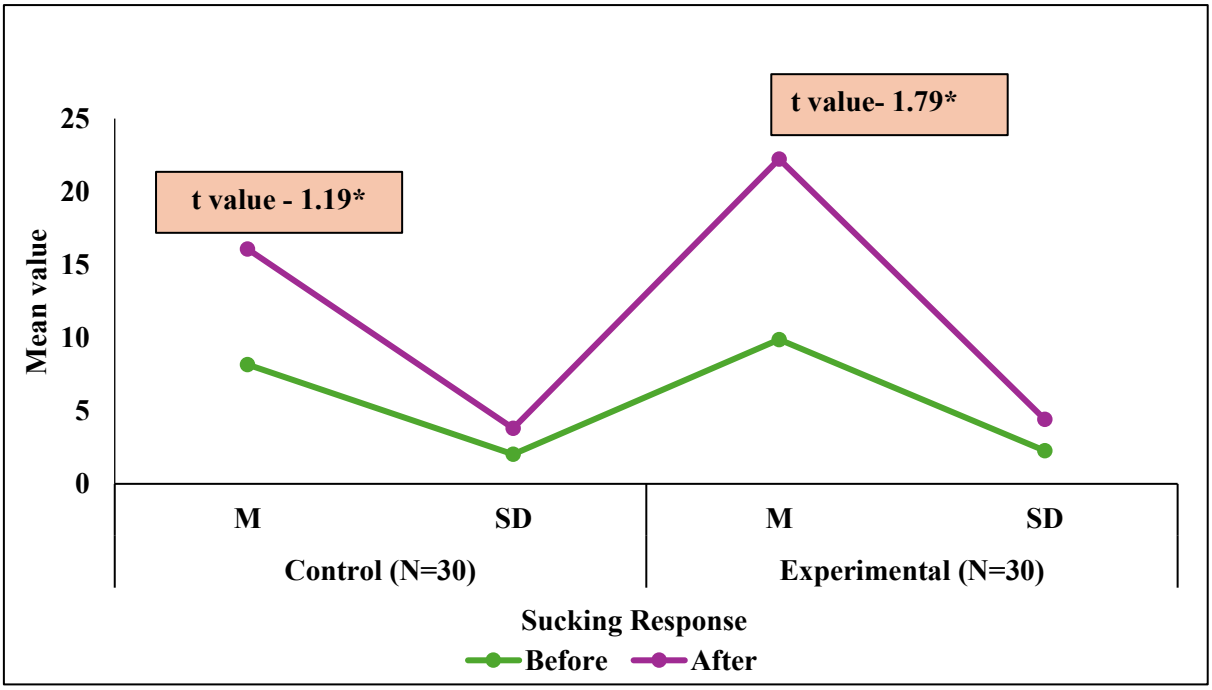
Our study showed clear improvement in sucking response among neonates in the experimental group following the nursingguided nesting intervention, as illustrated in **Figure 1**. The mean sucking response score increased from 9.88 ± 2.26 before intervention to 12.35 ± 2.15 after intervention. In contrast, the control group showed no improvement, with mean scores changing marginally from 8.16 ± 2.02 to 7.91 ± 1.78. This study indicates that the observed enhancement in sucking response was specific to the experimental group receiving nesting intervention, as reflected by higher post-intervention mean scores and corresponding t values.

Figure 2: Comparison of mean sucking response scores before and after nursing-guided nesting intervention among control and experimental groups.



***p-value<0.05**

Our study also examined the association between selected neonatal variables and sucking response before and after the nesting intervention, as summarized in **Table 2**. Prior to the intervention, sucking response showed no statistically significant association with neonatal age, birth weight, gestational age, or gender, indicating that baseline feeding performance was independent of these variables. This study further demonstrated that following the nesting intervention, an overall improvement in sucking response was observed across all categories of neonatal age and birth weight. Neonates aged 0–2 days showed

a higher proportion of moderate to successful feeding responses after intervention compared to pre-intervention observations. Similarly, neonates with birth weight above 2500 g and those born full term exhibited better post-intervention sucking outcomes than preterm and low-birth-weight neonates. Improvement in feeding response was evident in both male and female neonates, suggesting that the effect of nesting on feeding functionality was consistent irrespective of gender **(Table 2).**

Variables		Before administration Sucking response				After administration Sucking response		
		Poor feed	Moderate feed	Successful feed	X2	Moderate feed	Successful feed	X2
Age of the baby in days	0-2	1(3.3%)	8 (26.7%)	7 (23.3%)	1.27 (df=4)	9 (30%)	7(23.3%)	0.05 (df=2)
	3-5	0 (0%)	5(16.7%)	7 (23.3%)		7(23.3%)	5(16.7%)	
	6-8	0 (0%)	1 (3.3%)	1 (3.3%)		1(3.3%)	1(3.3%)	
Birth weight (gm)	< 2500	0(0%)	3 (10%)	2(6.6%)	3.90 (df=4)	3(10%)	2(6.6%)	4.15 (df=3)
	2501–3000	0(0%)	6(20%)	4 (13.33%)		8 (26.7%)	2(6.6%)	
	3001–3500	1(3.3%)	3(10%)	7(23.3%)		4(13.33%)	7(23.3%)	
	>3501	1(3.3%)	2 (6.6%)	2(6.6%)		2(6.6%)	2(6.6%)	
Term of the baby at birth.	Pre term	0(0%)	0(0%)	1(3.3%)	2.14 (df=4)	1(3.3%)	0(0%)	1.63 (df=3)
	Full term	1(3.3%)	13(43.3%)	14 (46.7%)		15 (50%)	13 (43.3%)	
	Post term	0(0%)	1(3.3%)	0(0%)		1(3.3%)	0(0%)	
Gender	Male	1(3.3%)	8(26.7%)	9(30 %)	0.71 (df= 2)	10(33.4%)	8(26.7%)	0.02 (df=1)
	Female	0(0%)	6(20%)	6(20%)		7(23.3%)	5(16.7%)	

Our study assessed maternal satisfaction with the nursing-guided nesting intervention and its association with selected clinical and obstetric variables, as shown in **Table 3.** A majority of mothers reported a high level of satisfaction with the nesting intervention, particularly those aged 21–30 years, where 56.7% expressed high satisfaction. Mothers who had more than five antenatal visits also demonstrated higher satisfaction levels compared to those with fewer visits. This study also revealed that maternal satisfaction varied with obstetric characteristics. Mothers with normal vaginal delivery reported higher satisfaction compared to those who underwent instrumental or caesarean delivery. First-time mothers expressed greater satisfaction than multiparous mothers, indicating better acceptance of the intervention among primiparous women. Additionally, mothers whose pregnancies were conceived naturally

showed higher satisfaction levels than those with treatment-induced conception. These findings highlight the acceptability and feasibility of nursing-guided nesting within routine neonatal care settings **(Table 3)**.

Variables	Level of satisfaction		
	Moderately satisfied	Highly satisfied	X2
Age of the mother in years			
>20	1 (3.3%)	5 (16.7%)	0.55 (df=2)
21-30	6 (20%)	17 (56.7%)	
31-40	-	1(3.3%)	
Ordinal position of the child's birth			
1st Child	3 (10%)	12(40%)	2.35 (df =2)
2nd Child	4 (13.3%)	7(23.3%)	
3rd Child	-	4(13.3%)	
Type of conception			
Normal	6 (20%)	21 (70%)	0.18 (df =1)
Treatment	1(3.3%)	2 (6.7)	
Mode of delivery			
Normal	3 (10%)	12 (40%)	3.40 (df =2)
Instrumental	1(3.3%)	-	
Cessarean	3 (10%)	11 (36.7%)	
No. of visit in the antenatal period			
<3	1(3.3%)	7 (23.3%)	2.24 (df=2)
3-5	1(3.3%)	7(23.3%)	
>5	5 (16.7%)	9 (30%)	

Discussions

Our study demonstrated a clear modulatory effect of nursing-guided nesting on neonatal feeding functionality and neurobehavioral organization. In the experimental group, the mean sucking response score increased from 9.88 ± 2.26 before intervention to 12.35 ± 2.15 after intervention, whereas the control group showed no improvement, with scores changing marginally from 8.16 ± 2.02 to 7.91 ± 1.78. This study further observed consistent improvement in feeding outcomes across neonatal age groups and birth-weight categories following nesting intervention. Additionally, behavioural state regulation and feeding efficiency were enhanced irrespective of neonatal gender. Our study also revealed a high level of maternal acceptance of the nesting intervention, with 76.7% of mothers reporting high satisfaction, particularly among those with adequate antenatal care. These findings collectively indicate that nursing-

guided nesting exerts a positive influence on neurobehavioral regulated feeding outcomes in neonates.

Our study demonstrated a significant improvement in neurobehavioral organization and feeding functionality among neonates following nursing-guided nesting intervention. Improvement in behavioural regulation and feeding performance observed in this study supports the concept that developmental positioning plays a critical role in early neonatal adaptation. A study by Ferrari et. Al., similarly reported enhanced postural organization and reduced motor disorganization among neonates placed in a nest, highlighting the neuromotor benefits of containment-based care[1]. Another study by Abu-Eleneen*et.al.*, also documented significant improvements in behavioural state regulation and alertness following nesting, which aligns closely with the neurobehavioral outcomes observed in our study[7]. This study further identified that feeding functionality, particularly sucking response, improved markedly following the nesting intervention. This finding is consistent with a study conducted by Reddy*et.al.*, which demonstrated enhanced sucking response and neurobehavioral activity among neonates receiving nesting and swaddling interventions[8]. Similarly, another study by Radzyminski*et.al.*, emphasized that feeding behaviour is neurobehavioral regulated and closely linked to state organization, supporting the improved feeding outcomes seen in our study[4]. A study by Das et.al., also reported better feeding tolerance and behavioural calmness among nested neonates, reinforcing the functional feeding benefits of developmental positioning[11].

Our study observed improved feeding outcomes across neonatal age groups and birth weight categories following nesting. This observation is supported by another study by El-Sayed*et.al.*, which reported improved neurobehavioral organization irrespective of gestational age following nesting intervention[5]. In contrast, a study by Nikam*et.al.*, primarily focused on physiological stabilization with nesting, suggesting that while physiological parameters improve, behavioural and feeding outcomes require structured neurodevelopmental assessment, as undertaken in our study[14]. This study highlights the role of posture and containment in facilitating neurobehavioral and feeding outcomes. A study by Sumathy*et.al.*, demonstrated improved flexed posture and reduced stress behaviours following nesting, while another study by Gill et.al., emphasized that supportive positioning enhances comfort behaviour and energy conservation[9,13]. These findings corroborate the improved postural stability and feeding efficiency observed in our study. Furthermore, a study by Hasanpour reported that developmental care interventions positively influence short-term behavioural outcomes, supporting the integrative benefits observed in this study[15].

Our study also underscores the importance of nursing-guided developmental care in neonatal units. Another study by Kleberg*et.al.*, reported improved behavioural recovery following nurse-led developmental

interventions, while a study by Buehler et.al., highlighted the effectiveness of individualized developmental care in supporting neonatal neurobehavioral[12,16]. These findings emphasize the critical role of nurses in implementing nesting interventions, consistent with the nursing-guided framework adopted in this study. A study published in Kaur*et.al.,*further supports nesting as a feasible nursing intervention within routine care settings, strengthening the practical relevance of our findings[17]. This study differs from a study by Mathai*et.al.,* which focused on tactile-kinaesthetic stimulation rather than nesting; however, both studies reported improved behavioural organization, indicating that sensory-motor modulation is central to neonatal neurodevelopment[2]. Unlike another study focusing solely on thermoregulationMarlia*et.al.*, our study integrated neurobehavioral and feeding outcomes, providing a broader developmental perspective[18].

Our study uniquely contributes to existing literature by simultaneously examining neurobehavioral maturation, feeding functionality, and maternal acceptability of nesting within a nursing-guided framework. While previous studies primarily focused on isolated physiological or behavioural parameters, this study provides an integrative analytical perspective, strengthening evidence for incorporating structured nesting interventions into routine neonatal nursing practice.

Ethical aspects: This study was approved by Institutional Ethical Committee of B.R.D Medical College, Gorakhpur, Uttar Pradesh, India

Conflict of interest: The authors have no conflicts of interest regarding this investigation**.**

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