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Effect of Facilitated Tucking and Gustatory Stimulation on Preterm Neonates' Physical Growth and Behavioral Regulation

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Abstract: Facilitated Tucking (FT) position as an innovative nursing approach and Gustatory Stimulation (GS) would mimic the feeling of being held within mother's hug. **Purpose:** To determine the effect of FT and GS on preterm neonates' physical growth and behavioral regulation. **Research Design:** A quasi experimental design was used. **Setting:** This study was conducted at the Neonatal Intensive Care Unit (NICU) of Abo Hommos Hospital for Children, Damanhour City, Al-Behira Governorate, Egypt. **Sampling:** A consecutive sample of 60 preterm neonates who achieved the inclusion criteria were equally allocated into intervention and control groups. **Instruments:** Three instruments were used. Instrument one: Preterm Neonates' Characteristics and Medical Data Assessment Record. Instrument two: Preterm Neonates' Physical Growth Indices Record. Instrument three: Preterm Neonate's Behavior Assessment Scale. **Results:** Neonates in the intervention group gained greater weight at the second and last assessments than neonates in the control one, with the final assessment showed a statistically significant difference (p= 0.003). The percentage of neonates in the intervention group who exhibit normal behavior are greater than neonates in the control one at the second and last assessments. **Conclusion:** Facilitated tucking and GS for preterm neonates was effective in improving weight gain, autonomic visceral neurophysiological responses and state regulation and attention- interaction. **Recommendation:** Facilitated tucking and GS should be incorporated into the care of premature infants in NICUs.

Key words: *Behavioral Regulation, Facilitated Tucking, Gustatory Stimulation, Physical Growth, Preterm Neonates.*

Introduction

Prematurity is a prominent reason of neonatal death, decreasing the mortality rate is considered among the valued aims of the United Nations' 2030 agenda. The World Health Organization (2018) stated that 15 million neonates are born before 37 weeks of pregnancy annually. Hence, they require unique care, advanced therapeutic interventions besides special nursing approaches to survive. Definitely, all survival modalities can be achieved in Neonatal Intensive Care Units (NICUs) (Muhe et al., 2019; Lan et al., 2018). Unfortunately, during their hospitalization, they are continuously exposed to painful procedures in addition to, several environmental stimuli as: odors, sounds and lights which may affect their behavioral states. This environment could delay the organization and maturation of their central nervous system (Muhe et al., 2019; Hockenberry & Wilson, 2017).

Organization reveals the neonate's capability to incorporate behavioral and physiological systems and dealing with the surrounding environment without interruption in his state or physiological response. According to the newborn behavioral organization and development synactive theory, organization occur via a continuous interaction of five interrelated subsystems including autonomic, motor, state and attention/interaction, and self-regulatory (Maltese et al., 2017; Halder et al., 2015).

It is well known that touch is the first way of communication between the neonate and his mother. It maintains the neonate's physiological and psychological regulations (Bigelow & Power, 2020). On the other side, the neonate is acquainted with his maternal scent as well as the odor and taste of her breast milk. In this regard, several evidence-based practices strongly supported the therapeutic effect of both tactile and gustatory stimulations among preterm neonates (Rhooms et al., 2019; Altimier & Phillips, 2016; Wigert et al., 2014). Therefore, using innovative nursing approaches that involve participation of the neonatal mothers in their care is crucial. One of the modern inventions is using mother scented simulated hand. Which is considered a virtual hand uses the effect of touch to mimic the feeling of being held within mother's hug. This maneuver improves the release of both serotonin and melatonin hormones that encourage neonatal relaxation and quietness (Ceylantekin et al., 2021; Yapicioğlu et al., 2021).

Repeated exposure to NICU environmental stimuli may cause permanent alterations in the neonatal brain regulation and perhaps lead to the occurrence of maladaptive behaviors (Schlatterer et al., 2022). According to Cignacco et al. (2012), Facilitated Tucking (FT) is a potential technique that contains advantages of touch and position. Throughout this position, the newborn is held with warm hands as a tactile and thermal stimulus. It helps the neonate to feel with postural security, promotes motor development, and conserves neonatal energy. Moreover, FT aids a neonate's ability to use his self-regulatory skills like bringing hands to mouth and grasping, so the neonate can better handle the surrounding stress (Joseph et al., 2020).

Unfortunately, premature newborns do not have the opportunity to experience the fundamental feeding-related cues and sensations, such as taste, smell, and hunger. Feeding is delivered through a nasogastric tube. This leads to bypassing the gustatory receptors and hindering cephalic response. The current researches revealed that the cephalic response has a great role in neonatal nutrition as; increase nutrient absorption, improve gut and stomach motility and release of metabolic and digestive hormones. All these factors lead to improve neonatal physical growth (Arafa et al., 2021; Medeiros et al., 2021; Bigelow & Power, 2020).

Neonatal nurses play a preemptive role in the newborn management. Therefore, they have to be prepared with inventive evidences in the neonates' care. The neonatal nurses should be aware with the most optimal nursing approaches which would improve the neonates' clinical outcomes (Lan et al., 2018). Researches addressing the adoption of modern techniques like mother scented simulated hand in NICUs are insufficient. Optimistically, the current research would use the effect of touch and tucking position in the form of simulated human hands with Gustatory Stimulation (GS) that could enhance the preterm neonates' behavioral regulation and physical growth in NICUs.

Purpose:

Determine the effect of facilitated tucking and gustatory stimulation on preterm neonates' physical growth and behavioral regulation.

Research Hypotheses:

1) Preterm neonates who receive facilitated tucking and gustatory stimulation exhibit more improved physical growth indices than those who do not.
2) Preterm neonates who receive facilitated tucking and gustatory stimulation exhibit more stable behavioral regulation than those who do not.

Operational Definitions:

Facilitated Tucking: The preterm is located in a side-lying, flexed fetal posture. This position continues for one hour twice/day for ten consecutive days. Two hands simulator is used to encircle preterms' body and provide a sense of containment.

Gustatory Stimulation: It refers to the stimulation of a preterm neonate's taste sense via putting a few drops of mother's breast milk on a preterm neonate's lips using a Sterile pacifier or syringe.

Method

Research Design

To carry out this study, a quasi-experimental research design was used (intervention and control groups).

Setting

The study was conducted in the NICU of Abo Hommos hospital for children (Demesna) at Al-Behira Governorate which is affiliated to the Ministry of Health and Population. The hospital contains 40 incubators in the third floor. The NICU is categorized into three levels which provide services for neonates in Al-Behira Governorate. Level I provides neonatal services which enhance feeding and growing. Level II deals with neonates who have health problems related to prematurity. While, critically ill neonates who require mechanical ventilation are treated in level III NICUs. The current study was carried out at level I NICU which contains 15 incubators.

Sampling:

The sample size was estimated using the Epi-Info program utilizing the following parameters:

- Population size of 105 preterm neonates (three months prior to collection of data)
- Confidence coefficient =97%.
- Expected frequency = 50%.
- Acceptable error =5%.
- The required minimum sample size was 52 preterm neonates.

A consecutive sampling of 60 preterm neonates who fit the following inclusion criteria were included:

- Postnatal age was 3 days.

(To permit full anesthesia effect alleviation if given to the mother during childbirth and allow for neonatal adjustment for the new surrounding as well as avoid neurodevelopmental maturation before study application).

- The range for gestational age was 32 to less than 37 weeks.
- Did not receive either analgesics or sedatives.
- Begin enteral feeding via orogastric tube.
- Free from neonatal sepsis and any congenital anomalies.
- The subjects were allocated into two groups namely; control and intervention groups. Each one composed of 30 preterm neonates. The control group received only the routine care for preterm neonates in NICU. While, those neonates in intervention group were subjected to the FT and GS intervention besides the NICU routine care (Figure 1).

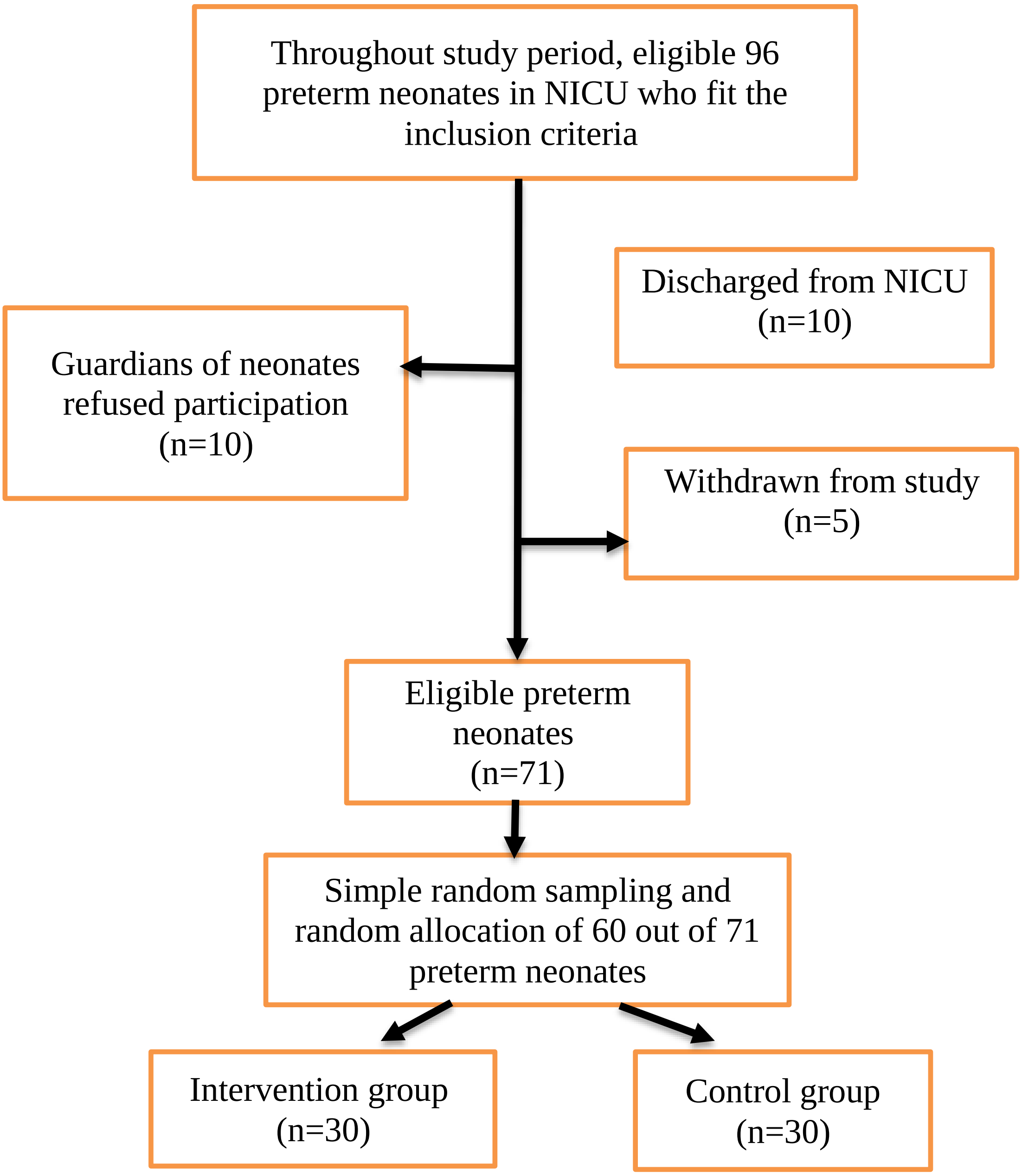

Figure-1: Flow chart of preterm neonates' recruitment process.

Three instruments were utilized to gather the essential data.

<u>Instrument one:</u> Preterm Neonates' Characteristics and Medical Data Assessment Record:
The instrument was created by the researchers following a thorough review of current and pertinent literature (Muhe et al., 2019; Hockenberry & Wilson, 2017). It contained two parts:

- Part one: Preterm Neonates' Characteristics such as postnatal age, gender and the current weight.
- Part two: Preterm Neonates' Medical Data such as gestational age, the current diagnosis and feeding method.

<u>Instrument two:</u> Preterm Neonates' Physical Growth Indices Record:
The researchers developed this instrument after a comprehensive revision of current and relevant literature (Medeiros et al., 2021;

Bigelow & Power, 2020). It involved the weight in kilograms, recumbent length as well as head circumference in centimeters.

<u>Instrument three:</u> Preterm Neonate's Behavior Assessment Scale (NBAS):

This scale was created by Als H et al. (1982) and was adopted by the researchers. The NBAS was used to evaluate the preterm neonates' behavior regulation in the NICU. It has two subsystems namely; autonomic/visceral and the state regulation and attention interaction. Autonomic/visceral subsystem involved respiration, color, visceral and neurophysiological responses. While, the state regulation and attention-interaction subsystem, consisted of state regulation, orientation to auditory stimulus and alertness. Content validity of the scale was 0.95 and the test-retest reliability (r) was 0.96 for autonomic/visceral subsystem and 0.92 for state regulation and attention-interaction subsystem revealing a valid and reliable scale for assessing the preterm neonates' behavior.

Scoring system:

Each of these items in the two subsystems was assessed using three-point likert scale. Each item ranged from 0–2.

The total score of autonomic/ visceral subsystem is the sum of its four items which is 8. The higher scores represent the more regulated preterm neonate's behavioral responses. A score of 5-8 denotes "normal behavioral response", a score of 2-4 indicates "suspected abnormal behavioral response". Whereas, a score ≤1 represents "definite abnormal behavioral response".

The total score of state regulation and attention-interaction subsystem is the sum of its three items which is 6. The higher the scores the more regulated behavior response the preterm neonate demonstrated. A score of 4-6 reflects "normal behavioral response" a score of 2-3 signifies "suspected abnormal behavioral response". Whereas, a score ≤1 represents "definite abnormal behavioral response". ``

Validity:

A jury of five experts (professors in pediatric nursing) evaluated the face validity of instruments one and two. No modification was required.

Reliability:

Reliability of instruments one and two was ascertained by quantifying the internal consistency of their items using Cronbach's Alpha coefficient test and the results were accepted as it yielded 0.85 and 0.86 for both tools respectively.

Pilot study:

A pilot study was conducted on 6 neonates (10% of sample size) to assess the research tools' feasibility, clarity, and applicability. No modification was done. Those neonates were omitted from the study sample.

Ethical considerations:

A permission to conduct the current study was obtained from the Research Ethics Committee of the Faculty of Nursing, Damanhour University. A written informed consent was obtained from neonates' parents after explaining the purpose of the study and method of data collection. Each parent was assured that they have the right to withdraw from the study at any time. Privacy of mothers was maintained. Confidentiality of the collected data was ascertained and participants' anonymity was assured.

Method:

1) An official letter from the Dean of the Faculty of Nursing, Damanhour University was directed to the director of the hospital (Demesna). The letter contained the study purpose and method of data collection.
2) In order to avoid subject contamination, data were first gathered from the preterm newborns in the control group who were given regular NICU care. Then, FT and GS were applied for the preterm neonates in the intervention group.
3) Collection of data was done during the morning and evening shifts. The preterm neonates' characteristics as well as medical data for both control and intervention groups were obtained from their records using instrument one.
4) Hand washing was performed by the researcher before data collection and before touching each preterm.
5) Disinfection of all utilized equipment was done with alcohol (scale, measuring meter and simulator).
6) For both groups, baseline assessment was done at 3rd day of life; physical growth indices (weight, length, and head circumferences) were measured using instrument two. Assessment of preterms' behaviors was conducted by the researchers using instrument three.
7) Preterm neonate's behavior assessment scale was applied as follows: The researchers assessed, evaluated, and scored the following items:
   - Preterm neonates' color and counted the respiratory rate per minute then documented its characteristics.
   - Visceral items were assessed through examining the existence of feeding intolerance via orogastric tube aspiration, observing gastro-oesophageal reflux and assessing the bowel movement by stethoscope.
   - Neurophysiological responses were assessed by provoking their reflexes like palmar grasp reflex: The researcher stroked the neonates' palms by his finger; which motivated the preterm neonate to grasp that finger.
   - The preterm neonates' state regulation was assessed by inspecting them during the stressful situation as heel lance.
   - For orientation to auditory stimulation: A gentle rattle was utilized to check the neonate response to auditory stimuli which were offered to every side of the neonates' ears and out of their sights.
   - Lastly, the preterm neonates' alertness was assessed via visual stimulation: The researchers used a red ball to check the preterm neonates' abilities to fix their eyes on an object and visually flow it horizontally.
8) For the intervention group:
   - The mothers were asked to wash their hands and breasts thoroughly. Then, they were instructed to squeeze their breasts in sterile bottles. The researchers put a few drops of fresh squeezed mothers' Breast Milk (BM) on preterms' lips if they were asleep or on their tongues if they were awake via sterile syringes or pacifiers. This stimulation was done for nearly 3-5 minutes twice / day along with FT for ten successive days.
   - The hands of the simulator were scented with the odor of the neonates' mothers after they were left inside the mothers' naked chest strictly for 10-15min. Then, the simulated hands were maintained under a radiant warmer for around

five minutes to achieve the mothers' distinctive warm touch. The preterm neonates were placed in a side-lying flexed position inside the incubator.

- Preterms were put in a C shape position using the two palms of the simulator. One of the hands of the simulator was cupped in order to be placed on the head of the preterm neonate while, the palm of the other gloved hand was also cupped and placed on the inferior part of the neonate's body and extremities. Such intervention was performed twice / day/ ten successive days (once in the morning shift and once in the evening shift after feeding).The preterm was left in this position for an hour as illustrated in Figure (2).

Figure 2. Preterm neonate in FT position with mother scented simulated hands.

9) For intervention group second assessment for preterms' behaviors and physical growth measurements were conducted on the tenth day of intervention (last day of intervention) and third assessment was conducted after another 10 days using the same data collection instruments.
10) For control group second assessment was conducted after 10 days of the baseline assessment and the third assessment was conducted after another 10 days.
11) The data were collected during a period of seven months (starting from March to the end of September 2022).

Data Analysis

Concerning data analysis, the Statistical Package for Social Sciences (SPSS) version (25) was utilized. Descriptive statistics which comprised of number, percentage, mean and standard deviation were used. Student t test was used as well as Chi-square and Fisher's Exact tests. A statistical significant difference was considered if $p \leq 0.05$ and a highly statistical significant difference was judged if $p \leq 0.001$.

Results:

The characteristics and medical data of preterm neonates in the intervention and control groups are illustrated in **Table 1.** It is portrayed that no statistical significant differences were found between preterms (gender, weight and medical data) at 5% level of statistical significance.

Table 2 highlights the weight, length and head circumference of preterms in intervention and control groups during the initial, second and last assessments. Regarding to neonates' weights, the current table revealed that mean weights of preterms were highly increased in the last assessment. Therefore, there was a statistical significant difference between both groups ($p = 0.003$).

Concerning the neonates' lengths, the differences were not statistically noteworthy between the two groups. Also, there were no statistical noteworthy differences between head circumferences of preterms in the intervention and control groups as well.

Table 3 shows the color, respiration, visceral and neurophysiological responses of preterms during the initial, second and last assessments. In relation to color, the last assessment clarified that 56.7% of preterms in the intervention group had pink color compared to 26.7% of them in the control group. Hence, there was a statistical substantial difference between both groups at the last assessment (p=0.040).

Regarding neonates' respiration, no statistical significant differences were found among neonates in the intervention and control groups during the three assessments.

For preterms visceral reactions, the final assessment disclosed that 90.0% of the newborns in the intervention group showed nil gastro-oesophageal reflux in comparison with only 30.0% of preterms in the control group. So, there were highly statistically substantial differences between preterms in the two groups at the final assessment (p=0.001).

In respect to the neonates' neurophysiological responses, the final assessment displayed that 86.7% of the newborns in the intervention group showed stable responses oppositely to 40.0% of preterms in the control group. For this reason, there was a highly statistical significant difference between both groups during the final assessment (p= 0.001).

Table 4 clarifies regulation status, orientation of auditory stimulation and alertness of preterms during the initial, second and last assessments. Regarding to the preterm state regulation, at the last assessment 70.0% of the preterms in the intervention group were awake alert compared to only 23.3% of preterms in the control one. A highly statistical significant difference was discovered between the two groups in the last assessment (p=0.001).

Concerning the neonates' orientation of auditory stimulation, at the last assessment the newborns in the intervention group revealed more reactions to auditory stimulation as two thirds of them focused on stimulus and followed it using smooth continuous head movements contradicted to 20.0% of preterms in the control group. Thus, there was a highly statistical significant difference between the intervention and control groups at the final assessment (p=0.001).

The same table presents that at the last assessment, preterms in the intervention group were more alert in the second and last assessments. That's why, there were statistical and highly statistical significant differences in the second and the last assessments consequently among preterms (p= 0.034 and 0.001 respectively).

Table 5 and figure 3 clarify distribution of preterms according to their autonomic visceral behavioral responses during the initial, second and last assessments. During the second assessment, more than half of the preterm newborns (53.3%) in the intervention group had "normal behavioral response" compared to only 26.7% of preterm neonates in the control group. Furthermore, at the last assessment, 80.0% of the preterm newborns in the intervention group in contrast with 53.3% of the preterm newborns in the control group demonstrated "normal behavioral response". Therefore, there was a statistical significant difference between preterms in the last assessment (p=0.028).

Table 6 and figure 4 portray distribution of preterms according to their regulation status and attention interaction during the initial, second and last assessments. Preterms in the intervention group showed improved behavioral responses than preterms in the control group during the second and last assessments. For this reason, there was a statistical significant differences between them in the second assessment (p=0.019).

Table 1: Characteristics and Medical Data of Preterm Neonates in the Intervention and Control Groups

Characteristics and Medical Data	Study group (n=30)		Control group (n=30)		Test of Significance
	No.	%	No.	%	
Characteristics					
Gender					
• Male.	25	83.3	24	80.0	X^2= 1.000
• Female.	5	16.7	6	20.0	*P*= 0.500
Current Weight / grams					
• 1000 –	11	36.7	12	40.0	F^{ET}=0.120
• 2000 -<3000	19	63.3	18	60.0	*P*= 0.060
Mean ± SD	1899 ± 6.85		1886 ± 5.99		
Medical Data					
Gestational age/ Weeks					
• Moderately preterm (32 - < 34 weeks).	2	6.7	3	10.0	F^{ET}=0.023
• Late preterm (34 -< 37 weeks).	28	93.3	27	90.0	*P*= 1.000
Mean ± SD	35.87 ± 1.551		35.72 ± 1.672		
Current Diagnosis					
• Respiratory Distress Syndrome. • Congenital Pneumonia. • Hyperbilirubinemia.	12 9 9	40.0 30.0 30.0	15 8 7	50.0 26.7 23.3	X2= 0.642 P= 0.725
Method of Feeding					
• Oral	4	13.3	4	13.3	---------------
• Orogastric Tube.	26	86.7	26	86.7	

X^2 = Chi Square Test F^{ET} = Fisher's Exact Test *Significant at $p \leq 0.05$
p: p value of Chi Square test/ Fisher's Exact Test *Highly Significant at $p \leq 0.001$

Table 2: The Weight, Length and Head Circumference of Preterms in Intervention and Control Groups during the Initial, Second and Last Assessments.

Physical Growth Indices	Baseline data (Initial assessment)		Second assessment (at 10 th day)		Last assessment (at 20 th day)	
	Intervention group (n=30)	Control group (n=30)	Intervention group (n=30)	Control group (n=30)	Intervention group (n=30)	Control group (n=30)
Weight (kg) Mean ± SD	1.18±0.09	1.19±0.13	1.13±0.61	1.11±0.88	1.29±0.10	1.21±0.10
Test of significance	t = 0.42, *P*= 0.673		t = 0.77, *P*= 0.443		**t = 3.1, *P*= 0.003***	
Length (cm) Mean ± SD	38.73±1.56	38.51±1.59	39.56±1.46	39.29±1.57	40.36±1.35	39.87±1.53
Test of significance	t = 0.55, *P*= 0.585		t = 0.69, *P*= 0.493		t = 1.3, *P*= 0.188	
Head Circumference (cm) Mean ± SD	27.66±1.33	27.84±1.10	28.56±1.21	28.52±1.04	29.59±1.24	29.23±1.2
Test of significance	t = 0.56, *P*= 0.567		t = 0.15, *P*= 0.882		t = 1.1, *P*= 0.258	

t= Student t Test *p: p* value of Student t Test *Significant at $p \leq 0.05$
*Highly Significant at $p \leq 0.001$

Table 3: Color, Respiration, Visceral and Neurophysiological Responses of Preterms during the Initial, Second and Last Assessments.

Autonomic /Visceral Subsystem Domains	Baseline data (Initial assessment)				Second assessment (at 10 th day)				Last assessment (at 20 th day)			
	Intervention group (n=30)		Control Group (n=30)		Intervention Group (n=30)		Control group (n=30)		Intervention group (n=30)		Control group (n=30)	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Color												
Pale/cyanotic.	11	36.7	12	40.0	1	3.3	2	6.7	1	3.3	2	6.7
Pink but changes rapidly with slow recovery, not returning to good color	19	63.3	18	60.0	21	70.0	24	80.0	12	40.0	20	66.7
Pink.	0	0.0	0	0.0	8	26.7	4	13.3	17	56.7	8	26.7
Test of significance	X^2 = 0.071, *P*= 0.791				F^{ET} = 1.900, *P*= 0.490				**F^{ET} = 5.576, *P*= 0.040***			
Respiration												
Gasping, frequent apnea, unstable respiratory rate	5	16.7	7	23.3	4	13.3	8	26.7	0	0.0	0	0.0
Occasional apnea, unstablerespiratory rate	25	83.3	23	76.7	22	73.4	21	70.0	10	33.3	11	36.7
Regular, stable respiratory rate.	0	0.0	0	0.0	4	13.3	1	3.3	20	66.7	19	63.3
Test of significance	X^2 = 0.417, *P*= 0.519				F^{ET} = 2.968, *P*= 0.220				X^2 = 0.073, *P*= 0.787			
Visceral												
Vomits feed, feed intolerance.	15	50.0	10	33.3	0	0.0	0	0.0	0	0.0	1	3.3
Bowel movement grunt and Strain	15	50.0	20	66.7	19	63.3	24	80.0	3	10.0	20	66.7
Gastro-oesophageal refluxNil	0	0.0	0	0.0	11	36.7	6	20.0	27	90.0	9	30.0
Test of significance	X^2 = 1.714, *P*= 0.190				X^2 = 2.052, *P*= 0.152				**F^{ET} = 23.416, *P*= 0.001***			
Neurophysiological responses												
Flaccid in stimulation	13	43.3	13	43.3	2	6.7	1	3.3	0	0.0	0	0.0
Abnormal jerks, Twitch	17	56.7	17	56.7	23	76.7	25	83.3	4	13.3	18	60.0
Stable	0	0.0	0	0.0	5	16.7	4	13.3	26	86.7	12	40.0
Test of significance	-------------------------				F^{ET} = 0.650, *P*= 0.794				**X^2 = 14.067, *P*= 0.001***			

X^2 = Chi Square test F^{ET} = Fisher's Exact Test *Significant at $P \leq 0.05$

p: p value of Chi Square test/ Fisher's Exact Test *Highly Significant at $p \leq 0.001$

Table 4: Regulation Status, Orientation of Auditory Stimulation and Alertness of Preterms during the Initial, Second and Last Assessments.

State regulation and Attention-Interaction Subsystem Domains	Baseline data (Initial assessment)				Second assessment (at 10 th day)				Last assessment (at 20 th day)			
	Intervention group (n=30)		Control group (n=30)		Intervention group (n=30)		Control group (n=30)		Intervention group (n=30)		Control group (n=30)	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Regulation status												
Intense crying which is rhythmic with irregular breathing.	10	33.3	11	36.7	3	10.0	8	26.7	1	3.3	3	10.0
Active awake state with infant fussing but not crying but stressed and hyper alert.	20	66.7	19	63.3	21	70.0	21	70.0	8	26.7	20	66.7
Awake alert.	0	0.0	0	0.0	6	20.0	1	3.3	21	70.0	7	23.3
Test of significance	$X^2 = 0.073$, $P = 0.787$				$F^{ET} = 5.606$, $P = 0.064$				**$F^{ET} = 13.123$, $P = 0.001$***			
Orientation of Auditory Stimulation												
Does not focus on or follow stimulus.	30	100	30	100	7	23.3	15	50.0	0	0.0	0	0.0
Brightness with stimulus, may focus and follow briefly with jerky eye movements	0	0.0	0	0.0	22	73.3	14	46.7	10	33.3	24	80.0
Focuses on stimulus and follows with smooth continuous head movement	0	0.0	0	0.0	1	3.3	1	3.3	20	66.7	6	20.0
Test of significance	--------------				$F^{ET} = 4.852$, $P = 0.080$				**$X^2 = 13.303$, $P = 0.001$***			
Alertness												
Rarely or never responsive to direct stimulation	19	63.3	17	56.7	5	16.7	12	40.0	1	3.3	1	3.3
When alert, responsivity brief and variable, may be delayed	11	36.7	13	43.3	21	70.0	18	60.0	10	33.3	23	76.7
Always alert in best periods, stimulation always elicits alerting and orientating	0	0.0	0	0.0	4	13.3	0	0.0	19	63.3	6	20.0
Test of significance	$X^2 = 0.278$, $P = 0.598$				**$F^{ET} = 6.758$, $P = 0.034$***				**$F^{ET} = 12.164$, $P = 0.001$***			

X^2 = Chi Square test F^{ET} = Fisher's Exact Test   *Significant at $P \leq 0.05$

p: p value of Chi Square test/ Fisher's Exact Test   *Highly Significant at $p \leq 0.001$

Table 5: Distribution of Preterms according to their Autonomic Visceral Behavioral Responses during the Initial, Second and Last Assessments.

Total Percent Score of Autonomic /Visceral Subsystem	Baseline data (Initial assessment)				Second assessment (at 10 th day)				Last assessment (at 20 th day)			
	Intervention group (n=30)		Control group (n=30)		Intervention group (n=30)		Control group (n=30)		Intervention group (n=30)		Control group (n=30)	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Normal behavioral response **(5-8)**.	3	10.0	3	10.0	16	53.3	8	26.7	24	80.0	16	53.3
Suspected abnormal behavioral response **(2-4)**.	22	73.3	23	76.7	13	43.3	19	63.3	6	20.0	14	46.7
Definite abnormal behavioralresponse **(≤1)**.	5	16.7	4	13.3	1	3.3	3	10.0	0	0.0	0	0.0
Mean ± S.D	2.8 ± 0.55		2.6 ± 0.91		4.3 ± 0.66		3.7 ± 0.80		6.6 ± 0.13		5.3±0.71	
Test of significance	F^{ET} = 0.263, P= 1.000				F^{ET} = 4.664, P= 0.102				**X^2 = 4.800, P= 0.028***			

X^2 = Chi Square test F^{ET} = Fisher's Exact Test *Significant at $P \leq 0.05$

p: *p* value of Chi Square test/ Fisher's Exact Test *Highly Significant at $p \leq 0.001$

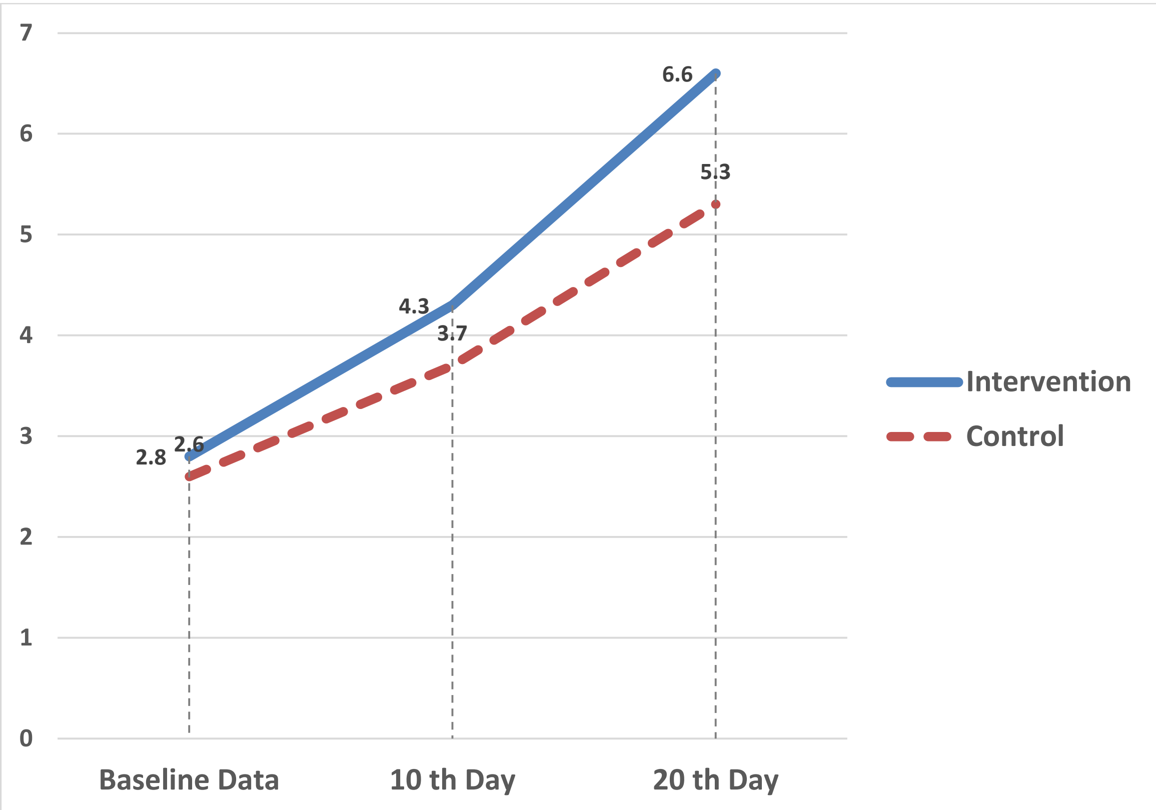

Figure 3: Distribution of Preterms according to their Autonomic Visceral Behavioral Responses during the Initial, Second and Last Assessments.

Table 6: Distribution of Preterms according to their Regulation Status and Attention Interaction during the Initial, Second and Last Assessments.

Total Percent Score of State regulation and Attention- Interaction Subsystem	Baseline data (Initial assessment)				Second assessment (at 10 th day)				Last assessment (at 20 th day)			
	Intervention group (n=30)		Control group (n=30)		Intervention group (n=30)		Control group (n=30)		Intervention group (n=30)		Control group (n=30)	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Normal behavioral response **(4-6)**.	2	6.7	2	6.7	6	20.0	3	10.0	19	63.3	11	36.7
Suspected abnormal behavioral response **(2-3)**.	7	23.3	7	23.3	21	70.0	15	50.0	11	36.7	18	60.0
Definite abnormal behavioral response **(≤1)**.	21	70.0	21	70.0	3	10.0	12	40.0	0	0.0	1	3.3
Mean ± S.D	1.3 ± 0.58		1.3 ± 0.71		2.5±0.54		1.9 ±0.88		4.4 ± 0.11		3.5 ± 0.32	
	--------------				**F^{ET} = 7.343, *P*= 0.019***				F^{ET} = 4.695, *P*= 0.070			

FET: Fisher's Exact Test *p: p* value of Fisher's Exact Test *Significant at P ≤ 0.05 *Highly Significant at *p* ≤ 0.001

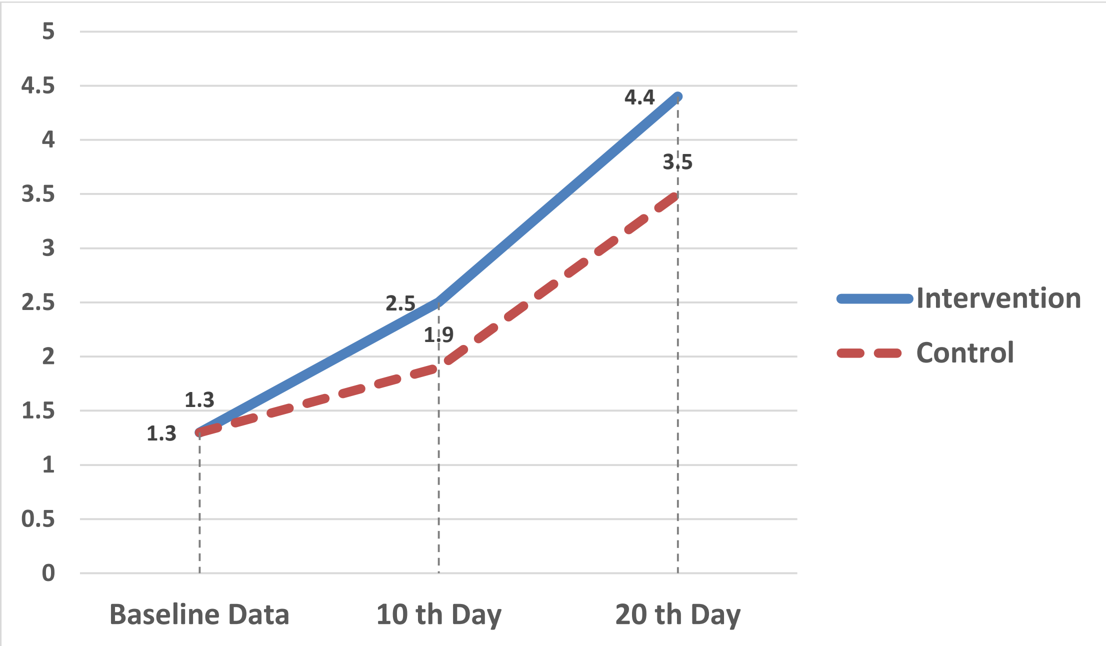

Figure 4: Distribution of Preterms according to their Regulation Status and Attention Interaction during the Initial, Second and Last Assessments

Discussion:

Birth of preterm neonates is associated with many complications. So, hospitalization and close health monitoring are necessary for these premature infants (Hockenberry & Wilson, 2017).

Parental physical closeness to the neonate during hospitalization in NICU is crucial for the promotion of his well-being (Flacking et al., 2012).

The essential determinant of neonatal health is gaining weight steadily (Vilanova et al., 2019). In this frame, the finding of the present study illustrated that the mean weight of preterm in the intervention group at the second and last assessments increased more than those in the control group. It could be justified by that the applied intervention may generate calmness and ease sleep that consecutively stimulates secretion of growth hormone and improves neonates' body weight. This finding was similar to the result of Lee & Lee (2018) and Sarapuk et al. (2017) who found that the body weight of the group who received a similar nursing intervention was higher than preterms in the control group (did not receive the designed intervention).

The enhanced body weight among neonates in the intervention group in the current study could be also related to the fact that smell of mothers' odor and GS using mothers' BM were strong stimulators of neonatal metabolism and digestion which could assist the absorption of feeds and promote weight gain (Muelbert et al., 2021). This result was in harmony with Beker et al. (2017) who declared in a Randomized Controlled Trial (RCT) that taste and smell of milk enhanced preterm neonates' weight. In the contrary, Beker et al. (2021) elaborated in a RCT that taste and smell of milk concomitant with the tube feeding did not increase weight of preterm neonates at discharge.

The results of the present study also showed that the percentage of neonates in intervention group who exhibited normal behavior were greater than those in the control group in the last assessment (autonomic /visceral subsystem) and in the second assessment that was related to regulation status and attention-interaction subsystem. Furthermore, preterms' alertness improved in the second and last assessments. These findings could be attributed to the fact that FT position calmed down the autonomic nervous system response and decreased hormonal markers for stress such as cortisol and epinephrine (Grunau & Linhares, 2014). Facilitated tucking position could also ease regulatory behaviors of neonates like sucking hands to deal with stress which help to ease self-control. The results of the current study were consistent with Halder et al. (2015) and Grenier et al. (2015) who revealed that alterations in preterm neonates' position could have a helpful effect on their behavior regulation. An analogous result was illustrated by Rubin Selvarani (2016) who concluded that FT could enhance infants' regulatory systems. Moreover, using mimic mothers' touch besides GS could promote neonates' sleep cycles, regulate the sleep cycle and improve interaction with the surrounding environment. This result was corroborated by Mohammed (2018) who mentioned that nearly two thirds of neonates who were exposed to FT were active sleeper; their eyes were closed and had facial movements. In this context, Welch (2016) affirmed that calming cycle theory recommended that emotionally closeness of neonate with his mother would help in the adjustment to the surroundings.

The findings of the present study reflected that the percentage of preterm neonates who exhibited pink color in the intervention group were more than those in the control especially at the last assessment. This could be attributed to the fact of sensory stimulation via simulated hands could have increased the flow of blood to the neonates' brain and body tissue and stimulated blood circulation (Parsa et al., 2018). Similarly, Salmani et al. (2017) appraised the impact of FT using simulated hands that significantly enhanced physiological parameters like oxygen saturation and respiratory rate among intervention group. A study by Parsa et al. (2018) established that the percentage of preterm infants who exhibited pink color in the study group was greater than those in the control group.

The current study demonstrated that freshly expressed BM as gustatory stimulus elicited motor responses among preterm neonates. It helped almost three quarters of the neonates in the intervention group to be awake and alert compared to only one quarter of preterms in the control group at the last assessment. In addition to the majority of neonates in the intervention group did not develop gastro-oesophageal reflux compared to around one third in the control one during the last assessment. It could be due to the fact that olfactory stimulation associated with their mothers' expressed BM may improve the gustatory effect of BM through increasing salivation, peristaltic movements, digestive enzymes secretion and the release of digestion hormones as insulin and gastrin which could enrich enteral feeding tolerance (Muelbert et al., 2021). The finding of the present study was congruent with Lin et al. (2022) who concluded that BM provided nutrition besides reduced the bio behavioral stress that may occur for the neonates in the NICU.

CONCLUSION:

The present study concluded that the initiation of FT and GS for preterm neonates was effective in improving weight gain, autonomic visceral neurophysiological responses and state regulation and attention- interaction in preterm neonates.

RECOMMENDATIONS:

Based on the current study results, the following recommendations are suggested:

1) Facilitated tucking and GS as a developmental supportive care for preterm neonates should be incorporated into the care of premature infants in NICUs.
2) Collaboration and continuing education for all health care providers in the NICUs about neurodevelopmental supportive care are required to improve the quality of care provided for preterm neonates.
3) Proper in-service training program for neonatal nurses about developmental supportive care approach is mandatory to update their knowledge and improve their performance.
4) Simplified booklet or CD about FT using simulated hands and its application should be available for nurses in NICU and mothers' of premature neonates.

REFERENCES

Als, H., Lester, B. M., Tronick, E. Z., & Brazelton, T. B. (1982). Toward a research instrument for the assessment of preterm infants' behavior (APIB). In Theory and research in behavioral pediatrics (pp. 35-132). Springer, Boston, MA.

Altimier, L., & Phillips, R. (2016). The neonatal integrative developmental care model: advanced clinical applications of the seven core measures for neuroprotective family-centered developmental care. Newborn and Infant Nursing Reviews, 16(4), 230-244. https://doi.org/10.1053/j.nainr.2016.09.030.

Arafa, N. M., Radwan, R. I. M., & Mohammed, A. A. A. (2021). Effect of olfactory and gustatory stimulations on preterm neonates' feeding progression and sniffing away feeding tube. Egyptian Journal of Health Care, 12(4), 1681-1699.doi:10.21608/ejhc.2021.227154.

Beker, F., Liley, H. G., Hughes, I. P., Jacobs, S. E., Macey, J., Twitchell, E., & Davis, P. G. (2021). Effects on growth of smell and taste of milk during tube feeding of preterm infants: A randomized clinical trial. JAMA Pediatrics, 175(11), 1115- 1123. doi: 10.1001/jamapediatrics.2021.2336.

Beker, F., Opie, G., Noble, E., Jiang, Y., & Bloomfield, F. H. (2017). Smell and taste to improve nutrition in very preterm infants: A randomized controlled pilot trial. Neonatology, 111(3), 260-266.https://doi.org/10.1159/000450883

Bigelow, A. E., & Power, M. (2020). Mother–infant skin-to-skin contact: short-and long-term effects for mothers and their children born full-term. Frontiers in Psychology, 11, 1921. https://doi.org/10.3389/fpsyg.2020.01921.

Ceylantekin, Y., Duman, N. B., Ocalan, D., Topuz, S., & Ucar, B. Y. (2021). Mother's hand tool as a skin-to-skin contact simulation instrument decreases pain levels in newborns. Universa Medicina, 40(2), 87-95.https://doi.org/10.18051/UnivMed.2021.v40.90-98 Universa Medicina.

Cignacco, E., Sellam, G., Stoffel, L., Gerull, R., Nelle, M., Anand, K. J., & Engberg, S. (2012). Oral sucrose and facilitated tucking for repeated pain relief in preterm. Pediatrics, 129(2), 299-308. http://dx.doi.org/10.1542/peds.2011-1879.

Flacking, R., Lehtonen, L., Thomson, G., Dykes, F., Axlein, A., Ahlqvist-Bjorkroth, S., Hall Moran, V. Ewald, U., Ewald, F. (2012). Closeness and separation in neonatal intensive care. Acta Paediatrica, 101(10),1032-1037.doi: 10.1111/j.1651-2227.2012.02787.x

Grenier, I. R., Bigsby, R., Vergara, E. R., & Lester, B. M. (2015). Comparison of motor self-regulatory and stress. The American Journal of Occupational Therapy, 57, 289-297.

Grunau, R., & Linhares, M. (2014). Effect of multisensory stimulation on analgesia in preterm neo-nates. Pediatrics, 13(8), 460-463.

Halder, P., Bera, D., & Banerjee, A. (2015). Developmentally supportive care in neonatal intensive care unit (NICU): A review. Indian Journal of Medical Research and Pharmaceutical Sciences, 2(2), 17-23.

Hockenberry, M., & Wilson, D. (2017). Wong's essential of pediatric nursing (10th ed.). Mosby.

Joseph, M., Sasi, R. K., & Michael, A. (2020). Effect of facilitated tucking on physiological and behavioural responses to pain among infants receiving vaccination. Indian Journal of Forensic Medicine & Toxicology, 14(4), 7189-7193.

Lan, H. Y., Yang, L., Hsieh, K. H., Yin, T., Chang, Y. C., & Liaw, J. J. (2018). Effects of a supportive care bundle on sleep variables of preterm infants during hospitalization. Research in Nursing & Health, 41(3), 281-291.

Lee, E.J., & Lee, S.Y. (2018). The effects of early-stage neurodevelopmental treatment on the growth of premature infants in neonatal intensive care unit. Journal of Exercise Rehabilitation,14(3), 523-529.doi: 10.12965/jer.1836214.107

Lin, C. H., Liaw, J. J., Chen, Y. T., Yin, T., Yang, L., & Lan, H. Y. (2022). Efficacy of breast milk olfactory and gustatory interventions on neonates' biobehavioral responses to pain during heel prick procedures. International Journal of Environmental Research and Public Health, 19(3), 1240. doi: 10.3390/ijerph19031240.

Maltese, A., Gallai, B., Marotta, R. O. S. A., Lavano, F., Lavano, S. M., Tripi, G. A. B. R. I. E. L. E., ... & Salerno, M. (2017). The Synactive theory of development: the keyword for neurodevelopmental disorders. Acta Medica Mediterranea, 33(2), 1257-1263.

Medeiros, A. M. C., Nascimento Santi, V. D., Santos, F. B., Sá, T. P. L. D., Barreto, Í. D. C., Aquino, L. R. D., ... & Gurgel, R. Q. (2021). Effects of gustatory stimulation on oral readiness and behavioral states of newborns. Audiology-Communication Research, 26. https://doi.org/10.1590/2317-6431-2020-2413.

Mohammed, A.A.A. (2018). Effect of facilitated tucking versus swaddling positions on orogastric tube insertion pain among preterm neonates. IOSR Journal of Nursing and Health Science (IOSR-JNHS), 7(5), 75-86.

Muelbert , M., Bloomfield, F., Pundir, S., Harding, J., & Pook, C. (2021). Olfactory cues in infant feeds: volatile profiles of different milks fed to preterm infants. Frontiers in Nutrition Journal, 7. https://doi.org/10.3389/fnut.2020.603090.

Muhe, L. M., McClure, E. M., Nigussie, A. K., Mekasha, A., Worku, B., Worku, A., ... & Goldenberg, R. L. (2019). Major causes of death in preterm infants in selected hospitals in Ethiopia (SIP): A prospective, cross-sectional, observational study. The Lancet Global Health, 7(8), e1130-e1138.

Parsa, P., Karimi, S., Basiri, B., & Roshanaei, G. (2018).The effect of kangaroo mother care on physiological parameters of premature infants in Hamadan City, Iran. Pan African Medical Journal, 30(89),1-7. doi:10.11604/pamj.2018.30.89.14428.

Rhooms, L., Dow, K., Brandon, C., Zhao, G., & Fucile, S. (2019). Effect of unimodal and multimodal sensorimotor interventions on oral feeding outcomes in preterm infants: An evidence-based systematic review. Advances in Neonatal Care, 19(1), E3-E20.doi: 10.1097/ANC.0000000000000546.

Rubin Selvarani, G. (2016). Effectiveness of facilitated tucking on level of pain among preterm infants undergoing painful procedure at selected hospitals, Chennai, 2015 (Doctoral dissertation, Omayal Achi College of Nursing, Chennai).

Salmani, N., Dehghani, K., & Sadeghnia, A. (2017). Effect of facilitated tucking created with simulated hands on physiological pain indicators during venipuncture in premature infants. Iranian Journal of Neonatology IJN, 8(4), 7-12.

Sarapuk, I., Pavlyshyn, H., Lacina, L., & Królak-Olejnik B. (2017).Neurodevelopmental care of preterm babies and its key elements. International Journal of Medicine and Medical Research, 3(1), 26-33. doi 10.11603/IJMMR.2413-6077.2017.1.7063.

Schlatterer, S. D., Govindan, R. B., Barnett, S. D., Al-Shargabi, T., Reich, D. A., Iyer, S., ... & Mulkey, S. B. (2022). Autonomic development in preterm infants is associated with morbidity of prematurity. Pediatric Research, 91(1), 171-177.

Vilanova, C. S., Hirakata, V. N., de Souza Buriol, V. C., Nunes, M., Goldani, M. Z., & da Silva, C. H. (2019). The relationship between the different low birth weight strata of newborns with infant mortality and the influence of the main health determinants in the extreme south of Brazil. Population Health Metrics, 17(1),1-12. Available at: https://pophealthmetrics.biomedcentral.com/articles/10.1186/s12963-019-0195-7

Welch, M. G. (2016). Calming cycle theory: the role of visceral/autonomic learning in early mother and infant/child behaviour and development. Acta Paediatrica, 105(11), 1266-1274. doi: 10.1111/apa.13547.

Wigert, H., Dellenmark Blom, M., & Bry, K. (2014). Parents' experiences of communication with neonatal intensive-care unit staff: An interview study. BMC Pediatrics, 14(1), 1-8.

World Health Organization. (2018). Survive and thrive: transforming care for every small and sick newborn: key findings (No. WHO/FWC/MCA/18.11). Retrieved from: https://apps.who.int/iris/bitstream/handle/10665/276655/WHO-FWC-MCA-18.11-eng.pdf.(Accessed on December 18th, 2021).

Yapicioğlu, H., Barutçu, A., Gülcü, Ü., Ferda, Ö. Z. L. Ü., & LEVENTELİ, M. (2021). Effect of supportive positioning on Comfort scale scores in preterm newborns. Duzce Medical Journal, 23(1), 20-24. https://doi.org/10.18678/dtfd.833534.