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Effect of pre-feeding sensorimotor stimulation on preterm infants' Outcomes

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Abstract: **Background:** Preterm infants are more susceptible to develop feeding difficulties, and attaining independent oral feeding is a necessary condition for hospital discharge. The objective of the research was to assess the effect of sensorimotor stimulation on preterm infants' outcomes. A quasi-experimental research design was applied. **Sample:** A convenience sampling of 60 preterm infants. **Setting:** Four neonatal intensive care units included in the study's implementation in Assiut City, Egypt. **Tools:** Three tools were employed to obtain the required data: Preterm infant data, a premature oral feeding readiness assessment scale, and a feeding progression protocol. **Method:** 10% of preterm infants were involved in the pilot study to assess the sheet's applicability and clarity. **Results:** The results showed significant differences between the sensorimotor stimulation group and the control group regarding feeding readiness, transition time to oral feeding, and duration of hospital stay. **Conclusion:** Sensorimotor stimulation hastened transition to full oral feeding and diminished hospital stay duration. **Recommendations:** Sensorimotor stimulation should become a crucial part of basic nursing care offered in NICUs to preterm infants

Keywords: Feeding, Oral motor stimulation, Tactile kinesthetic stimulation, Preterm infants

Introduction

Worldwide, about 130 million neonates are born every year; 13.5 million are born preterm. A preterm infant is any baby born before the completion of 37 full weeks of pregnancy; this period is estimated from the first day of the last menstrual cycle to the date of birth [1]. Preterm infants often have gastrointestinal, cardiovascular, neurological, and cognitive systems that are still developing and typically result in long-term problems such as feeding and nutritional disorders [2].

The incidence of neonatal morbidity and mortality represented country's economic condition in addition to the standard and efficacy of its health care facilities. In Assiut University Children Hospital in Upper Egypt, about 56.8% of the neonatal critical care unit admissions were preterm [3].

About 80% of preterm infants during their stay in a neonatal intensive care unit (NICU), are expected to have trouble with oral feeding. [4]. Coordinating an infant's ability to breathe, swallow, and suckle is necessary for the development of oral feeding skills. Typically, this coordination is developed during breast and bottle feeding. Independent oral feeding is one of the criteria for discharge from hospital in accordance to the American Academy of Pediatrics [5].

Pre-feeding sensorimotor stimulation is considered one of the most widely used methods of stimulation. These therapies have demonstrated benefits for the development of full oral feeding skills, improving oral feeding abilities, and shortening hospitalization [6]. Oral-motor stimulation defined as sensory stimulation of the lips, jaw, tongue, soft palate, and throat. In order to strengthen and enhance the functions of the perioral tissues, it stimulates muscle contraction and movement against resistance [7].

Tactile kinesthetic stimulation (TKS) is a type of therapy that involves touch. It is made up of a low-cost, non-invasive method that is safe for preterm infants [8]. There are three phases in TKS: one kinesthetic phase and two tactile phases. Every phase lasts for five minutes. It acts by stimulating sensory receptors in the skin, muscles, bones, and joints [9].

Neonatal nurses have crucial role in assisting preterm infants in receiving adequate nutrition and have a smooth and safe transition to oral feeding. Their main role is helping preterm infants transition to oral feeding, and in order to attain this, they must be able to assess the infants' willingness for oral feeding and provide evidence-based protocols and interventions [10].

Significance of the study

Oral feeding is a complicated and dynamic process in preterm infants it requires an interaction between the oral-motor, neurological, cardio-respiratory, and gastrointestinal systems. Oral feeding challenges affect between 30%- 40 % of preterm infants during this time [11]. If preterm infants able to feed orally well, they can fulfill their needs through the mouth and tolerate oral feeding, they might get out from the hospital sooner. There for, sensorimotor interventions could be applied for all stable preterm infants admitted to NICUs to improve their feeding skills [12].

Research hypothesis:

Preterm infants who will receive sensorimotor stimulation are expected to have early feeding readiness, faster feeding progression, and less duration of hospital stay than those in the control group.

Operational definitions:

Sensorimotor stimulation is defined in this study as oral motor stimulation and tactile kinesthetic stimulation.

Oral motor stimulation is defined in this study as manipulation of the lips, jaw, tongue, and soft palate before feeding with non-nutritive sucking (NNS) to enhance a preterm infant's ability to suck.

Tactile kinesthetic stimulation is defined in this study as moderate-pressure stroking of the body and passive movements of the large joints of the limbs.

Preterm infants' outcomes are defined in this study as feeding readiness, progression, and length of hospital stay.

2. Patients and Method

Research design:

A quasi-experimental research design was utilized in this study.

Setting:

The study was carried out in four Neonatal Intensive Care Units at "Assiut University Children Hospital," which is affiliated with the Ministry of Higher Education and Scientific Research. "Gynecology, Obstetrics, and Children Hospital, Assiut General Hospital, and El-Eman Hospital" are affiliated with the Ministry of Health in Assiut, Egypt.

Subjects: convenience sampling of 60 preterm infants in the previous chosen settings, the sample was calculated by using power analysis according to the population flow at confidence interval of 99.9% with a precision level of 5% and $p \leq 0.05$. Sample calculated by using the following formula:

Sample size $n = [DEFF * Np(1-p)] / [(d^2 / Z^2_{1-\alpha/2} * (N-1) + p*(1-p)]$; **N:** population size; **P:** population; **D:** confidence limits as % of 100 (absolute +/- %); and **DEFF:** design effect (for cluster surveys).

Inclusion criteria:

Preterm infants were included according to the following criteria:

1. Preterm infants born between 30-34 weeks.
2. Clinically stable preterm infants.
3. Both sexes.

Exclusion criteria;

Preterm infants were excluded according to the following criteria:

1. Congenital anomalies.
2. Severe systemic diseases such as sepsis or necrotizing enterocolitis (NEC).
3. Brain injury (including intra-ventricular hemorrhage).
4. Major surgery and invasive mechanical ventilation

Tools of data collection:

To obtain the necessary data for this study, three tools were utilized:

Tool I: Preterm infant's data:

It was designed by the researchers in order to get the necessary data and involved gender, postnatal age, gestational age at birth, birth weight, and APGR score at the 1st and 5th minutes.

Tool (II): Premature oral feeding readiness assessment scale (POFRAS):

The premature oral feeding readiness assessment scale is the unique tool that evaluates all aspects of oral-motor abilities in preterm infants before feeding. It was designed by Fujinaga et al. (2007) [13]. It evaluates the state of readiness of preterm infants for oral feeding and has eighteen items. The scale has a maximum score of 36 and a range of 0 to 2. Scores less than 28, between 28 and 30, and greater than 30 indicate non-nutritive finger sucking, vigorous finger sucking, and willingness for oral feeding, respectively [14-15]. The aspects of this scale include corrected gestational age, behavioral organization, oral posture, oral reflexes, nonnutritive sucking, and stress signs. Its reliability was assessed according to previous studies ($r=0.933$; $p=0.0001$) [16].

Tool II: Infant feeding progression protocol:

Lessen, 2011 developed this protocol which estimated the feeding progression from the day oral feedings began until the day full oral feedings were attained and contained six phases [17].

Intervention:

In this study, the intervention group received 15-minute oral motor stimulation and tactile kinesthetic stimulation once every other day for 12 consecutive days. The premature oral feeding readiness assessment scale was employed on the first day of the intervention, four days later, and at time of discharge to assess the oral motor skill of both groups. The stimulation applied to preterm infants half hour before feeding to reduce the possibility of aspiration, when preterm infants were in quiet awake state.

Group (I): Oral motor stimulation and tactile kinesthetic stimulation (T/K):

- Oral motor stimulation: According to the procedure established by Fucile et al. 2002, preterm infants given 12 minute perioral and intraoral stimulation (movement of the tongue, cheek and jaw) and non-nutritive sucking for three minutes. It was altered as follows: in the final maneuver, the researcher stimulated sucking by using the little finger rather than a pacifier to prevent pacifier from hindering with the initiation of sucking at the breast [18].
- Tactile kinesthetic stimulation (T/K) involved of five minutes passive range of motion to the limbs and 10 minutes stroking of the head, neck, back, arms, and legs, following the procedure described by Field

et al. 2010. The researcher used vaseline to reduce the risk of friction between the preterm infants' skin[19].

- **Group (II):** The preterm infants in the control group did not receive any intervention other than the standard care provided by the unit.

Ethical Considerations

- The local Ethical Committee in the Faculty of Nursing at Assiut University, Egypt, was approved the research proposal by (IRB: 1120240418).
- After informing parents of the study's purpose and the confidentiality of the data collected, parents gave written consent for participation of their preterm infants in the research.

Statistical analysis:

The statistical package for social science, SPSS version 22, was used for both data entry and analysis. The frequency, percentage, mean, and standard deviation of the data were displayed. To compare different qualitative variables, the chi-square test was employed. To compare quantitative variables between two groups, the t-test was employed. A P-value of 0.05 was declared statistically significant.

3. Results:

Table (1): Personal and clinical data of the studied preterm infants (n= 60).

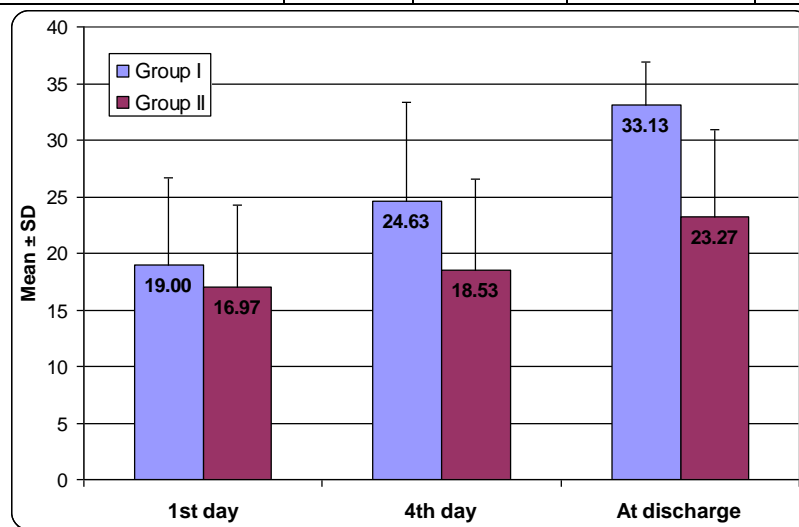
Personal & clinical data	Intervention group (n= 30)		Control Group (n= 30)		Total (n= 60)		P-value
	No.	%	No.	%	No.	%	
Gender:							
Male	11	36.7%	16	53.3%	27	45%	0.194
Female	19	63.3%	14	46.7%	33	55%	
Age (days):							
Mean ± SD	5.3 ± 3.9		4.3 ± 3.2		4.8±3.5		0.404
Gestational age at birth (weeks):							
Mean ± SD	33 ± 1.3		33 ± 1.4		33± 1.4		0.769
Birth weight gm:							
Mean ± SD	1490.7 ±326.2		1472.3 ± 477.7		1481± 402		0.863
APGR score at 1st minute:							
Mean ± SD	5.7 ± 1.6		5.2 ± 1.9		5.6±1.8		0.272
APGR score at 5th minute:							
Mean ± SD	8.4 ± 1.5		7.8 ± 1.8		8.1 ± 1.7		0.143

Intervention group: sensorimotor stimulation

Chi- square test

t-test

Readiness to oral feeding	Intervention group (n= 30)		Control group (n= 30)		P-value
	No.	%	No.	%	
1st day:					
No readiness	25	83.3%	26	86.7%	0.543
Strong sucking	2	6.7%	3	10.0%	
Readiness for oral feeding	3	10.0%	1	3.3%	
4th day:					
No readiness	16	53.3%	24	80.0%	0.012*
Strong sucking	1	3.3%	3	10.0%	
Readiness for oral feeding	13	43.3%	3	10.0%	
At discharge:					
No readiness	2	6.7%	21	70.0%	0.000*
Strong sucking	2	6.7%	2	6.7%	
Readiness for oral feeding	26	86.7%	7	23.3%	



Group I: sensorimotor stimulation

Group II: control

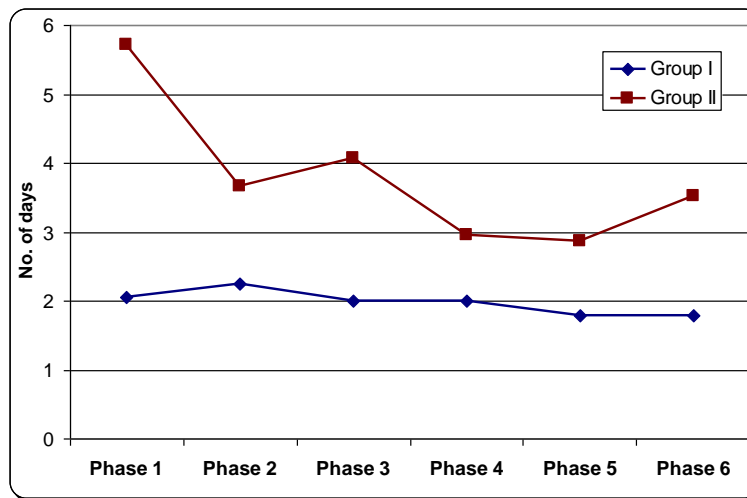
Figure (1): The scores of premature oral feeding readiness assessment scale in the intervention and control groups

Table (2): Distribution of studied preterm infants' regarding to their readiness to oral feeding (n=60).

(*) Statistical significant difference (p-value <0.05)

Intervention group: sensorimotor stimulation

Chi- square test



Group I: sensorimotor stimulation

Group II: control

Figure (2): Feeding progression in the intervention and control groups

Table (3): Mean \pm SD of the studied preterm infants according to outcomes (n=60).

infants' outcomes	Intervention group (n= 30)	Control group (n= 30)	P-value
Age at beginning oral feeding (days):			
Mean \pm SD	8.9 \pm 6.2	10.1 \pm 7.5	0.672
Age at total oral feeding(days):			
Mean \pm SD	13.1 \pm 7.6	22.3 \pm 15.6	0.027*
Transition time (days):			
Mean \pm SD	4.8 \pm 3.2	14 \pm 11.6	0.000*
Length of hospital stay (days):			
Mean \pm SD	12.8 \pm 7.7	26 \pm 17.5	0.002*

Intervention group: sensorimotor stimulation

(*) Statistical significant difference (p-value <0.05) t-test

The Personal and clinical data of studied preterm infants in the intervention and control groups are shown in **Table 1**, and there were no statistically significant differences between the groups in terms of their baseline data which indicated that they were matched. It was found that 55% of preterm infants were females; the mean \pm SD of their postnatal age, gestational age and birth weight were 4.8 \pm 3.5 days, 33 \pm 1.4 weeks and 1481 \pm 402 gm, respectively. Also, it was noticed that the mean \pm SD of the Apgar score at the 1st minute and at the 5th minute was 5.6 \pm 1.8 and 8.1 \pm 1.7, respectively.

Figure (1): The total mean score of the premature oral feeding readiness assessment scale at the 4th day of intervention and at the time of discharge in the intervention group was (24.63 and 33.13), respectively, compared to the control group (18.53 and 23.27), respectively.

Table (2): There was no statistically significant difference between preterm infants in intervention and control groups concerning to their readiness for oral feeding on the 1st day of intervention. But statistically significant differences were observed between them at the 4th day of intervention and at the time of discharge (P-value = 0.012* and 0.000*) respectively. Preterm infants who received the sensorimotor stimulation progressed faster across six phases of the feeding progression protocol than controls, as presented in **Figure (2)**.

Table (3): shows no statistically significant difference between preterm infants in the intervention and control groups according to age at the beginning of oral feeding (P-value = 0.672), but statistically significant differences were found between them related to age at total oral feeding, transition time, and length of hospital stay (P-value = 0.027*, 0.000*, and 0.002*) respectively.

Discussion:

The current study proved that sensorimotor stimulation is linked to an earlier start to oral feeding and a faster transition period between introduction and fully total oral feeding; also there is improvement in POFRAS score. The results of this study consistent with other research findings that feeding performance in the intervention group is markedly enhanced by pre-feeding sensorimotor stimulation.

These results are in accordance with Mahmoodi et al. in their study about the effect of oral motor intervention on oral feeding readiness and feeding progression in preterm infants. They concluded that the intervention group's mean time of oral feeding initiation was 9.55 ± 1.70 days, whereas the control group's had it at 11.5 ± 2.77 days. However, there was no statistically significant difference between the two groups [15].

Sensorimotor stimulation has been shown to significantly reduce the time required for complete oral feeding, according to the study's findings. These results were consistent with the results of other studies, for instance, Gutiérrez et al., who conducted a study about the effectiveness of 2 interventions for independent oral feeding in preterm infants and found that the combined interventions of "tactile, kinesthetic, and oral motor stimulation" achieved totally oral feeding earlier than those in the control group [20]. This might be viewed as sensorimotor procedures being useful and appropriate for improving oral feeding readiness and oral feeding success.

Also, these results are in contrast with Govindarajan et al who conducted a study about the effects of combined modalities of pre-feeding stimulation on feeding progression, length of stay, and weight gain in early preterm babies. They noticed that there was no statistically significant difference in the transition time to full-volume oral feeding between the intervention and control groups [21].

In this context, the results of the current study indicated once POFRAS scores increased oral feeding readiness and success consequently increased. These results were confirmed by the study conducted by Çamur & Çetinkaya, who carried out a study about the effect of sensorimotor interventions on feeding readiness and oral feeding success in preterm infants. They reported that the differences in T-POFRAS scores between the intervention and control groups were shown to be statistically significant differ 10 days after sensorimotor intervention compared to the control group [16].

In addition, preterm infants who were exposed to the sensorimotor stimulation throughout had oral feeding success and their feeding progression better than the preterm infants in the control group, these results in the same line with Shokri et al, who found that premature infant oral motor intervention (PIMO) combined with music therapy have a positive effect on the feeding progression of preterm infants [22]

As the intervention accelerates the time to totally independent oral feeding, consequently, preterm infants get out hospital earlier, Like similar studies of sensorimotor stimulation, Rodovanski et al., who carried out a study on the effects of multisensory stimulation on the length of hospital stay and weight gain in hospitalized preterm infants, concluded that routine care alone is not as effective at reducing hospital stays as multisensory stimulation [23].

Also, the current study result was in contrast with Gowda et al. who conducted study about multimodal sensory stimulation among very low-birth-weight preterm newborns, they found that the mean hospitalization duration was longer in the multimodal sensory stimulation group compared to the control group [24].

The research hypothesis is accepted, whereas the sensorimotor stimulation group achieved feeding readiness earlier, had a faster transition time, and had a less hospital stay than those in the control group.

Conclusion:

Sensorimotor stimulation enhancing feeding readiness, smoother transition to full oral feeding, and decreasing the duration of hospital stay. In this context, it is important to include sensorimotor stimulation for caring of preterm infants and to implement it by nurses in NICU.

Conflicts of Interest

No conflicts of interest exist.

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