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Effect of Oral Stimulation and Non-Nutritive Sucking Program on Feeding Readiness of Preterm Infants

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Abstract

Postpartum **The aim of this study** was to assess the effect of oral stimulation and non-nutritive sucking program on: The feeding readiness (sucking and feeding ability) of preterm infants, the behavioral states of preterm infants, and the feeding-related physiological changes of preterm infants. **A quasi experimental (intervention)** study design was utilized to achieve the aim of this study. **The study was conducted at** NICU in Benha University Hospital, and NICUs at Benha Specialized Pediatric Hospital affiliated to Ministry of Health. Sample consists of 52 preterm infant. **The tools** of data collection were a structured interviewing questionnaire sheet for the preterm infant, and preterm infant oral feeding readiness assessment scale. **The results** revealed that, there were statistical significant differences between pre and post application of oral stimulation and non-nutritive sucking program for preterm infants regarding their readiness to oral feeding. It was **concluded** from the study that applying oral stimulation and non-nutritive sucking program had a positive effect on enhancing sucking and feeding readiness of preterm infants, in addition, improving the oral feeding performance. The study **recommended** that emphasizing the importance of applying oral stimulation and non-nutritive sucking program, on feeding readiness and transition to gavage and oral feeding, which is effective and safe non-invasive intervention in all NICUs as a standard of care for all preterm infants.

Key words: Oral stimulation; Non-nutritive Sucking, Feeding Readiness, and Preterm infant

Introduction

Preterm neonates are defined as neonates born alive before 37 weeks of gestation. There are sub-categories of preterm birth, based on gestational age; extremely preterm (<28 weeks), very preterm (28 to <32 weeks) and moderate to late preterm (32 to <37 weeks). ***(Blencowe et al., 2013).***Preterm birth is one of the most common causes of neonatal mortality as every year an estimated 15 million newborn are born preterm in the world, and this number is rising. Over one million newborn die annually from preterm birth complications. Many survivors face a lifetime of disability, including learning disabilities and visual and hearing problems ***(World Health Organization, 2016).***

Sucking is vital in the early development of the infant whether it involves breast or bottle feeding. It is essential for the means of receiving nutrition, of providing stability in distress and also a means of exploring the environment. Successful and effective feeding is an energetic activity that is described as being complex, requiring the coordination of a suck-swallow-breathe

cycle. There is also evidence that a stable swallow rhythm appears to be established earlier than a suck rhythm. In the preterm infants, the suck-swallow- breathe sequence is rarely well coordinated before 34 weeks of gestation. Preterm infants often require approximately 20 postnatal days to achieve a maximal suck rate and their suck-swallow patterns are immature, displaying a dys-rhythmic pattern, although individual variation is recognized within this population ***(Gewolb et al., 2001)***.

Oral feeding is a complex task for preterm infants. The majority of infants born prematurely are not able to begin feeding from bottle or breast immediately after birth due to low muscle tone, immature oral-motor control, and poor coordination of suck, swallow, and breathing***(Rogers and Arvedson, 2005).*** Preterm infants generally need a period of full gavage feeding and then initiate oral feeding. So, the preterm infant may begin to feed from a bottle, and the remained amount of milk is administered by tube. This transition period of alternating tube and bottle feeding can sometimes be lengthy***(Pickler et al., 2009).***

Non-nutritive sucking (NNS) has been used as an intervention to facilitate transition from enteral to oral feeding and modulate neonatal state behaviors through its pacifying effects of reducing infant fussiness and crying during feeds ***(Boiron 2007).*** NNS help preterm infants to tolerate their feeds more easily by stimulating digestive juices during tube feeds. It also helps calm and soothe babies during painful procedures, decreasing their stress response and results in a shorter hospital stay (***Harding, 2009 and Boyle, 2011).***

Safe and efficient oral feeding in full term infants necessitates the coordination of sucking, swallowing, and breathing. Nutritive sucking is described as the intake of fluid from either the alternation of suction and expression or expression only. Suction is the negative intraoral pressure generated by lowering the tongue and jaw, and closure of the naso-pharynx to draw milk out. Expression is the stripping/ compression of the nipple between the tongue and the hard palate to eject milk.The majority of oral feeding strategies are aimed at improving oral feeding performance by enhancing sucking skills. However, few studies have investigated the direct benefits of these interventions on the components of sucking of preterm infants***(Lau et al., 2003)***.

Oral feeding readiness of preterm infants is a complex and multifactorial concept that is encountered on a daily basis**.**Oral feeding readiness can be defined both in terms of readiness to initiate oral feedings and readiness for any particular oral feeding event. It is affected by neurodevelopmental maturity, behavioral state organization, physiologic stability, and it both directly and indirectly influenced by caregivers and the nursery environment***(Kish, 2013)***

Inadequately trained nurses are the major risks for providing an effective nursing care to preterm neonates. So nurses need continuous education and training to improve their performance. Education and training are potential means for implementing effective nursing care at Neonatal Intensive Care Unit (NICU), as they alter perception, increase knowledge, and in turn change work practice. This education is provided by experienced nurses and other medical professionals who have qualified or experienced for educational tasks ***(Needleman et al., 2008).***

Significance of the study:

The preterm infants are losses the calm environment of the uterus which is full of sensory stimulations required for their growth and development, where these preterm infants are placed in the NICUs. This place may have full of noise, light, and stress. Whereas, impairment in growth and

development at early infancycan have permanent impacts on the future health of the preterm infants. So oral stimulation and non-nutritive suckingprogram provided by the researchers to the preterm infants to help them for sucking and feeding and enhancing their oral feeding readiness which subsequently enhancing their growth and development ***(Waldemar et al., 2011 and Islami et al., 2012).***

Aim of the study

The aim of this study was to evaluate the effect of oral stimulation and non-nutritive sucking program on the feeding readiness of preterm infants through:

- Assessing sucking and feeding ability of preterm infants
- Assess the behavioral states of preterm infants, and
- Assessfeeding-related physiological changes of preterm infants.

Research hypothesis:

Oral stimulation and non-nutritive sucking programwill enhancefeeding readiness of preterm infants.

SUBJECTS AND METHOD

Research design

An experimental research design was utilized in the current study.

Settings:

This study was conducted at the NICU (consisted of 6 incubators, each one attached with monitor, suction, air and oxygen outlets) in Benha University hospital, and NICUs at Benha specialized pediatric hospital (consisted of 2 rooms, the first room included 6 incubators, the second room included 22 incubators, and each incubator attached with monitor, suction, air and oxygen outlets) in affiliated to ministry of health and population(Secretariat of specialized medical centers) where these hospitals being of highest capacity of preterm infants.

Sampling:

A- Sample size: 52 preterm infants.

B- Sample type: all Available preterm infantsthrough 6 monthsof data collection,who fulfilling the inclusion criteria.

C- Inclusion Criteria:

- Preterm infants less than 37 weeks of gestation and weight less than 2500grams.
- Male and female
- Infants with weak or absent sucking
- Free from any congenital anomalies

Tools of data collection:

Two tools were utilized to collect data of the current study.

Tool 1:

A structured interviewing questionnaire sheet:it designed by the researchers in the light of relevant studies and researches. It composed of two parts:

Part one:personal data of the preterm infant, as: gestational age, gender, birth weight, weight on starting program, weight at the end of the program (weight on discharge).

Part two: Feeding-related physiological changes of preterm infants: it used to assess the infant's color, oxygen saturation, heart rate, and respiratory

ratebefore and after implementation of oral stimulation and non-nutritive sucking program. These data were obtained by the researchers through their observations and monitoring of these infants.

Tool 2:

Preterm infant oral feeding readiness assessment scale: it adopted from***Fujinaga et al., 2007.***This scale was used to assess the preterm infants' readiness to oral feeding, **(pre/post applying oral stimulation and non-nutritive sucking program)** for the study sample. It contains the following items (18 items): gestational age, behavioral organization (behavioral state, global posture and tonus), oral posture (lips and tongue), oral reflexes (rooting, sucking, and gag) and nonnutritive sucking (tongue movement, tongue cupping, jaw movement, sucking strain, sucking and pause, maintenance of rhythm of sucking and pause, maintenance of state of alertness and stress signs). Stress signs as; saliva accumulation; nose wings trembling; color changes; apnea; tonus variation; posture variation; tongue or jaw tremors; hiccupping; and crying. Each item was scored from (0-2), whereas, score (0) zero was determined when there was no reaction from the preterm infants and score (1) one was determined when there was a moderate reaction from the preterm infants, while score (2) two indicates there was good reaction from preterm infants.Maximum score for this scale was 36 (2x18).

Validity and reliability of study tools:

The researchers reviewed the past, current regional and international related literature covering all aspects of the study using textbooks, articles, journal, websites and scientific magazines. This helped the researchers to be acquainted with the research problem and guided them in developing the study tools. To measure content validity of the study tools, the researchers assure that items of the tools were adequately represent what are supposed to measure by presented it to three experts including neonatologist and pediatric nursing, in faculty of nursing Ain Shams and BenhaUniversity and faculty of medicine Benha university, for review and validation. Then the researchers performed two separate assessments at two different times; these two data sets from the same researchers and then compared with each other. Test and retest method was used to determine the reliability of the tool, and the reliability score was 0.86.

Administrative Design:

An official permission for data collection was obtained from the hospitals managers and head of NICUs in the previously mentioned study settings through submission of official letters issued from the dean of Benha faculty of nursing. The title, objectives, and outcomes of the study were illustrated as well as the main data items to be covered, and the study was carried out after gaining the necessary permission. The study was carried out during the period from the beginning of January 2015 (for pilot study) and from the beginning of February 2015 to the end of July 2015 (for implementation of the program).

Ethical and legal considerations:

- The aim and the expected outcomes of the study were explained to NICUs managers and each mother of preterm infant and before applying the tools to gain their confidence and trust.
- An oral consent was obtained from each mother of preterm infant before applying oral stimulation therapy and non-nutritive sucking for their preterm infants.
- The study was conducted in safe places for the preterm infants.

- Data were collected and treated confidentially.

- Each motherof preterm infant included in the current study, has the right to withdraw at any time of the study.

Pilot study:

A pilot study was carried out on 10% of the total sample size (approximately5 preterm infants) over a period of one month (January 2015) to test feasibility, objectivity, and applicability of the study tools. Carrying out the pilot study gave the researchers experience to deal with the included subjects, and the data collection tools.Based on the results of the pilot study the necessary modifications were done through adding or omission of unneeded and pilot study subjects were not included from the actual study sample.

The field work:

The field work was performed from the beginning of February 2015 to the end of July 2015to collect data. The researchers were available all over the days per week in feeding times only (Saturday to Friday) in the morning and afternoon shifts by rotation in different study settings. The numbers of preterm infants receiving oral stimulation and non-nutritive sucking program/week were ranged from 4-5for studied preterm infants. The study tools were filled out by the researchers and the average times required for completion of each tool was around 15-25 minutes. The same researcher was appliedoral stimulation and non-nutritive sucking program every time for the same specified preterm infant.

Procedure of the study:

- Sampling was started and completed within 6 months.

- Purpose and expected outcomes of the study were simply explained to mothers of studied preterm infants prior to any data collection.

- The researchers started to collect data using the pre - constructed tools.

- The same tools for data collection were used pre and post program.

- Preterm infants were assessed for gestational age, diagnosis, birth weight, and date of birth from the neonates' medical record.

- **Feeding-related physiological changesof preterm infants** were also assessed by the researchers(pre/post applying oral stimulation and non-nutritive sucking program), it included; the infant's color, oxygen saturation, heart rate, and respiratory rate.

- To start oral stimulation and non-nutritive sucking program, placing the preterm infant gently and comfortably in prone position inside the incubator.

- The first researcher stimulated the preterm infant to wake up, using auditory, visual and tactile stimuli.

- The second researcher assessed behavioral organization, oral posture and presence of oral rooting and vomiting reflexes.

- The first researcher simultaneously observed preterm infant's behaviors. The second researcher assess preterm infants' stress signs as; saliva accumulation; nose wings trembling; color changes; apnea; tonus variation; posture variation; tongue or jaw tremors; hiccupping; and crying.

Applying oral stimulation and non-nutritive sucking program: by the researchers for studied preterm infants:

Oral Stimulation Program and non-nutritive sucking:

Each oral stimulation session consisted of 5minutes. The program included two forms of oral stimulation: three minutes of manual peri- and intraoral stimulation followed by two minutes of sucking on a pacifier through the following technique:

- Placing the preterm infant gently and comfortably in prone position or flexed lateral decubitus position of the lower and upper limbs and aligned head inside the incubator.

- Rubbing the researchers' hands to warm it up.

- Starting the oral stimulation by gently talking and speaking to the preterm infant in a calm tone.

Perioral Stimulation was done as the follow:

- **For cheeks**: gently tap the cheeks with the index finger eight for each cheek. (Stroke the cheek with the index finger from the base of the nose toward the ear, and then return back to the corner of the lips, (eight strokes for each cheek). Repeat on the other side.

- **For lips**: Place the index and the middle fingers on the middle of upper lip (lower lip) and quickly, but gently, stretch outward (eight stretch for each lip). Gently stroke the area around the lips in a circular way, from the corner toward the center and to the other corner, then reverse (four strokes for each lip).

Intraoral Stimulation

1. **Gums**: Rub the upper gum with gentle, but firm pressure from the center toward the back and return to the center for each side using a pacifier (four rub for each side of the gum). Repeat the procedure on the lower gum.

2. **Tongue:** Place a pacifier on the tongue and gently stroke forward, combining with downward pressure (eight times) (If the infant displays tongue protrusion, only downward pressure is administered.).

3. **Pacifier sucking**: Place a pacifier at the center of the hard palate for preterm infant, gently stroke the palate forward to elicit a suck. Allow the infant to suck on a pacifier for 2 minutes

- The biting and sucking reflexes and nonnutritive sucking were assessed twice, once by each researcher, by introducing safe, sterile pacifier or gloved little finger. Nonnutritive sucking was evaluated during 1 minute.

After applying oral stimulation and non-nutritive sucking program by the researchers for studied preterm infants: (post oral stimulation therapy)

- Assessing the preterminfants' feeding-related physiological changes (color, oxygen saturation, heart rate, and respiratory rate).

- The oral stimulation and non-nutritive sucking programwas continued for four consecutive days for all preterm infants.

- Each preterm infant had three sessions daily, andduration of each

session was 5 minutes (three minutes of manual peri- and intraoral stimulation followed by two minutes of sucking on a pacifier).

- The first session of oral stimulation and non-nutritive sucking program was performedafter assessing weak or absent sucking in the morning shift andthe second and third sessions of oral stimulation therapy and non-nutritive sucking was performedin the afternoon shift by theresearchers.

- After four consecutive days of oral stimulation therapy and non-nutritive sucking, bottle feeding was introduced to each preterm infant and they were assessed for their ability of sucking and readiness to oral feeding at each feeding time.

- The feeding ended when one of the following conditions occurred: feeding time reached a 30-minutes limit, the preterm infant finished the prescribed volume in less than 30 min, or they did not resume sucking after using necessary strategies (e.g., burping, oral stimulation therapy, slowly pulling out and reinserting the nipple, and non-nutritive sucking) to facilitate sucking.

- Assessing the preterm infants' weight gain at discharge as documented in the nursing records by the NICUs nursing staff.

Results:

Table (1): Number and percentage distribution regarding characteristics of studied preterm infants (n=104).

Characteristics	Study Sample N=52	
	No	%
Gestational age in weeks		
- Less than 30	3	5.8
- 30 - < 32	9	17.3
- 32 - < 34	17	32.7
- 34 - ≤ 37	23	44.2
Mean ±SD	33.15± 0.91	
		Gender
- Male	31	59.6
- Female	21	40.4
Birth weight (kg)		
- < 1.500	2	3.8
- 1.500 - < 2.000	18	34.6
- 2.000 - ≤ 2.500	32	61.6
Mean ±SD	2.05 ± 0.42	
		Weight at beginning of the program (kg)
- < 1.500	3	5.8
- 1.500 - < 2.000	19	36.5
- 2.000 - < 2.500	29	55.8
- 2.500 and more	1	1.9
Mean ±SD	2.07± 0. 90	
		Weight at end of the program (kg)
- < 1.500	0	0.0
- 1.500 - < 2.000	16	30.8
- 2.000 - < 2.500	34	65.4
- 2.500 and more	2	3.8
Mean ±SD	2.32 ± 0. 87	

Table (1) illustrated characteristics of studied preterm infants; it was observed that, the mean gestational age of them were 33.15± 0.91 weeks, while the mean birth weight were 2.05 ± 0. 42kilograms. In addition, this table showedthat, the mean weight at the end of the program was**2.32 ± 0. 87**kilograms.($p<0.05$)

Fig. (1): Type of feeding for studied preterm infants before applying oral stimulation and non-nutritive suckingprogram (n: 52)

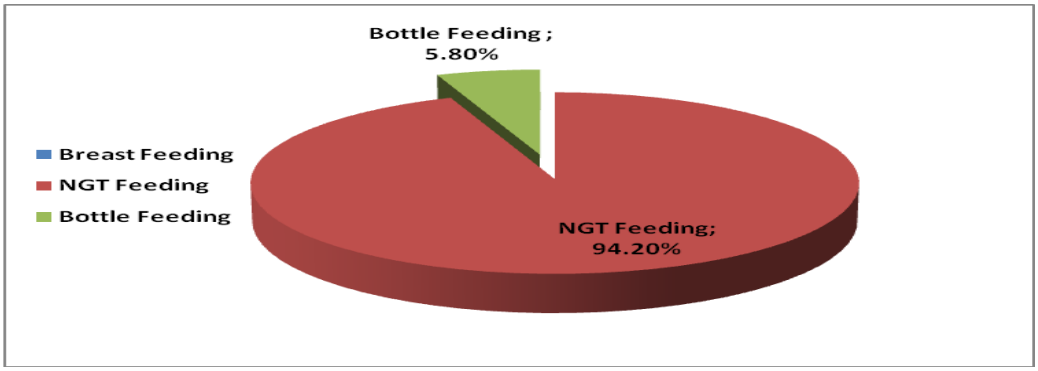

Figure 1 regarding Type of feeding for studied preterm infants before applying oral stimulation and non-nutritive suckingprogram, it was observed that no one of them were breast fed, while the majority of them were bottle fed and 1.9% of them were nasogastric tube fed.

Fig. (2): Type of feeding for studied preterm infantsafter applying oral stimulation and non-nutritive suckingprogram (n: 52)

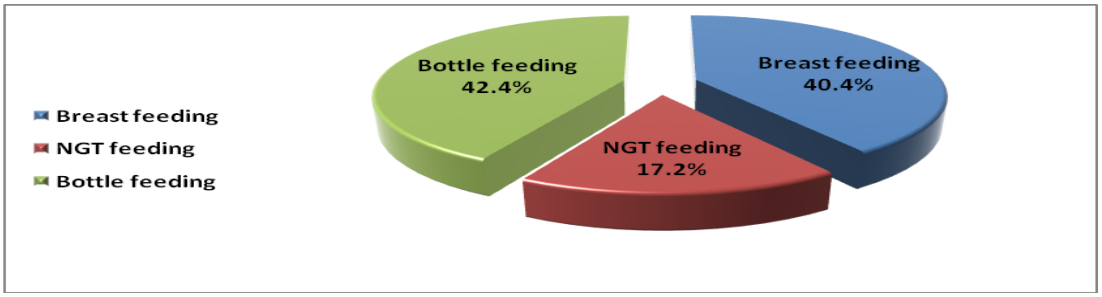

Figure 2regardingType of feeding for studied preterm infants after applying oral stimulation and non-nutritive suckingprogram, it was observed that 40.4% of them were breast fed, while 42.4% bottle feeing and 17.2% of them were nasogastric tube feeding.

Table (2): Number and percentage distribution regarding Feeding related physiological changesof studiedpreterm infants (pre/post applying oral stimulation and non-nutritive suckingprogram) (n=52).

Items	Study group N=52				x^2	P value
	pre		post			
	No	%	No	%		
Oxygen saturation:						
- Normal	27	51.9	24	46.2	2.18	>0.05
- Abnormal	25	48.1	28	53.8		
Mean ±SD	92+4.2		99+1.2			
The infant's color:						
- Normal	27	51.9	28	53.8	3.02	>0.05
- Abnormal	25	48.1	24	46.2		
Heart rate:						
- Normal	27	51.9	24	46.2	2.94	>0.05
- Abnormal	25	48.1	28	53.8		
Mean ±SD	118.57+17.28		122.59+21.08			
Respiratory rate:						
- Normal	26	50.0	27	51.9	2.84	>0.05
- Abnormal	26	50.0	25	48.1		
Mean ±SD	34.07+7.22		33.07+6.62			

Not significance P value >0.05

Table 2 regarding feeding related physiological changesof studied preterm infants, it was highlighted that, there were no statistical significance for studied preterm infants pre and post program implementation (**Not significance P value >0.05**)

Table (3): Preterm infant oral feeding readiness assessment scale(behavioral organization, oral posture, and oral reflexes)(pre/post applying oral stimulation and non-nutritive suckingprogram) (n=52).

Items	Study group N=52				x^2	P value
	pre		post			
	No	%	No	%		
BEHAVIORAL ORGANIZATION						
Behavioral state						
- Alert	4	7.7	42	80.8	16.4	<0.05
- Drowsy	4	7.7	6	11.5		
- Sleep	44	84.6	4	7.7		
Global Posture						
- Flexed	5	9.6	43	82.7	12.3	<0.05
- Partly flexed	12	23.1	6	11.5		
- Extended	35	67.3	3	5.8		
Global tonus						
- Normo-tonic	4	7.7	43	82.7	13.9	<0.05
- Hypertonic	12	23.1	5	9.6		
- Hypotonic	36	69.2	4	7.7		
ORAL POSTURE						
Lips posture:						
- Closed	2	3.8	37	71.2	14.7	<0.001
- Half-open	25	48.1	10	19.2		
- Open	25	48.1	5	9.6		
Tongue posture						
- Flat	4	7.7	26	50.0	9.8	<0.05
- Elevated	10	19.2	20	38.5		
- Retracted	34	65.4	4	7.7		
- Protruded	4	7.7	2	3.8		
ORAL REFLEXES						
Rooting reflex						
- Present	2	3.85	40	76.9	14.6	<0.05
- Weak	44	84.65	10	19.3		
- Absent	6	11.5	2	3.8		
Sucking reflex						
- Present	0	0.0	28	53.8	13.5	<0.05
- Weak	26	50.0	22	42.4		
- Absent	26	50.0	2	3.8		
Gag reflex						
- Present	20	38.5	30	57.7	15.3	<0.05
- Present in anterior region	28	53.8	20	38.5		
- Absent	4	7.7	2	3.8		

Significance P value <0.05
Highly Significance P value <0.001

Table3: illustrated that there was a significance relation for studied preterm infantsregarding oral feeding readiness assessment scale about behavioral organization, oral posture, and oral reflexes pre/post applying oral stimulation and non-nutritive sucking program. It was seen than 80.8 % of them were alert post program compared to 7.7% preprogram.

Table (4): Preterm infant oral feeding readiness assessment scale(non-nutritive sucking)(pre/post applying oral stimulation and non-nutritive sucking program) (n=52).

Items	Study groupN=52				x^2	P value
	pre		post			
	No	%	No	%		
Tongue movement:						
- Normal	2	3.8	36	69.3	12.3	<0.05
- Altered	42	80.8	14	26.9		
- Absent	8	15.4	2	3.8		
Tongue cupping						
- Present	11	21.2	36	69.2	18.6	<0.05
- Absent	41	78.8	16	30.8		
Jaw movement						
- Normal	2	3.8	39	75.0	14.5	<0.001
- Altered	28	53.9	10	19.2		
- Absent	22	42.3	3	5.8		
Sucking strain						
- Strain	1	1.9	30	57.7	15.3	<0.001
- Weak	29	55.8	22	42.3		
- Absent	22	42.3	0	0.0		
Sucking and pause						
- Between 5 and 8 sucks per respiratory pause	6	11.6	32	61.6	13.9	<0.05
- More than 8 sucks per respiratory pause	1	1.9	18	34.6		
- Less than 5 sucks per respiratory pause	45	86.5	2	3.8		
Maintenance of rhythm of sucking and pause						
- Rhythmic	2	3.8	32	61.5	14.7	<0.001
- Arrhythmic	6	11.6	20	38.5		
- Absent	44	84.6	0	0.0		
Maintenance of alert state						
- yes	10	19.2	28	53.8	12.8	<0.05
- Partial	24	46.2	20	38.5		
- No	18	34.6	4	7.7		
Stress signs						
- Absent	32	61.5	43	82.7	13.7	<0.05
- Up to 3 stress signs	8	15.4	7	13.5		
- More than 3 stress signs	12	23.1	2	3.8		

Significance P value <0.05

Table4: showed that there was a significance relation for studied preterm infants regarding oral feeding readiness assessment scale about non-nutritive sucking pre/post applying oral stimulation and non-nutritive sucking program.

Table (5): Preterm infant oral feeding readiness assessment scale(stress signs)(pre/post applying oral stimulation and non-nutritive sucking program) (n=52).

Items	Study groupN=52				x^2	P value
	pre		post			
	No	%	No	%		
Saliva accumulation						
- Normal	2	3.8	36	69.3	13.1	<0.05
- Altered	42	80.8	14	26.9		
- Absent	8	15.4	2	3.8		
Nose wings trembling						
- Present	11	21.2	36	69.2	10.7	<0.001
- Absent	41	78.8	16	30.8		
Color changes						
- Normal	32	61.5	43	82.7	13.6	<0.05
- Altered	8	15.4	7	13.5		
- Absent	12	23.1	2	3.8		
Apnea						
- Present	4	7.7	2	3.8	10.9	<0.05
- Absent	48	92.3	50	96.2		
Tonus variation						
- Present	11	21.2	32	61.5	11.2	<0.05
- Absent	41	78.8	20	38.5		
Posture variation						
- Present	10	19.2	32	61.5	11.5	<0.05
- Absent	42	80.8	20	38.5		
Tongue or jaw tremors						
- Present	4	7.7	36	69.2	10.9	<0.05
- Absent	48	92.3	16	30.8		
Hiccupping						
- Present	2	3.8	3	5.8	10.7	>0.05
- Absent	50	96.2	49	94.2		
Crying						
- Present	2	3.8	4	7.7	11.1	>0.05
- Absent	50	96.2	48	92.3		

Significance P value <0.05 **Not significance P value >0.05**

Table5: illustrated that there was a significance relation for studied preterm infantsregarding oral feeding readiness assessment scale about stress signs)(pre/post applying oral stimulation and non-nutritive suckingprogram). While there was non significance relation regarding hiccupping and crying of the stress signs.

Table 6:Total and Subtotal Means Scores of Preterm Infant Oral Feeding Readiness Assessment Scale(pre/post applying oral stimulation and non-nutritive suckingprogram) (n=52).

Items	Study group N=52		ANOVA	
	pre	post	F/T test	P value
	Mean ±SD	Mean ±SD		
BEHAVIORAL ORGANIZATION				
- Behavioral state	0.96 ±.3	1.12 ±32		<0.05
- Global Posture	0.88 ±26	1.17 ±38	F test 0.085	
- Global tonus	1.04±.14	1.84±36		
ORAL POSTURE				
- Lips posture	1.02 ±26	1.7 ±0.46	T test 0.072	<0.05
- Tongue posture	1.04±.16	1.5±0.5		
ORAL REFLEXES				
- Rooting reflex	0.96 ±.33	1.4 ±0.49	F test 0.078	<0.001
- Sucking reflex	0.94 ±.18	1 1.46 ±0.50		
- Gag reflex	0.98 ±.44	1.61±0.49		
NON-NUTRITIVE SUCKING				
- Tongue movement	0.98 ±.07	1.06 ± 0.5	F test 0.462	<0.05
- Tongue cupping	0.88 ±26	1.01± 0.46		
- Jaw movement	1.04±.84	1.44± 0. 50		
- Sucking strain	0.96 ±.38	1.42 ± 0.49		
- Tongue posture	0.94 ±.24	1.69 ± 0.54		
- Maintenance of rhythm of sucking and pause	0.99 ±.14	1.61 ± 0.49		
- Maintenance of alert state	0.98 ±.16	1.53 ± 0.5		
STRESS SIGNS	1.26±0.48	0.80±0.41	F test 0.408	<0.05
Total	1.07±0.16	1.12±0.19	F test 0.482	0.000

Significance P value <0.05

Table6: showed that there was a significance relation for studied preterm infantsregardingtotal and subtotal means scores of preterm infant oral feeding readiness assessment scale pre/post applying oral stimulation and non-nutritive sucking program.

Discussion:

Early oral motor stimulation is encouraged to maintain and develop the sucking reflex. Non-nutritive sucking promotes an infant's readiness to begin oral feeding. Additionally, oral stimulation program and NNS program are widely used to accelerate the independent oral feeding of preterm infants. This study aimed to assess the effect of oral stimulation and non-nutritive sucking program on feeding readiness of preterm infants, the behavioral states of preterm infants, and the feeding-related physiological changes of preterm infants.

As regard the personal characteristics of preterm infants, mean birth weight was 2.05 ± 0. 42kilograms and gestational age was 33.15± 0.91weeks. This was in agreement with a study by ***Gewolb et al., (2001)*** about

"Developmental patterns of rhythmic suck and swallow in preterm infants" who found that the mean birth weight of the study infants was 1187g (SD 244 g) (range 740 to 1590 g). Mean gestational age was 29.4 weeks (SD 2.1) ranged from 32.1 to 36.6 weeks. These results also came in agreement with ***Bayomi and El-Nagger, (2015)*** in a study about "Effect of applying massage therapy on physical, physiological and behavioral states of premature neonates" who found that, half of premature neonates were $34 \leq 36$ weeks of gestational age. Meanwhile, regarding the birth weight of these premature neonates nearly less than half of them, their birth weight was 1.500-2.000 kilograms. The results of the current study were supported by ***Bridget (2012)***in a study about "Causes of premature Birth" and ***Badr et al. (2011)***in a study about " Nursing care in Lebanon: A nursing perspective. Newborn and Infant Nursing Reviews" who emphasized that the birth weight is an indicator for good general health condition of the preterm neonates. ***Shah et al. (2011)***in a study about "Intention to become pregnant and low birth weight and preterm birth" mentioned that the gestational age and birth weight for neonates indicates the adequacy of intrauterine growth, whereas the maturity of neonates' organ systems depends on gestational age.

Regarding the preterm infants' weight at discharge, the mean weight of them was **2.32 ± 0. 87**. This result was confirmed by ***Bayomi and El-Nagger, (2015)*** in a study about "Effect of applying massage therapy on physical, physiological and behavioral states of premature neonates" who found that, more than half of premature neonates gained from 150-200 grams after applying massage therapy, this result also was in agreement with ***Golchin et al. (2010)*** in a study about "Effect of deep massage on increasing body weight in low birth weight infants" and ***Tekgündüz et al. (2014)***in a study about "Effect of abdomen massage for prevention of feeding intolerance in preterm infants" who mentioned that weight gain is the most consistent indicator which is associated with massage therapy in neonates. While, ***Bernbaum (1983),*** in a study about" Nonnutritive sucking during gavage feeding enhances growth and maturation in premature infants" demonstrated a significant difference in weight gain favor the study group by the second week and the difference remained significant during the study period (six weeks).

Regarding physiological parameters of preterm infants pre and post oral stimulation and non-nutritive sucking program, it was found that there were no statistical significance difference, these results were supported by ***Pickler; 2009***, in a study about " The effect of feeding experience on clinical outcomes in preterm infants" who found that no difference between the study and control groups regarding heart rate, oxygen saturation, and color. Also, ***DiPietro 1994***in a study about "Behavioral and physiologic effects of nonnutritive sucking during gavage feeding in preterm infants"reported the effect of NNS on physiological parameters in tube fed infants. She found NNS to have no effect on oxygen saturation and heart rate.

As regard behavioral organization of preterm infants pre and post oral stimulation and non-nutritive sucking program, it was found that, there were statistical significant differences (X^2= 16.4, 12.3 and 13.9 at P value< 0.05) regarding behavioral state, global posture and global tonus respectively, meanwhile there was highly statistical significant difference (X^2 = 14.7 at P value<0.001) regarding lips posturepre and post oral stimulation program and non-nutritive sucking. As illustrated by ***lau, 2006,*** in a study about "Oral Feeding in the Preterm Infant"**,** there are six levels of state organization: quiet sleep, active sleep, drowsiness, quiet alert, active alert, and crying/fussing. However, due to immaturity of preterm infants, one of the characteristics of them is their inability to regulate their states. Because they spend most of their time transitioning from one state to another, some preterm infants cannot feed by mouth for

extended periods of time. The result of the current study also supported by ***Pickler; 2009***, in a study about "The effect of feeding experience on clinical outcomes in preterm infants" who found that there were statistical significant differences regarding behavioral state of premature newborn. Neurobehavioral studies have proposed that an organized pattern of state regulation is considered a good indicator of preterm infant's ability to cope with the environment, particularly that of a neonatal intensive care unit. As a result, improvement in state regulation is interpreted as evidence of central nervous system maturation and can be a key to their ability to orally feed successfully for an extended period of time. Behavioral organization is identified by the calmness, relaxation, and regular breathing that an infant exhibits at a particular time. Thus, behavioral state and organization can affect significantly the ability of a preterm infant to feed by mouth.

The results of this study revealed that the oral stimulation and NNS program had a beneficial effect on the time needed to attainment to oral feeding readiness. The preterm infants in oral stimulation and NNS program reached 1.12±0.19. These results agreed with ***Asadollahpour, et al., (2015)*** in a study about "The Effects of Non-Nutritive Sucking and Pre-Feeding Oral Stimulation on Time to Achieve Independent Oral Feeding for Preterm Infants" those found that, the preterm infants in NNS and pre-feeding oral stimulation groups reached 7.55 and 6.07 days sooner than control group to these criteria. Therefore in term of performance in oral feeding, NNS program seemed to be more beneficial than pre-feeding oral stimulation and pre-feeding oral stimulation was more fruitful than shame intervention. These results also agreed with ***Lessen et al., 2011*** in a study about ″Effect of the premature infant oral motor intervention on feeding progression and length of stay in preterm infants" ,***Fucile et al. 2012,*** in a study about″ Oral and non-oral sensorimotor interventions facilitate suck-swallow-respiration functions and their coordination in preterm infants"and ***Rocha et al. 2007,***in a study about"A randomized study of the efficacy of sensory-motor-oral stimulation and non-nutritive sucking in very low birth weight infant" who confirmed the desired outcomes of their interventions regarding to feeding readiness. Also these results in disagreement with several studies who did not find any improvement in feeding readiness of preterm infants ***(Boiron et al., 2007)*** in a study about " Effects of oral stimulation and oral support on non-nutritive sucking and feeding performance in preterm infants" and ***Bragelien et al., (2007)***in a study about " Stimulation of sucking and swallowing to promote oral feeding in premature infants". Non-nutritive sucking during gavage feeding may encourage the initiation of gavage feeding, which may encourage the development of sucking behavior and improve digestion of the feeding. Non-nutritive sucking may also have a calming effect on the preterm infants, although it may interfere with breastfeeding.

Preterm infants display significant feeding difficulties by mouth in the first weeks after birth, particularly those born at a lower gestational age and/or with a greater degree of morbidity. Contributing factors as immature or dysfunctional sucking skills and poor suck–swallow– breathe coordination. In addition, while necessary to ensure adequate nutrition when feeding skills are inadequate, several studies documented adverse effects of tube feeding in relation to establishing suck feeding in preterm infants***(Dodrill 2011).***

Oral and gag reflexes appear at about 12-16 weeks of gestation and sucking at 24 weeks of gestation. Sucking and swallowing are present by 28 weeks of gestation, although not fully coordinated until about 32-34 weeks of gestation. This may be related to those preterm infants less than 32 weeks' gestations are usually not able to feed from breast or bottle effectively***(Lessen. 2011)***.

Regarding oral feeding readiness of preterm infants, the results of the current study revealed that there was a highly statistical significance difference for studied preterm infants pre and post applying oral stimulation and NNS program. ***Sehgal 1990***reported in a study about "Evaluation of beneficial effects of nonnutritive sucking in preterm infants" that the time for feeding readiness from tube feeds to bottle feeds was significantly reduced by 1.6 days in preterm infants receiving NNS. ***Widstrom 1988***in a study about " Nonnutritive sucking in tube-fed preterm infants: Effects on gastric motility and gastric contents of somatostatin" also reported a significant decrease in tube feeding time in those infants receiving NNS. ***Yu 1999***in a study about "The effects of nonnutritive sucking on behavioral state and feeding in premature infants before feeding" found that feeding performance was improved for preterm infants receiving pacifiers or NNs. there was significantly more intake within the first five minutes after NNs, more total amount of feeding, less feeding time and a faster feeding rate. ***Picklerand Reyna 2004*** in a study about "Effects of non-nutritive sucking on nutritive sucking, breathing and behavior during bottle feedings of preterm infants" found no statistically significant effect of NNS on the amount of consumed bottle feeding per minute. ***DiPietro 1994***in a study about "Behavioral and physiologic effects of nonnutritive sucking during gavage feeding in preterm infants" found that infants receiving NNS spent significantly less time in fussy and active awake states during and after tube feeding, and settle more quickly into a sleep state. Research suggests that promoting oral stimulation and non-nutritive sucking will facilitate nipple feeding. ***(McGrath & Braescu, 2004).***In a study about " State of the science: feeding readiness in the preterm infant." Delaying the initiation of feeding opportunities may unnecessarily prolong hospitalization. Oral stimulation program and non-nutritive sucking prior to feeding may reduce pauses in sucking, increase rate of intake, and increase volume of intake during feeds.

Conclusion

Implementation of the oral simulation and non-nutritive sucking program in this study enhancing sucking and feeding readiness of preterm infants, in addition,shortened the transition time from introduction of oral feeding to complete oral feeding and improved the oral feeding performance.

Recommendations:

-Because the oral stimulation program is safe, easily applied and beneficial to preterm infants, itproposed that such an intervention should be implemented in the NICUs.

-Training program should be provided for all nurses working in NICUs as regards applying oral stimulation therapy and non-nutritive sucking.

-Training program should be provided for all mothers of preterm infants through their encouragement for participation in providing oral stimulation therapy and non-nutritive sucking for their preterm infants pre discharge.

-Further study should be conducted in all NICUs to assess the neonatal nurse's knowledge, attitudes and performance regarding oral stimulation therapy and non-nutritive sucking and its effect on health status of preterm infants.

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