-Effect of Breast Milk Olfactory Stimulation on Behavioral Responses and Feeding Progression of Preterm Neonates

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Abstract

Background: *Stimulating preterm neonates with breast milk odor is a useful strategy for enhancing the physiological, behavioral responses and feeding progression of preterm neonates.* ***Aim:*** *The study aimed to assess the effect of breast milk olfactory stimulation on behavioral responses and feeding progression of preterm neonates* ***Settings:*** *The study was conducted in Neonatal Intensive Care Unit (NICU) at Alexandria University Children's Hospital at Smouha* ***Subjects****: A convenient sample of 60 preterm neonates who admitted to the previously mentioned setting. The neonates randomly assigned into two equal groups, study and control (30 neonates for each). The preterm neonates of the control group received routine care of the unit. Whereas the preterm neonates of the study group received breast milk olfactory stimulation.* ***Tools*** *three tools were used to collect data. Characteristics and physiological parameters of Preterm Neonates Assessment Record, Neonatal Behaviors Assessment Record and Preterm Neonates Feeding Progression Assessment Record* ***Results:*** *There were statistical significant differences found between the both groups according to weight of preterm neonates on the first, third and seventh days (p=<0.001 for each). Further statistical significant differences were found regarding to mean amount of milk between both groups on the third and seventh days (p=<0.005 & p=<0.001 respectively).****Conclusion:*** *Preterm neonates who received olfactory stimulation exhibited better organized behaviors than preterm neonates who do not****.*** *Moreover, the preterm neonates who received breast milk olfactory stimulation also had feeding progression (weight gain and amount of milk received daily) more than preterm neonates in the control group.* ***Recommendation:*** *Neonatal Intensive Care Nurses should be trained about the application of olfactory stimulation for the preterm neonates. Various types of sensory stimulation should be integrated in NICU routine care for preterm neonates*

Keywords: Breast Milk Olfactory Stimulation, Behavioral Responses, Feeding Progression, Preterm Neonates

Introduction

Prematurity is now the most important cause of death in the first month of life. Globally, it was estimated that 13.4 million neonates were born preterm in 2020, with almost 1 million of them dying from preterm complications (WHO, 2023). In Egypt, the incidence of preterm neonates is about 49.4% of admitted neonates. According to this incidence rate, preterm admissions to the NICU are increasing each year in Egypt (Hassan, 2022).

Immaturity presents a significant challenge in providing an effective nutrition and maintains stable physiological parameters for preterm neonates. Due to their underdeveloped respiratory, cardiovascular, and neuro-regulatory systems, preterm newborns frequently exhibit abnormal physiological responses such as bradycardia, apnea, and desaturation of blood oxygen (Marshall et al., 2019). Preterm neonates have a greater nutritional needs and nutrition risks in the neonatal period than at any other time of their lives for many reasons including: low birth weight, early birth, which limits nutrient stores such as calcium, iron, and fat and rapid growth, which increases nutrient demand. Furthermore, immature gastrointestinal tract, which present as decreased gut motility, decreased digestive abilities, and decreased

tolerance of feedings (Mustapha et al ., 2021). Additionally, due to their immature oral skills and a failure to organize sucking, swallowing, and breathing, preterm neonates commonly struggle with oral feeding (Khodagholi et al., 2018).

It is important to improve preterm neonates' feeding capabilities to meet their nutritional requirements and decrease the complication of feeding delay. Many current interventions that could improve the ability to progress to successful feeding focus on promoting the neural maturation of sucking and swallowing and the coordination of the muscles of the jaw, lips, tongue, palate and pharynx, upper trunk, and respiratory systems to support a safe swallow (Farneti & Genovese, 2017). It is also dependent on normal sensory functioning seen in primitive reflexes such as rooting, gag and an intact swallow reflex, and intraoral and pharyngeal sensation (Keven & Akins, 2017). Therefore, using cost-effective intervention measures such as olfactory stimulation could be helpful in preterm neonates (De Clifford et al., 2017).

The olfactory system is a complex structure that develops early during embryogenesis. The main olfactory system develops during the fifth week in gestation, and the olfactory bulb develops during the eleven week (Tufo et al., 2022). The fetuses discriminate the odor molecules in the amniotic fluid after 28-30 weeks of gestation. Olfactory receptor neurons (smell receptor) were developed in preterm neonates at 24–27 weeks of gestation and nasal chemoreception begins its function during the last gestational trimester (Lyons-Warren et al., 2021). Preterm neonates can respond to olfactory stimuli in their first few weeks of life and their sense of smell is more developed than other senses (Beker et al., 2017). Neonates are able to distinguish the distinct smell of their own mother's milk from other mothers' milk. This is because they have the olfactory ability to remember since birth and recognize the smell of amniotic fluid, breast milk, and other baby's scent (Loos et al., 2019). So, early stimulation using breast milk could improve oral feeding abilities through activation of physiological processes at multiple sites to optimize digestion, including increased salivation, increased peristaltic movements, and increased secretion of digestive enzymes and digestive-related hormones (Muelbert et al., 2019). Additionally facilitate sucking-swallowing-respiration coordination in preterm neonates with delayed feeding (Louyeh et al., 2020).

However, the negative olfactory experiences in the surrounding NICU environment, such as substances used for skin preparation, disinfectant, may hinder preterm neonates 'ability to handle with stressful experiences (Altimier & Phillips, 2016). Positive benefits from sniffing these preferred odors such as those from the mother's breast milk, body, and amniotic fluid can improve physiological stability for preterm neonates through decrease the stress rates, stabilize heart rate, respiratory rate and oxygen saturation. Moreover, breast milk odor improves adaptive behavior and decrease negative complications of long-term hospitalization. Another positive effect, neonates' stress reactions, including crying and motor activity can be reduced and weight gain can be achieved (Akcan & Polat, 2016; Tasci & Kuzlu yildiz, 2020; Park & Im, 2020).

Neonatal nurses play a vital role in providing care for the preterm neonates. It can be challenging for neonatal nurses to give the preterm neonates safe feeding and proper nutritional care, organize the preterm neonates' behavior and maintain stable physiological parameters. So, they should integrate early olfactory stimulation using breast milk in NICU routine preterm neonate's care to improve their oral feeding abilities. They also should use various sensory stimulations to decrease the stressors and improve the preterm neonates' outcomes. Moreover, they should train mothers how to

express their breast milk to be used as an odor stimulus as well as used for feeding of their preterm neonates (Beker et al., 2021).

AIM OF THE STUDY

The aim of the present study is to assess the effect of breast milk olfactory stimulation on behavioral responses and feeding progression of preterm neonates.

RESEARCH HYPOTHESIS

Preterm neonates who receive breast milk olfactory stimulation exhibit organized behavioral responses more than those who do not. Preterm neonates who receive breast milk olfactory stimulation exhibit improved feeding progression than those who do not.

Materials and Methods

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

Setting:

The Neonatal Intensive Care Unit at Alexandria University Children's Hospital at Smouha served as the site of this study. Three levels are assigned to the unit. Neonates with some prematurity-related health issues and those who require respiratory help, such as continuous positive airway pressure, can be handled in level II, while level I deal with feeder and grower neonates. Level III care is available for neonates who have breathing problems and are fed intravenously rather than with milk. This study conducted at Level I which includes 15 beds and incubators

Subjects

The subjects will be 60 preterm neonates that are admitted to the previously described setting and meet the following criteria: age between 34 and 37 weeks, stable vital signs, and starts oral feeding on the first day. The 30 neonates in each group were randomly divided into the study and control groups. The first group will be the control group, which will merely get standard treatment from the unit. The second group will receive stimulation from the smell of breast milk.

Tools:

Three tools will be used to collect the necessary data.

Tool One: Characteristics and physiological parameters of the Preterm Neonates Assessment Record:-

This tool was developed by the researcher to assess characteristics and physiological parameters of preterm neonates**. It includes two parts:-**part I Characteristics and medical data of preterm neonates such as age, sex, gestational age, current weight and diagnosis. Part II: Physiological parameters of preterm neonates such as, respiratory rate, heart rate and oxygen saturation (SPO2).

Tool Two: Neonatal Behaviors Assessment Record: - After evaluating the appropriate literature, the researcher created this measure to evaluate the behavioral and feeding readiness of neonates. **It includes two parts.** Part I:- Preterm Neonate's Orally Directed Behavioral Responses For Feeding: it includes pre feeding cues such as rooting, hand to mouth, empty sucking and sucking on hand. Part II: -Behavioral State of Preterm Neonates: such as quite sleep, alert drowsy and crying.

Tool Three: Preterm Neonates Feeding Progression Assessment Record. This tool was developed by the researcher after reviewing relevant literature to assess preterm neonate's feeding progression**.** It includes feeding progression criteria such as: sucking, swallowing, and amount of feeding and current weight of preterm neonates**.**

METHOD

- • Prior to conducting the current study, Alexandria University's Faculty of Nursing requested approval from its research ethics committee.
- An official permission to conduct study was obtained from the responsible authorities of Neonatal Intensive Care Unit (NICU) at the Alexandria University Children's Hospital

at Smouha to conduct the study after explaining the aim of the study.

- A tool was developed by the researcher after thorough reviewing of current and relevant literature.
- Content validity of tools was tested by five experts in the pediatric nursing field.
- Reliability of tools was ascertained using appropriate statistical test.
- A pilot study was carried out on 6 neonates (10% of sample size) to test the feasibility and clarity of the tools. Those neonates were excluded from the sample size and necessary modifications were done.
- Initially, preterm neonates' characteristics and medical data were obtained by reviewing medical and nursing records for both groups using tool I.
- Physiological parameters of preterm neonates assessed immediately before feeding using tool I for both groups.
- Preterm neonates were weighed at the morning before feeding without clothes on a digital weighing scale by the researcher. The scale was disinfected, rechecked and calibrated to zero before each measurement.
- Preterm neonate's readiness to feeding assessed using tool II immediately before feeding for both groups at first, third and seventh day.
- For study groups:- (Breast milk olfactory stimulation group)
- Firstly, the neonatal records were checked for the parent's phone number.
- Mothers of preterm neonates were instructed to take daily baths and wear clean clothes, wash their hands and breasts before starting the collection of breast milk.
- The mothers were instructed to boil the bottle before pouring the expressed milk in it.
- The mothers were instructed to label the bottle using complete data such as the mother's name and date and time of milk expression.
- The mothers were instructed to keep the bottle in an ice bag during transportation.
- The researcher received a bottle from mothers and transferred it to the NICU.
- The bottles containing the expressed breast milk were kept in the refrigerator in milk storage shelves.
- The researcher warmed the bottle of expressed milk by using a breast milk -heater.
- The researcher instructed the medical staff in the NICU who were directly contacted with the preterm neonates to avoid using perfume or fragrant products during the intervention period to minimize the effects of additional olfactory stimulation other than maternal breast milk.
- The researcher obtained 5cc of fresh squeezed milk in a sterile syringe and prepare a tongue depressor covered by sterile gauze, and then the tongue depressor steeped in the fresh squeezed milk.
- The preterm neonates were positioned in the supine position and the head turned to one side
- The steeped tongue depressor with milk was placed near the preterm neonate's nostril for 10 minutes before feeding to stimulate an olfactory sense of preterm neonates 3 times per day (9 am, 3 pm, and 5 pm).
- The preterm neonates received breast milk olfactory stimulation for seven consecutive days.
- Feeding progressions of preterm neonates were assessed during the feeding of preterm neonates with their mother's milk using tool III on the first, third, and seventh day for both groups.
- The control group: preterm neonates were received routine care of NICU.
- Physiological responses of preterm neonates were assessed immediately after feeding for both groups using a tool I
- Preterm neonates' behavioral state was assessed after feeding for both groups using tool II.
- Feeding progression of preterm neonates was assessed during feeding for the control group using tool III.

- From November 2021 to September 2022, a total of 11 months were used to collect the data..
- The selected data were analyzed using appropriate statistical.

Ethical Considerations

Informed written consent was obtained from the neonate's parents after explaining the aim of the study to them. The neonate's parents were on a voluntary base, and they had the right to withdraw from the study at any time. The confidentiality of collected data was assured. Privacy of subjects and confidentiality of data were considered

Results

Table (2) illustrates comparison between olfactory stimulation and control groups according to oral directed behavioral responses of preterm neonates before feeding. Regarding to the rooting reflex, it was found that 100.0% of preterm neonates in OSG exhibited rooting reflex before feeding compared to 60.0% of preterm neonates the control group on the seventh day. Statistical significant difference was found between both groups on the seventh day (*p=0.035). The same table also revealed that 63.3% of preterm neonates among OSG moved their hands to mouth compared to only 20% of preterm neonates among control group. Statistical significant difference was found between two groups on the seventh day (p=0.001).In relation to empty sucking, it was observed that the percentage of preterm neonates among OSG who displayed empty sucking was to 83.3% compared to 50 % among control group on the seventh day. Statistical significant differences were found between both groups on the seventh days (p=0.006). It was obvious from the same table that 40.0% of preterm neonates among olfactory stimulation group displayed hand sucking before feeding compared to only 10.0% of preterm neonates in control group on the first & seventh day. Statistical significant differences were found between two groups on the first and seventh day (p=0.007 for each). **Table (3)** describes Comparison between the olfactory stimulation and control groups according to behavioral state of preterm neonates after feeding. It was revealed from the table that 70% of preterm neonates among OSG compared to 43.3% of preterm neonates in the control groups had quite sleep on the third and seventh days. Statistical significant differences were found between the two groups on the third and seventh days (p=0.037 for each). Concerning the alert drowsy state, it was also found that no statistical significant difference between both groups on the three days. The same table also revealed that none of preterm neonates among OSG cried after feeding compared to 36.7% of preterm neonates among control group on the seventh days. Highly statistical significant difference was found between the two groups on the seventh day (p= <0.001).**Table (4)** Table 4.16 represents a comparison between the OSG and the control group according to the mean amount of milk. It was found on the seventh day the mean total amount of milk received by preterm neonates in OSG showed an increase to 100.43 ± 9.04 cc compared to 86.67 ± 9.97 cc in the control group. Statistical significant differences were found between both groups on the third and seventh days (p=<0.005 & p=<0.001 respectively).**Table (5)** illustrates a comparison between the OSG and control group according to the weight progress of preterm neonates. It was clear from the table that the mean body weight of preterm neonates among both groups had statistical significant differences on the first, third and seventh days (p=<0.001 for each).

Table (1): Characteristics and Medical Neonates among Olfactory Data Preterm Stimulation and Control groups

Characteristics and medical data of preterm neonates	Olfactory stimulation group (n = 30)		Control group (n = 30)	
	No.	%	No.	%
1- Age \days				
• Less than 10	8	26.7	3	10.0
• 10-20	17	56.7	12	40.0
• More than 20	5	16.7	15	50.0
2- Gestational age\ weeks				
• 34-35 weeks	24	80	10	33
• 36-37 weeks	6	20	20	66.6
3- Gestational age with weight				
• Appropriate for gestational age	8	26.7	3	10.0
• Small for gestational age	22	73.3	27	90.0
Mean ± SD	34.90 ± 0.71		34.60 ± 0.72	
4- Gender				
• Male	20	66.7	13	43.3
• Female	10	33.3	17	56.7
5- Weight on admission Mean ± SD.	1390.57 ± 46.55		1322.10 ± 66.26	
6- Diagnosis				
• Delayed transition	11	36.7	13	43.3
• RDS	11	36.7	12	40.0
• Prematurity related complication	5	16.7	5	16.7
• Jaundice	3	10.0	0	0.0

Table (2): Comparison between the Olfactory Stimulation and Control Groups according to Oral Directed Behavioral Responses among Preterm Neonates before the Feeding

Oral Behavioral Responses (Before feeding)	Olfactory stimulation group (n = 30)		Control group (n = 30)		Significant	
	No.	%	No.	%		
1- Rooting					χ^2=	P=
• 1st day	14	46.7	22	73.3	4.444*	0.035*
• 3rd day	23	76.7	20	66.7	0.739	0.390
• 7th day	30	100.0	18	60.0	15.0*	<0.001*
2- Hand to Mouth					χ^2=	P=
• 1st day	8	26.7	8	26.7	0.000	1.000
• 3rd day	15	50.0	10	33.3	1.714	0.190
• 7th day	19	63.3	6	20.0	11.589*	0.001*
3- Empty Sucking					χ^2=	P=
• 1st day	14	46.7	17	56.7	0.601	0.438
• 3rd day	23	76.7	12	40.0	8.297*	0.004*
• 7th day	25	83.3	15	50.0	7.50*	0.006*
4- Sucking on Hand					χ^2=	P=
• 1st day	12	40.0	3	10.0	7.20*	0.007*
• 3rd day	7	23.3	5	16.7	0.417	0.519
• 7th day	12	40.0	3	10.0	7.20*	0.007*

χ^2: **Chi square test**
p: p value for comparing between the two studied groups *: Statistically significant at $p \leq 0.05$

Table (3): Comparison between the Olfactory Stimulation and Control Groups according to Behavioral State exhibited by Preterm Neonates after Feeding

Behavioral State (After feeding)	Olfactory Stimulation group (n = 30)		Control group (n = 30)		Significant	
	No.	%	No.	%		
1- Quite Sleep					χ^2=	
• 1st day	11	36.7	11	36.7	0.000	P= 1.000
• 3rd day	21	70.0	13	43.3	4.344*	0.037*
• 7th day	21	70.0	13	43.3	4.344*	0.037*
2- Alert Drowsy					χ^2=	P=
• 1st day	15	50.0	11	36.7	1.086	0.297
• 3rd day	8	26.7	13	43.3	1.832	0.176
• 7th day	9	30.0	13	43.3	1.148	0.284
3- Crying					χ^2=	P=
• 1st day	5	16.7	8	26.7	0.884	0.347
• 3rd day	2	6.7	6	20.0	2.308	p=0.254
• 7th day	0	0.0	11	36.7	13.469*	<0.001*

χ^2: **Chi square test p:**
p value for comparing between the two studied groups
*: Statistically significant at $p \leq 0.05$

Table (4): Comparison between the Olfactory Stimulation Group and Control Group According to mean amount of milk

Amount of feeding (After feeding)	Olfactory Stimulation group (n = 30)	Control group (n = 30)	Significant	
Total amount\ day				
1st day			t	p
Mean ± SD.	85.83 ± 13.34	80.17 ± 11.78	1.744	0.087
3rd day				
Mean ± SD.	92.70 ± 13.12	83.40 ± 11.69	2.899*	0.005*
7th day				
Mean ± SD.	100.43 ± 9.04	86.67 ± 9.97	5.604*	<0.001*

t: Student t-test
p: p value for comparing between the two studied groups *: Statistically significant at $p \leq 0.05$

Table (5): Comparison between the Olfactory Stimulation and Control Groups according to Weight progress of Preterm Neonates

Current weight /day	Olfactory Stimulation group (n = 30)	Control group (n = 30)	Significant	
1st day Mean ± SD.	**1440.83 ± 48.22**	**1363.03 ± 34.76**	**T= 7.169***	**P= <0.001***
3rd day Mean ± SD.	**1451.93 ± 46.71**	**1367.40 ± 36.35**	**T= 7.822***	**P= <0.001***
7th day Mean ± SD.	**1482.50 ± 51.81**	**1374.17 ± 38.36**	**T= 9.205***	**P= <0.001***

t: Student t-test
p: p value for comparing between the two studied groups
*: Statistically significant at $p \leq 0.05$

DISCUSSION

Preterm neonates often face many obstacles due to developmental delays in their bodies and immature organs. Moreover, dysfunction of respiration and oxygen uptake, heart rate changes, and physiological behaviors weakness such as poor sucking reflex and swallowing that require hospitalization (Hay et al., 2018; McDonald et al., 2020). Compared to the development of the other senses, the olfactory system develops more rapidly in preterm neonates (Khakpour et al., 2022). Additionally, early olfactory stimulation provides preterm neonates with a singular form of sensory stimulation and can act as a gateway to the massive effect of breast milk odor by improving physiological responses such as increasing oxygen delivery, improving heart rate and developing the infant's sucking and swallowing reflexes (Park & Im, 2020). Furthermore, this stimulation provides a calming effect, reduces stress and improves the nutritional status of preterm neonates (Tasci & Kuzlu Ayyildiz, 2020; Davidson et al., 2019). In these regards, the provision of preterm neonates with various forms of supplemental stimulation is the main responsibility of the NICU nurses.

Preterm neonates have disorganized behavior that can negatively affect the ability of them to initiate the oral feeding. Orally directed behaviors are critical indicators of organized oral, motor and neural behaviors. These orally directed behaviors are often evaluated by the occurrence of several prefeeding cues; one of these is the rooting reflex (White et al., 2014). The current study findings showed that the preterm neonates who are exposed to breast milk odor have more organized oral directed behaviors than preterm neonates who are not exposed. In addition the findings of the present study revealed that all preterm neonates among the olfactory stimulation group exhibited rooting reflex before feeding more than those in the control group on the seventh day before feeding (table 2). This finding could be justified by the mother's breast milk odor stimulate the aggressive searching for the nipple and the rooting actions by the preterm neonate. This finding are congruent with the findings of Hym et al. (2021) who did a study about newborn crawling and rooting response to maternal breast odor and reported that the neonates exhibited noticeably greater head-rooting movements when the breast milk odor was present.

Sucking of fingers, pacifiers, hand or other items is referred to as non-nutritive sucking which it is also included in orally directed behavior as prefeeding cues. It is accepted that non-nutritive sucking (NNS) is a normal stage of fetal and neonate' feeding development. The findings of the present study pointed out that there were significant differences between olfactory stimulation and the control group on the seventh day according to NNS (empty sucking& sucking on hand) (table 2). These findings could be interpreted in the light of the fact that breast milk odor can enhance neonates' sucking through stimulation of the facial and trigeminal motor nerves in the brain and increase sucking bursts. These results are consistent with According to Khodagholi et al. (2018), a study on the effects of non-nutritive sucking and maternal milk odor on preterm neonates' oral feeding development, stimulating preterm neonates with breast milk odor led to longer sucking bursts and noticeably more sucking bursts overall. Long bursts of sucking suggest the baby is changing to a more mature feeding and sucking style.

Sleep considered as an important physiological function for health of all children. Bad physical and psychological health outcomes result from inappropriate sleep pattern. It was found in the current study that there were statistical significant differences between both groups concerning quiet sleep after feeding on the third and seventh days (table 3). This finding may be justified by maternal odor can soothe neonates, reduce crying, and induce feeding behaviors, a suite of effects that can accelerate sleep onset. From another point of view, the smell of breast milk is preferred by neonates and thus helps them to feed in more quantity, which leads to a feeling of satiety, which in turn helps preterm neonates sleep in a better way. The findings of the present study are in line with Gaeta & Wilson, (2022) who conducted study about reciprocal relationships between sleep and smell. They reported that familiar odors can modulate sleep latency, quality, and duration.

Crying is probably the most salient, and the most likely behavior to seek the clinical concerns (Shinya et al., 2014). The present study findings revealed that none of the preterm neonates in the olfactory stimulation group cried after feeding compared to only one-third of the preterm neonates in the control group on the seventh day (Table 3). This finding may be justified by the nature of exposure to familiar odors such as breast milk can be effective in reducing preterm neonates crying and facial changes during traumatic procedures. Therefore, preterm neonates may sometimes experience flatulence and colic after feeding which unfortunately leads to discomfort and crying after feeding. Therefore, breast milk odor had a better analgesic effect in premature infants. So that preterm neonates who were exposed to the smell of milk, felt less discomfort than other preterm neonates that were not exposed to it. The findings of the present study are consistent with Zhang et al. (2018) who conducted a study about the analgesic effects of maternal milk odor on newborns and reported that maternal milk odor have analgesic role in neonates. Another study about the effect of inhaling mother’s breast milk odor on the behavioral responses to pain caused by vaccine in preterm infants which conducted by Rad, et al. (2021) who demonstrated that fetal-maternal smells, such as those from the mother's breast milk, body, and amniotic fluid, can reduce stress reactions in neonates, such as crying and motor activity, particularly in those who are separated from their breast milk or who are undergoing traumatic therapies.

The provision of an adequate amount of nutrition to preterm neonates is very important to overcome their needs for immature organs, especially the gastrointestinal system. In this regard, the results of the current study revealed that the preterm neonates in the olfactory stimulation group received more amount of milk than preterm neonates in the control group in the three days (table 4). This could be explained in the light of the following; the breast milk odor can reduces gastric residual

volume and improves digestive function in preterm neonates which in turn, leads to increase of the non-nutritive sucking and their ability to feed more (Lee et al., 2019). Furthermore, the breast milk odor is attractive and stimulates the appetite of preterm neonates which acts as a feeding stimulant that can stimulate the tendency to consume more amounts of milk, and speed up the process of digestion in preterm neonates (Muelbert et al., 2021). From another perception, The smell of milk stimulates different parts of the digestive system first, increasing saliva secretion from the salivary glands and the digestion process begins as a result of the presence of salivary enzymes, then stomach secrete digestion enzymes and this leads to increased bowel movement. This in turn helps stimulate stomach emptying by increasing the contraction of parts of the digestive tract (Muelbert et al, 2019).The findings of the current study are in the same line with Tafrishi et al. (2020) who conducted a study about the association of weight of premature infant and aromatherapy. They reported that the infants exposed to the odor of breast milk fed a more amount of milk and had discharge early from hospital.

The ability of preterm neonates to gain weight is standard for early discharge from the hospital. Also, weight gain of preterm neonates is one of the important indicators of preterm neonates' health (Younesian, et al., 2015; Niknajadet al., 2012). The result of the present study illustrated that there was a statistically significant increase in the weight of preterm neonates among the olfactory stimulation group on the third and seventh days (table 5). This finding could be justified by the fact of breast milk has a very specific effect that are extremely attractive to neonates which increase the preterm neonate's preferences to increase enteral feeding intake. This increase in the amount of enteral feeding intake among the olfactory stimulation group was the main indicator to weight gain. This result is congruent with findings of a study conducted by Pouraboli et al. (2015) who showed that preterm neonates who are motivated by the breast milk odor begin breastfeeding more quickly and acquire weight at a more acceptable rate than other preterm neonates. Ahmad (2019) also found that preterm neonates who smell breast milk started oral feeding faster and started gaining weight while spending less time in the hospital.

CONCLUSION

According to the findings of the present study, it can be concluded that the preterm neonates who received breast milk olfactory stimulation had organized behaviors including oral directed behavior and behavioral states than preterm neonates in the control group. Moreover, the preterm neonates who received breast milk olfactory stimulation also had feeding progression (weight gain and amount of milk received daily) more than preterm neonates in the control group.

RECOMMENDATIONS

Based on the previous findings and conclusion, the following recommendations were suggested:

1. Various types of sensory stimulation should be integrated in NICU routine care for preterm neonates
2. Neonatal Intensive Care Nurses should be trained about the application of olfactory stimulation for the preterm neonates.
3. Establishing a health education program regarding olfactory stimulation for mothers.

FURTHER STUDY:

1. Study about the effect of odor of breast milk versus vanilla odor on physiological parameters and on relaxation among preterm neonates.
2. Study about the effect of breast milk olfactory stimulation on growth parameters among low birth weight neonates.
3. Study about the effect of breast milk olfactory stimulation in reducing neonate's pain during painful procedures.

References

Ahmed, F. (2019). Breast Milk Odor Effecton Weight Gain, First Breastfeeding Time and Length of Hospital Stay in Premature Infants. Journal of Nursing and Health Science, 8(3), 42-49.

Akcan, E., & Polat, S. (2016). Comparative effect of the smells of amniotic fluid, breast milk, and lavender on newborns' pain during heel lance. Breastfeeding Medicine, 11(6), 309-314.

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.

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.

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), 260-6.

Davidson, J., Ruthazer, R., & Maron, J. L. (2019). Optimal timing to utilize olfactory stimulation with maternal breast milk to improve oral feeding skills in the premature newborn. Breastfeeding Medicine, 14(4), 230-235.

De Clifford-Faugère, G., Lavallée, A., & Aita, M. (2017). Olfactive stimulation interventions for managing procedural pain in preterm and full-term neonates: a systematic review protocol. Systematic Reviews, 6, 1-6.

Farneti, D., & Genovese, E. (2017). Swallowing disorders in newborn and small children. IntechOpen.

Gaeta, G., & Wilson, D. A. (2022). Reciprocal relationships between sleep and smell. Frontiers in Neural Circuits, 16, 1076354

Hassan, A. M. (2022). Incidence of Preterm Infants, Indications of Admission, Risk Factors, and Discharge Outcome: A Retrospective Study. The Open Nursing Journal, 16

Hay, W. W. (2018). Nutritional support strategies for the preterm infant in the neonatal intensive care unit. Pediatric gastroenterology, hepatology & nutrition, 21(4), 234-247.

Hym, C., Forma, V., Anderson, D. I., Provasi, J., Granjon, L., Huet, V., & Barbu-Roth, M. (2021). Newborn crawling and rooting in response to maternal breast odor. Developmental science, 24(3), e13061.oral d bfdairected behavioral responses of preterm neonates

Khakpour, M., Akhavan, H., Eshkil, S., Khodabakhshi, A., Dolatian, Z., Raji, S., & Soleimani Houni, M. (2022). Olfactory Stimulation by Breast Milk Odor May Improve Behavioral Feeding in Preterm Infants: A Review. International Journal of Pediatrics, 10(1), 15191-15204.

Khodagholi, Z., Zarifian, T., Soleimani, F., Shariati, M. K., & Bakhshi, E. (2018). The effect of non-nutritive sucking and maternal milk odor on the independent oral feeding in preterm infants. Iranian journal of child neurology, 12(4), 55.

Keven, N., & Akins, K. A. (2017). Neonatal imitation in context: Sensorimotor development in the perinatal period. Behavioral and Brain Sciences, 40, e381..

Lee, E. J. (2019). The effects of breast milk olfactory stimulation on physiological responses, oral feeding progression and body weight in preterm infants. Journal of Korean Academy of Nursing, 49(2), 126-136.

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

Loos, H. M., Reger, D., & Schaal, B. (2019). The odour of human milk: Its chemical variability and detection by newborns. Physiology & behavior, 199, 88-99.

Louyeh, Z. S., Naderifar, M., Faghihi, H., Knoll, B. S. L., & Mahmoodi, N. (2020). Comparing the effect of breast milk odor and incubator cover on nutritional adequacy of premature infants: a quasi-experimental study. Medical-Surgical Nursing Journal, 9(2).

Lyons-Warren, A. M., Herman, I., Hunt, P. J., & Arenkiel, B. R. (2021). A systematic-review of olfactory deficits in neurodevelopmental disorders: From mouse to human.

Neuroscience & Biobehavioral Reviews, 125, 110-121.

Marshall, A. P., Lim, K., Ali, S. K., Gale, T. J., & Dargaville, P. A. (2019). Physiological instability after respiratory pauses in preterm infants. Pediatric Pulmonology, 54(11), 1712-1721.

McDonald, F. B., Dempsey, E. M., & O'Halloran, K. D. (2020). The impact of preterm adversity on cardiorespiratory function. Experimental Physiology, 105(1), 17-43.

Muelbert, M., Bloomfield, F. H., Pundir, S., Harding, J. E., & Pook, C. (2021). Olfactory cues in infant feeds: volatile profiles of different milks fed to preterm infants. Frontiers in Nutrition, 7, 603090.

Muelbert, M., Lin, L., Bloomfield, F. H., & Harding, J. E. (2019). Exposure to the smell and taste of milk to accelerate feeding in preterm infants. Cochrane Database of Systematic Reviews, (7).

Mustapha, M., Wilson, K. A., & Barr, S. (2021). Optimising nutrition of preterm and term infants in the neonatal intensive care unit. Paediatrics and Child Health, 31(1), 38-45.

Niknajad, A., Ghojazadeh, M., Sattarzadeh, N., Hashemi, F. B., & Shahgholi, F. D. K. (2012). Factors affecting the neonatal intensive care unit stay duration in very low birth weight premature infants. Journal of caring sciences, 1(2), 85.

Park, Y. A., & Im, Y. J. (2020). The effects of a continuous olfactory stimulation using breast milk (COSB) on behavioral state and physiological responses in Korean premature infants. Journal of pediatric nursing, 53, e114-e120.

Pouraboli , B., Shamsi, A.,& Iranmanesh, S. (2015). The effect of breast milk odor on first breast feeding time and weight gain in premature infants. I-Manager's Journal on Nursing, 5(3),27-34.doi:10.26634/jnur.5.3.3627.

Rad, Z. A., Aziznejadroshan, P., Amiri, A. S., Ahangar, H. G., & Valizadehchari, Z. (2021). The effect of inhaling mother's breast milk odor on the behavioral responses to pain caused by hepatitis B vaccine in preterm infants: a randomized clinical trial. BMC pediatrics, 21, 1-6.

Séassau, A., Munos, P., Gire, C., Tosello, B., & Carchon, I. (2023). Neonatal Care Unit Interventions on Preterm Development. Children, 10(6), 999.

Tasci, B., & Kuzlu Ayyildiz, T. (2020). The calming effect of maternal breast milk odor on term infant: A randomized controlled trial. Breastfeeding Medicine, 15(11), 724-730.

Tufo, C., Poopalasundaram, S., Dorrego-Rivas, A., Ford, M. C., Graham, A., & Grubb, M. S. (2022). Development of the mammalian main olfactory bulb. *Development*, *149*(3), dev200210.

Shinya, Y., Kawai, M., Niwa, F., & Myowa-Yamakoshi, M. (2014). Preterm birth is associated with an increased fundamental frequency of spontaneous crying in human infants at term-equivalent age. Biology letters, 10(8), 20140350.

Tafrishi, R., Ghahremani, S., Moeindarbary, S., Badpeyma, M., Heydari, O., Ashrafinia, F., ... & Ahmadian, M. (2020). Association of Weight of Premature Infant and Aromatherapy: A Systematic Review. International Journal of Pediatrics, 8(1), 10789-10798.

White-Traut, R., Rankin, K. M., Pham, T., Li, Z., & Liu, L. (2014). Preterm infants' orally directed behaviors and behavioral state responses to the integrated H-HOPE intervention. Infant Behavior and Development, 37(4), 583-596

World Health Organization [WHO]. (2023). Preterm birth. WHO.

Younesian, S., Yadegari, F., & Soleimani, F. (2015). Impact of oral sensory motor stimulation on feeding performance, length of hospital stay, and weight gain of preterm infants in NICU. Iranian Red Crescent Medical Journal, 17(7).

Zhang, S., Su, F., Li, J., & Chen, W. (2018). The analgesic effects of maternal milk odor on newborns: a meta-analysis. Breastfeeding Medicine, 13(5), 327-334.

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