Effect of Olfactory and Gustatory Stimulation on Premature Neonates ' Feeding Progression and Sniffing Away Feeding Tube

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Abstract
Background: Premature neonates have feeding problems due to immaturity; As a result, until they acquire sufficient oral eating abilities, they require continuous enteral feeding. Interventions to enhance feeding outcomes of premature neonates and feeding outcomes is olfactory and gustatory stimulation. **The study was aimed to** determine the effect of olfactory and gustatory stimulations on premature neonates ' feeding progression and sniffing away feeding tube. **Subjects and method:** A quasi-experimental research design was used in the present study. Convenience sampling of fifty premature neonates. The study was conducted at Neonatal Intensive Care Unit of Tanta Main University Hospital which affiliated to Ministry of Higher Education and Scientific Research. **Three Tools include:** Characteristics of premature neonates, Feeding pattern and intolerance of premature neonates' assessment tool 2018, Growth monitoring and physiological measurement of premature neonates. **The result** indicated that majority of studied neonates in the study group sniffed away the feeding tube to achieve full sucking in a shorter duration than neonates within the group under control. **The study concluded that** premature neonates who received olfactory and gustatory stimulation had improved feeding abilities and had faster sniffing away feeding tube to reach full feeding. **The study recommended** that written guidelines and procedures of the NICU should adopt the olfactory and gustatory stimulations in their care.
Keywords: premature neonates, olfactory and gustatory stimulation, feeding progression, sniffing away feeding tube.

Introduction

Premature birth is the primary factor associated with decreased survival and quality of life. Every year, almost 15 million newborns are prematurely born throughout the world. Neonates born prematurely are especially susceptible to problems because of their weakened breathing, trouble feeding, irregular body temperature, and increased risk of infection **(Parada et al 2019)**. Premature neonates are not fully established sucking, swallowing, and gastric emptying and they only become effectively coordinated when a child reaches term. Consequently, the gastrointestinal system of a premature neonates is not as developed functionally to receive breast milk as it would be at a full age to properly digest and absorb the nutrients from milk feedings, the gastrointestinal tract must be mature. Nutritional assistance, which supports the newborn based on its gastrointestinal maturity status, is an essential component of neonatal care. **(Indrio et al 2022).**

Premature newborns who are premature to consume their milk orally must be fed via a feeding tube multiple times a day. Before placing the tube, measure its length (from the corner of the nose or mouth to the lobe of the ear to the tip of the xiphoid process). The literature has found several mechanisms behind feeding difficulties, including underdeveloped or defective sucking skills and poor coordination between the sucking, swallowing, and breathing movements. **(Thoyre et al 2018)**

One of the primary requirements for a discharge from the hospital is complete oral feeding. Finding how to accelerate the switch from tube feeding to full oral feeding is therefore critically needed. A number of therapies have been shown to enhance their abilities for transition to autonomous oral feeding that include non-nutritive sucking, oral stimulation, and tactile or kinetic manipulations **(Girgin et al 2021).**

Premature neonates struggle to feed Because of their immaturity in both physiology and neurology, Consequently, until sufficient oral feeding capacity is attained, enteral nourishment is administered. As a result, oral feeding skills development is delayed and an extended hospital stay. Premature neonates had functional taste receptors from 18 weeks postmenstrual age. This was confirmed at 24 weeks postmenstrual age **(Elsayed & Kunswa,2022)**.

Olfactory development was known to be greater maturity at birth than other aspects of sensory development in term and premature neonates, olfaction was reported to begin approximately the 24th week of gestation, that premature neonates show responses to olfactory stimulation after 28 weeks of gestation **(Beker et al 2019).** The senses of smell and taste play an important role in nutrition. The brain triggers a sequence of pre-absorptive physiological reactions known as cephalic-phase responses in response to these stimuli **(Park et al 2020)**

In order to maximize digestion, the cephalic phase response is crucial in triggering a variety of physiological processes, such as increased peristalsis, salivation and digestion enzyme. **(Granger et al 2018**). Giving safe feeding and proper nutritional support is a crucial aspect of providing care for premature neonates. This has presented challenges for nurses who have to train mothers to express their breast milk as premature neonates are in need for feeding by gavage and also for the stimulating effect of its smell and taste. This will enable them to switch rapidly to oral feeding **(Le et al 2021)** .

Significance of the study

Extended intravenous feeding raises the possibility of long stays in the hospital and late-onset sepsis and increased healthcare costs. In addition, delays in enteral nutrition can affect the mucosa of the gastrointestinal tract and raise the possibility of necrotizing enter colitis once tube feeding is initiated, affecting hospital expenses and early survival.so, interventions that hasten transition to tube feeding, to oral feeding, might potentially be quite beneficial to premature neonates, their family as well as the medical system. The two main kinds of interventions included gustatory and olfactory stimulations that improve the standard of premature neonates, their feeding outcomes, accelerate oral intake and removing feeding tube **(Johnson et al 2014).**

Aim of the study

The study was aimed to determine the effect of olfactory and gustatory stimulations on premature neonates ' feeding progression and sniffing away feeding tube.

Research hypotheses:

1- Premature neonates who receive olfactory and gustatory stimulation are expected to be improved feeding abilities than in control group.

2- Premature neonates who receive olfactory and gustatory stimulation are expected to be faster sniffing away feeding tube than in control group

Research Design:

A quasi-experimental research design was used in the present study.

Setting:

The study was conducted at: **Neonatal Intensive Care Unit of Tanta Main University Hospital** which affiliated to Ministry of Higher Education and scientific Research. It consisted of three rooms, room one contained five incubators, room two contained twelve incubators and room three contained seven incubators. The rooms are equipped with phototherapy device, monitor, pulse oxmeter, glucometer, syringe pump and mechanical ventilators.

Subjects

Convenience sampling of 50 premature neonates from above previously mentioned setting. The calculation of sample is based on type 1 error 0.05 and confidence level 95%, The neonates were selected randomly for either the study group or the control group, based on the serial numbers of their cases. Neonates with single numbers were selected for the study group, while those with double numbers were selected for the control group. Based on the following inclusion criteria:

Inclusion criteria of premature neonates:

-Both sexes

-On the first day of beginning orogastric or nasogastric tube feeding. and not reached full sucking feeds

-Gestational age from 28 to 36 weeks
-Premature neonates who were under phototherapy or placed on oxygenated Incubator
-Physiological stability

Exclusion criteria of premature neonates:

-Critically ill who were on mode Assist control mode on MV

- Brain injury or head trauma, congenital anomalies of gastrointestinal tract and neonatal sepsis or who receive any analgesics or sedatives.

Group (I): Twenty-five of premature neonates who received olfactory and gustatory stimulation before and during tube feeding in addition to routine premature neonates' care.

Group (II): Twenty-five of premature neonates received routine care as tube feeding without stimulation.

Tools of Data Collection

In order to collect the necessary data, three different tools were used:

Tool 1: Characteristics and medical history of premature neonates

-Part (1): Characteristics of premature neonates such as age when admitted neonatal intensive care units, sex and birth weight.

-Part (2): Medical history of the premature neonates It included gestational age, diagnosis, type of delivery, length of hospitalization, weight, chest and mid arm circumference

Tool II: Feeding pattern and intolerance of premature neonates' assessment tool 2018: The researcher created this tool following a careful analysis of the most recent studies. It was employed to evaluate the feeding progression and feeding tube sniffing of premature neonates **(Neelam et al 2018) (Rosen et al 2018).** There were five parts to it:

Part (1) premature neonates feeding pattern which included:

-Time of start tube feeding
-Type of feeding through tube feeding
-Duration of reaching full feeding

Part (2): Feeding intolerance criteria which included:

-Increase Gastric residual volume (more than 30%) of the previous feed
- Vomiting.
- Abdominal distension

Part (3): Premature neonates consumed milk to prescribed volume per feed

Part (4): Premature neonates' abilities to organize oral motor function which included:

- At the start of feeding, open mouth when lips are stroked
-When feeding is underway, maintain a steady, rhythmic sucking pattern
-Maintain a stable sucking and swallowing pattern with rhythmic feeding

Part (5): Time to sniffing away feeding tube of premature neonates to reach full sucking: It included premature neonates' time of transfer from tube feeding to oral feeding.

Tool III: Growth monitoring and physiological measurement of premature neonates which consisted of two parts: -

Part (1): Measurement of weight, arm, chest and abdominal circumference

Premature neonates' weight gain was measured in grams using a digital scale from initiation of tube feeding until the initiation of oral feeding. And a measuring tape to determine the circumference of the chest, abdomen, and midarm. (**Pouraboli et al 2015)**

Part (2): Physiological measurement and oxygen saturation

The researcher measured physiological responses as temperature, heart rate, oxygen saturation (less than 90%) and bradycardia from cardiac monitor, and also recorded the occurrence of aspiration, gaging, chocking or apnea. **(Neshat etal. 2016) (Shamsi et al 2014)**

Method

1-Administrative process:

Following an explanation of the goal of the study, the administration of the mentioned setting formally gave permission for the study to be carried out.

2-Ethical and legal considerations: -

- Ethical and legal approval was obtained from Faculty of Nursing Scientific Research Ethical Committee code No.111-10/2022 and from faculty of medicine Ethical Committee No.36033/11/22
- Premature neonates' privacy and confidentiality were taken into consideration. After informing the parents of the study's purpose and their ability to withdraw from it at any time and they gave their agreement to participate.

3- Tools Development:

The researcher used three tools that included: Characteristics of premature neonates, Feeding pattern and intolerance of premature neonates' assessment tool 2018, Growth monitoring and physiological measurement of premature neonates.

4-Content validity: The study instruments were given to a panel of five experts in the field to assess content validity, comprehensibility, applicability and ease of administration. The content validity index was 98.5%.

5- Internal consistency was used to test the reliability of the tools used. The value of Cronbach's alpha coefficient was 0.831 for Tool II and 0.682 for Tool III.

6-A pilot study: To test the clarity, visibility and applicability of the study instruments, it was carried out on a sample of five premature neonates, who were then included in the study.

Phases of the study:

1-Assessment phase: It was conducted by the researcher for two groups to assess premature neonates in the NICU who met the inclusion criteria.

2-Implementation phase:

a-The researcher was present from 9am in the morning shift to 3am in the evening shift every day to collect the data.

b-Initially, the researcher recorded the baseline data of premature neonates using. (Tool, I part 1,2)

-for the intervention group: Tool II, Tool III was used for all premature neonates in the intervention group, all parts of Tool II except part (5) were used for the initial assessment (first day of tube feeding).

a- Evaluate the progress of the premature neonates and assess the feeding pattern of the premature neonates which includes: Time of initiation of tube feeding, type of tube feeding, duration of achieving full feeding,

b- Evaluate feeding intolerance criteria .

c- Weight measurement every morning, using a digital scale to observe the weight changes between starting of tube feeding and oral feeding**.**

d-The researcher measured growth measurements by using measuring tape

Original picture: Fresh breast milk taken from the mothers for neonate olfactory and gustatory stimulation

-**Olfactory and Gustatory stimulation was applied on study group before and during starting tube feeding as follow:**

e-The olfactory (smell) stimulation:
A few drops of freshly expressed breast milk should be placed on a sterile cotton swab 1.5 to 2 cm from the premature baby's nasal septum before and during tube feeding.

f-The gustatory (taste) stimulation by the application of a few drops of a mother's fresh breast milk with sterile cotton wool to the lips or tongue of premature infants before and during tube feeding. (Tool II)

h-The researcher started to give amount of milk via tube feeding

i-The researcher repeated this procedure during tube feeding and assess physiological measurements and oxygen saturation, the researcher measured physiological responses during feeding.

j-Evaluate for any adverse effects such as apnea during feeding, aspiration, gagging or choking.

Second assessment (first day of oral feeding) using Tool II, Tool III.

a-The researcher measured the premature infants' weight gain on the first day, of oral feeding every morning using a digital scale. then performed olfactory and gustatory stimulation before starting oral feeding.

b-Assessment of oral motor skills and time taken to sniff the feeding tube in premature infants to achieve full feeding.

C- The researcher measured mid-arm, abdomen and chest circumference using a tape measure then temperature, heart rate, oxygen saturation during oral feeding.

d-Assess the occurrence of any adverse effects such as apnea during oral feeding, aspiration, gagging or chocking

d- The study group who had received a previous the oral stimulation program lasted fifteen minutes, the first ten minutes of which involved the researcher gently touching neonates' cheeks, lips, gums and tongue, and the last five minutes involved sucking on a pacifier commonly used in the nursery.

For the control group

a- Tool II, Tool III were used for all premature neonates in the control group in the same way and at the same times as mentioned above for the study group.

b- Then, routine care was received before and during the tube feeding of the premature neonates .

3- **Evaluation phase:** At the end of the study, the effect of the intervention on the feeding progress of premature neonates will be compared between the two groups. After six months, data was gathered from the beginning of December 2022 to June 2023.

Statistical analysis:

The data was organized, tabulated, and statistically analyzed using IBM SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). For calculated subject's sample, descriptive statistical analysis was performed. For numerical values, the range, mean, and standard deviations were evaluated. For categorical variables, the number and percentage were determined, and differences between subcategories were examined using the Fisher or Monte Carlo exact tests. Pearson's correlation coefficient was used to determine the relationship between two variables. The level of significance was adopted at p 0.05. **(Whit 2019)**

Results

Table (1): Illustrates percentage distribution of premature neonates according to their medical history. This table showed that 60% of the study group neonates were late premature and their gestational age was 34-36 weeks while 48% of neonates in the control group were moderate premature ranged from 32 to less than 34 weeks. Regarding their diagnosis, 52% of the premature neonates in the study group had hyperbilirubinemia also 52% of the control group had respiratory distress syndrome. Regarding their type of delivery 92% and 80% of the premature neonates in the study and control groups respectively was born through caesarean section. Regarding their length of hospital stay, there were 68% of the premature neonates in the study group ranged from 8-14 days and 36% of the control group ranged from 15-21days.

Table (2): Demonstrates percentage distribution of premature neonates according to duration of reaching full enteral feeding. This table represents that 96% and 76% of premature neonates in study and control group respectively reaching full enteral feeding less than ten days with mean ± SD= 6.32± 0.85 and 9.60 ± 1.32.

Table (3): Demonstrates percentage distribution of premature neonates according to their feeding intolerance criteria**.** This table showed that 76% and 68% of premature neonates in study and control group in the first day of tube feeding had gastric residual volume less than 30% respectively without statistically significant differences between where p=0. 529. While at the first day of oral feeding, there were 92% and 64% of them in study group and control group, respectively had gastric residual volume less than 30% respectively. Regarding to occurrence vomiting, Neonates in the study and control group ,40% and 52% had vomiting in first day of initiating tube feeding. While in the first day of oral feeding there were 92% and 60% of neonates in study and control group had not vomiting respectively, there were statistically significant differences among two groups where p=0.008. Regarding to the abdominal distention, there were 56% and 52% in the study and control group respectively had not abdominal distention before feeding while 64% and 52% in the study and control group respectively had not abdominal distention after feeding in first day of tube feeding. While in the first day of oral feeding there were 96% and 72% in the study and control group respectively had not abdominal distention before feeding, all of study sample and nearly three quarters (76%) in the study and control group respectively had no abdominal distention after feeding in the first day of oral feeding, there were statistically significant differences between both groups where p=0.049 and p=0.022 before and after feeding respectively.

Figure (1): shows the time premature neonates takes to sniff feeding tube and achieve optimal sucking. This figure showed that the majority of premature neonates (96%) in the study group sniffed the feeding tube to achieve optimal sucking less than 15 days compared to all of them in the control group sniffed the feeding tube from 15 to 19 days. There were statistically significant differences between two groups where p=<0.001.

Figure (2): Illustrates premature neonates according to their weight**.** This figure showed that there were 60% and 56% of the premature neonates, their weight ranged from 1500 to 2500 gm in the study and control group respectively. There were no statistically significant differences between two groups p=0.991. During first day of tube feeding, all premature neonates (100%) in study group their weight ranged from 1500 to 2500 gm while 52.0% in control group their weight was less than 1500gm. There were statistically significant differences among two groups where p=<0.002.

Figure (3): Illustrates premature neonates according to their mid arm circumference**.** This figure showed that there were 68% of the neonates in the study group, their mid arm circumference ranged from 8-10cm, and 60% of the control group, their mid arm circumference ranged from 6-7.5cm in first day of tube feeding. At the first day of oral feeding, there were 76% in study and control group, their mid arm circumference ranged from 8-10cm.

Figure (4): Illustrates premature neonates according to their abdominal circumference**.** This figure showed that there were 56% and 48% of the premature neonates, their abdominal circumference ranged from 26-30 cm in the study and control group respectively in the first day of tube feeding with mean ± SD=27.04 ± 2.80 and 25.98 ± 2.38 in study and control group respectively. While at the first day of oral feeding, there were 68% and 96% in study and control group respectively, their abdominal circumference ranged from 26-30cm with mean ± SD =29.62±2.36 and 27.26 ± 1.79 in study and control respectively.

Figure (5): Illustrates premature neonates according to their chest circumference**.** This figure showed that there were 48% of the study group's premature neonates, their chest circumference ranged from 27-30cm, and 68.0% of the control group, it ranged from 24-26 cm in the first day of tube feeding, compared to in first day of initiating oral feeding, there was 64% and 72% in study and control group respectively, their chest circumference ranged from 27-30 cm.

Table (4): Demonstrates effectiveness of two studied group according to their occurrence of adverse effects during feeding. This table showed that**,** oxygen saturation <90%, in did not occur in both group during tube and oral feeding. Regarding to bradycardia, 28% and 40% of premature neonates in study and control group respectively, in the first day of tube feeding suffered from bradycardia. compared to 40% and 48% of premature neonates in study and control group respectively in the first day of oral feeding. It was observed that 20% and 24% of premature neonates in study and control group respectively, in the first day of tube feeding suffered from aspiration, gaging and chocking that became 32% and 40% at the first day of oral feeding. On the other hand, 16% and 20% of premature neonates in study and control group respectively, in the first day of tube feeding suffered from apnea. that became 12% and 16% at the first day of oral. There were no statistically significant differences between two groups regarding to Oxygen saturation <90%, bradycardia, aspiration, gaging, chocking and apnea where p=0.370, p=0.733 and p=1.000 during first day of tube feeding respectively, p=0.569, p=0.556 and p=1.000 during first day of oral feeding respectively.

Table (1): Percentage distribution of premature neonates according to their medical history

Medical history of the premature neonates	Study group (n = 25)		Control group (n = 25)	
	No.	%	No.	%
Gestational age				
Late premature (34-36weeks)	15	60.0	10	40.0
Moderate premature (32-<34weeks)	8	32.0	12	48.0
Very premature (28-< 32weeks)	2	8.0	3	12.0
Current diagnosis				
Hyperbilirubinemia	13	52.0	8	32.0
Neonates of diabetic mother	8	32.0	4	16.0
Respiratory distress syndrome	4	16.0	13	52.0
Other	0	0.0	0	0.0
Type of delivery				
Vaginal delivery	2	8.0	5	20.0
Cesarean section	23	92.0	20	80.0
Length of hospital stay				
1-7 days	5	20.0	6	24.0
8-14 days	17	68.0	8	32.0
15-21 days	3	12.0	9	36.0
22-28 days	0	0.0	2	8.0

Table (2): Percentage distribution of premature neonates according to duration of reaching full Enteral feeding (days)

Duration of reaching full Enteral feeding (days)	Study group (n = 25)		Control group (n = 25)		Test of Sig.	p
	No.	%	No.	%		
<10 days	24	96.0	19	76.0	χ^2= 4.153	^{FE}p= 0.098
10-13days	1	4.0	6	24.0		
Range	6.0 – 10.0		9.0 – 13.0		t= 10.421*	<0.001*
Mean ± SD.	6.32 ± 0.85		9.60 ± 1.32			

Table (3): Percentage distribution of premature neonates according to their feeding intolerance criteria

Feeding intolerance criteria:	1st day of tube feeding					1st day of oral feeding				
	Study group (n = 25)		Control group (n = 25)		χ^2 (p)	Study group (n = 25)		Control group (n = 25)		χ^2 (p)
	No.	%	No.	%		No.	%	No.	%	
Gastric residual volume										
Less than 30%	19	76.0	17	68.0	0.397 (0.529)	23	92.0	16	64.0	5.711* (0.017*)
More than 30%	6	24.0	8	32.0		2	8.0	9	36.0	
Presence of vomiting										
Yes	10	40.0	13	52.0	0.725 (0.395)	2	8.0	10	40.0	7.018* (0.008*)
No	15	60.0	12	48.0		23	92.0	15	60.0	
Presence of abdominal distension										
Before feeding										
Yes	11	44.0	12	48.0	0.081 (0.777)	1	4.0	7	28.0	5.357* (^{FE}p=0.049*)
No	14	56.0	13	52.0		24	96.0	18	72.0	
After feeding										
Yes	9	36.0	12	48.0	0.739 (0.390)	0	0.0	6	24.0	6.818* (^{FE}p=0.022*)
No	16	64.0	13	52.0		25	100.0	19	76.0	

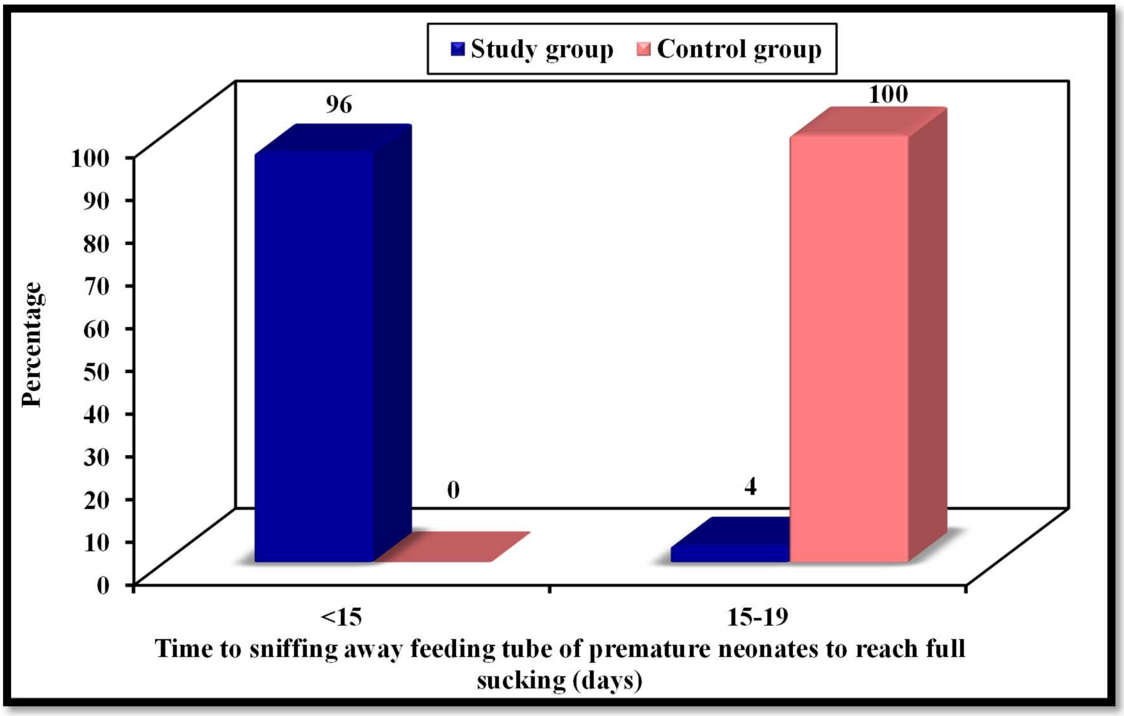

Figure (1): premature neonates according to their Time to sniff away feeding tube and reach full sucking. (n=50)

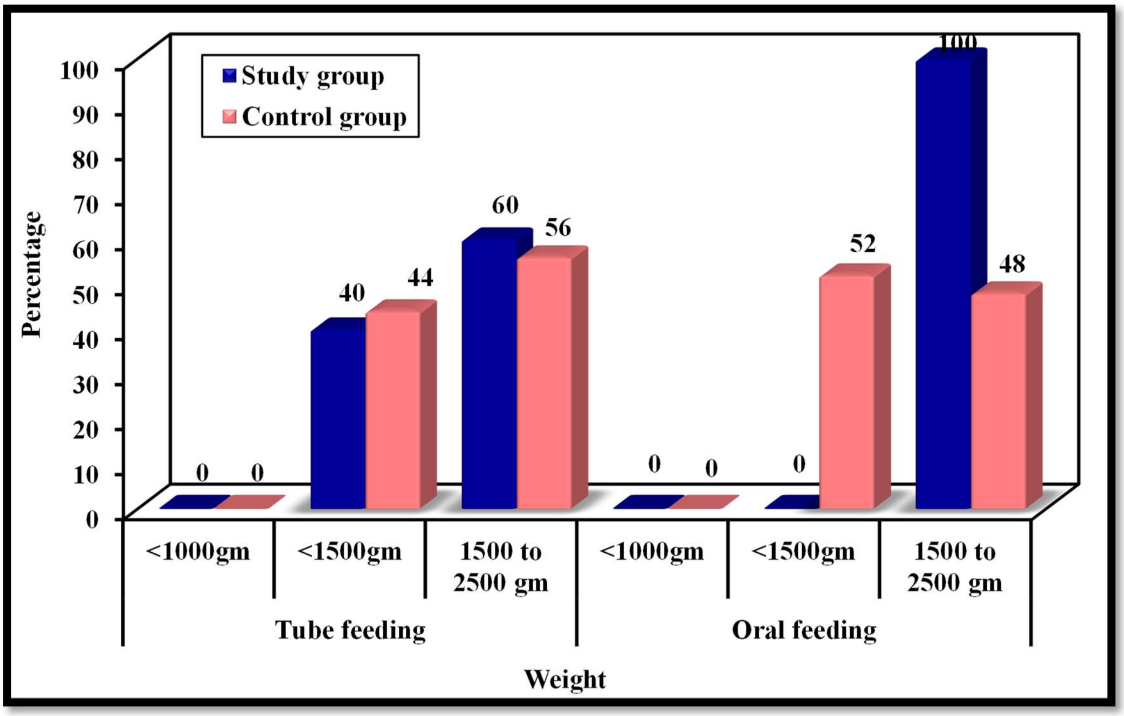

Figure (2): premature neonates according to their weight. (n=50).

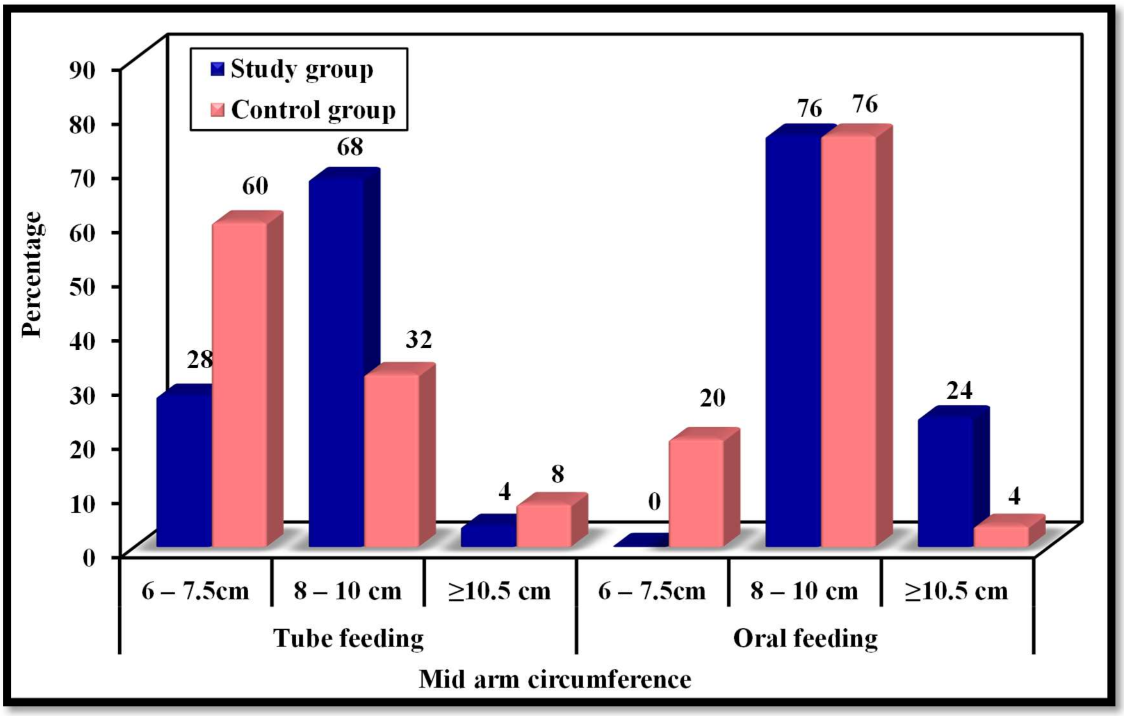

Figure (3): Premature neonates according to their mid arm circumference. (n=50).

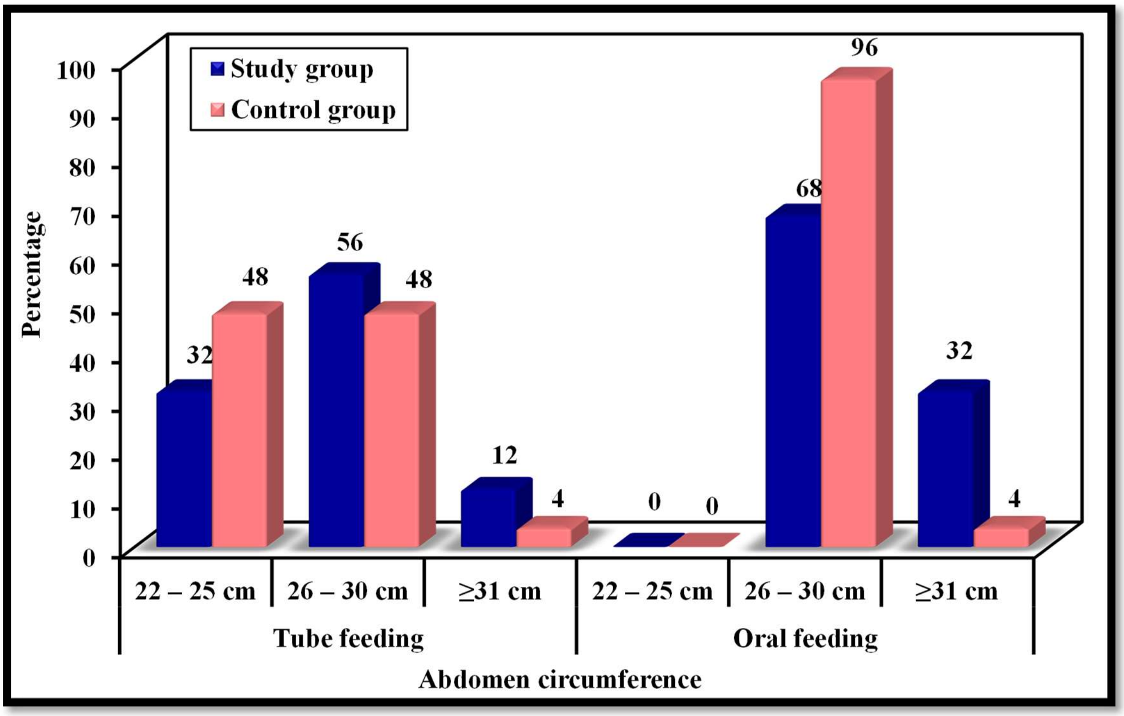

Figure (4): Premature neonates according to their abdominal circumference. (n=50)

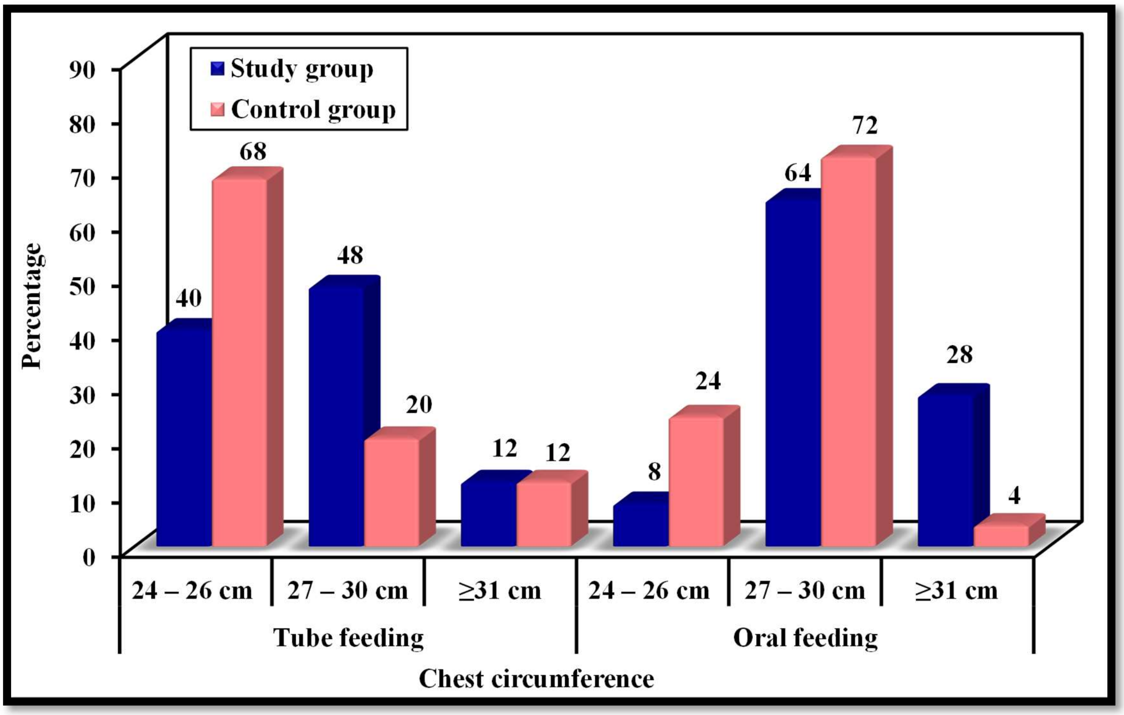

Figure (5): Premature neonates according to chest circumference. (n=50).

Table (4): Distribution of two studied group according to their occurrence of adverse effects during feeding.

Occurrence of adverse effects during feeding	1st day of tube feeding					1st day of oral feeding				
	Study group (n = 25)		Control group (n = 25)		χ^2 (p)	Study group (n = 25)		Control group (n = 25)		χ^2 (p)
	No.	%	No.	%		No.	%	No.	%	
Oxygen saturation <90%,	0	0.0	0	0.0	–	0	0.0	0	0.0	–
Brady cardia	7	28.0	10	40.0	0.802 (0.370)	10	40.0	12	48.0	0.325 (0.569)
Aspiration, Gaging, Chocking	5	20.0	6	24.0	0.117 (0.733)	8	32.0	10	40.0	0.347 (0.556)
Apnea	4	16.0	5	20.0	0.136 (^{FE}p= 1.000)	3	12.0	4	16.0	0.166 (^{FE}p= 1.000)

Discussion

Nowadays, Main reason of mortality during the first four weeks of life is prematurity. Over one million newborns globally are estimated to have died from prematurity, out of 15 million premature births **(WHO Organization 2018)**. Most Premature newborns spent weeks or more in (NICU) as a result of respiratory, nutritional, and other issues. **(Louyeh et al 2020)**. Premature neonates struggle with coordinating feeding due to immature neurologic and digestive systems. They initially receive nutrition through intravenous and tube feedings, gradually transitioning to sucking feeds as their coordination improves **(Beker et al 2021)**. Feeding intolerance, characterized by difficulties in digesting enteral feeds and symptoms like increased gastric residuals and abdominal distension, can delay full enteral feeding and necessitate prolonged intravenous nutrition, having risks such as infection and necrotizing enterocolitis **(Louyeh et al 2020)**.

Olfactory and gustatory stimulation play an important part of the digestive process, triggering cephalic phase responses that optimize various digestive processes. However, the impacts of these stimulation in premature neonates remain poorly understood. Some premature neonates receive olfactory and gustatory stimulation while using a feeding tube, but the practice lacks sufficient evidence and may carry potential risks like aspiration or bradycardia **(Muelbert et al 2021)** . This study indicated that sixty percent of neonates were late premature (34-36 weeks)in study group and half of them were moderate premature(32-less than 34 weeks) in control group, with half of premature neonates diagnosed with hyperbilirubinemia and respiratory distress syndrome ,most of premature neonates were delivered via caesarean section in study and control group respectively, sixty eight percent had a hospital stay of 8-14 days in study group and thirty six percent had a hospital stay of 15-21 days in control group.

In a study by **Khakpour et al. (2022),** in which, between 30 and 33 weeks of gestation, premature newborns were born. Another study included 32 neonates in two groups with gestational ages ranged from 28 to 32 weeks. **(Khodagholi et al., 2018).** Moreover, **Arafa et al. (2021**) who demonstrated that, the study group's mean gestational age was 34.5±4.55 weeks, whereas the control group was 34.7±4.51 weeks. Most of the premature neonates were late premature. Hyperbilirubinemia was the most common premature diagnosis in both groups. Premature neonates in both groups were born by caesarean section.

The current findings demonstrated that majority of premature neonates and three quarter of them in study and control group respectively reaching full enteral feeding less than ten days. This conclusion may be supported by the observation that the taste and smell of milk may increase salivation, digestion-related enzyme secretion during tube feeding, and the emission of hormones concerned with digestion, including insulin, ghrelin, leptin, and gastrin **(Zolotukhin 2012).** This was matched with **(Arafa et al. 2021**) and (**khodagholi et al. 2018**) who indicated that the premature infants in the study group reached full sucking one week earlier than those in control group. Furthermore, it was observed by (**Shamsi et al. 2014) and (Yildiz et al. 2011)** that the smell of mother's milk helped premature newborns attain full feeding quickly.

According to the study of **(Schriever et al 2018)**, who stated that neonates in the intervention group initiated full oral feeding one week prior to control neonates**.** This current study revealed that on feeding tube initiation, a similar proportion of neonates in both groups had gastric residual volumes less than thirty percent, with no significant difference between them. However, during the initial day of oral feeding, a significantly higher percentage of intervention group had gastric residual volumes less than thirty percent compared to sixty four percent of the control group. With regard to vomiting, there were no significant differences between the groups on starting of feeding tube, but during the starting of oral feeding, the study group had significantly less vomiting and abdominal distention compared to the other group.

These findings can be explained by taking into account the importance of the gustatory and olfactory systems, since the ability to taste chemicals has an influence on the amount of milk that is ingested. The brainstem and higher centers trigger response of cephalic phase, releasing hunger hormones when food intake is anticipated. These salivary hormones are believed to increase the peristaltic motions of the intestines and have an effect on metabolism **(Beker et al 2021).**

This was consistent with **Arafa et al. (2021**) who found that on oral feeding initiation following the intervention, there were significantly improvement in all parameters, including mean residual volume of the stomach, without vomiting and abdominal distension. This was in agreement with (**Moore & Wilson, 2011)** who reported that, for premature newborns, enteral feedings are often started at low amounts and raised gradually until the full amount is tolerated. The incapacity to process enteral feeds linked to elevated gastric residue, distended abdomen, vomiting, or both is known as feeding intolerance. This is in line with (**Muelbert et al. 2019),** which highlighted that taste and smell is important to facilitate the absorption and digestion of food. Therefore, giving newborns a taste and smell of milk may increase their tolerance of larger amounts of milk.

The results showed in contrast to every neonate the control group, most of them in the experimental group were sniffing the feeding tube at less than fifteen days. As the smell of milk attracts the neonate to the nipple and induces sucking movements, the beneficial effects of olfactory and gustatory stimulation may be responsible for these results.

In addition, the traditional sequence of pre-feeding behaviors, which includes the experience of sucking and can improve the bond between mother and child, includes the taste stimulation of breast milk as a key component. As tube feeding bypasses the nasal and oral cavities, newborns are less exposed to the taste and smell of their food. As a result, the cephalic phase response to digestion is not as stimulated, which can lead to feed intolerance. This was in harmony with (**Arafa et al 2021)** who reported that average length of time until complete sucking or sniffing among the premature neonates in both groups.

Regarding growth parameters, the findings showed that, there were no statistically significant differences during tube feeding initiation regarding growth parameters that become statistically significant during oral feeding initiation between both groups. This finding may be supported by that neonates who received the intervention were able to better organize their oral-motor functions, sniff away their feeding tubes more quickly, and consume milk than the recommended volume per feed that reflected on increasing their body weight **(Khakpour 2022).**

The results of this study agreed with those of **Beker et al. (2017**), who discovered that premature neonates' weight was improved by the taste and smell of milk. According to research by **Aboli et al. (2015)**, premature neonates that are motivated by the scent of breast milk begin breastfeeding earlier and acquire weight in a way that is far more appropriate than that of other premature neonates. In addition, **Ahmad (2019)** found that premature neonates triggered by the pleasant smell of breast milk began breastfeeding earlier, resulting in improved weight growth and shorter hospital stays. These findings contradict those of **Beker et al (2021)**, and **Khodagholi et al. (2018**) who found that premature infants' weight at discharge did not increase with the regular taste and odor of milk associated with tube feeding.

The current study revealed that, there were no adverse effects of oxygen desaturation, bradycardia, aspiration, gagging, and choking and apnea in either group during tube and oral feeding initiation. These outcomes may be explained by the intervention's favorable impact on premature newborns' feeding patterns without causing distress or negative consequences to those neonates. In addition, Increased oxygen supply to brain cells during sensory stimulation causes an increase in oxygenated hemoglobin concentration in the cerebral cortex. These outcomes were consistent with those of (**Beker et al. 2021)**, who came to the conclusion that being contacted to milk' taste and smell was a cheap, easy applied that may have positive effects with no detectable negative side effects. The current study's findings congruent with those of (**Beker et al. 2017**), who demonstrated that no negative effects associated with taste and smell stimulation. **Muelbert et al. (2021)** agreed with this result and shown how taste and odor have a strong relationship with feeding, and how the orbital frontal cortex may integrate taste and odor information.

Conclusion

Based on these results, it can be concluded that premature neonates who received olfactory and gustatory stimulation had improved feeding abilities and had faster sniffing away feeding tube to reach full feeding. These stimulations were successful in improving oral motor skills, amount of milk consumed, feeding tolerance, physiological responses, weight gain and reducing adverse feeding effects of premature neonates.

Recommendation

Based on this study's findings, these recommendations were indicated:

1- Educational programs on olfactory and gustatory stimulation to improve feeding progress in premature neonates should be provided to NICU nurses.

2- Written policies relating to olfactory and gustatory stimuli should include caring of the Premature neonates and motivate nurse to implement it of their routine nursing care

3- Olfactory and gustatory stimulation could be applied as a supplemental strategy to speeds up the premature newborns' health promotion.

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