Assessment of Time Predictors to Achieve Full Oral Feeding in Preterm Infants

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ABSTRACT

Background: The initiation and achievement of full oral feedings presents a challenge for the preterm infants. Therefore, there is a need to determine when to initiate oral feeding for preterm infants. **Aim:** This study aimed to assess the time predictors to achieve full oral feeding in preterm infants. **Research settings:** The study was carried out at the neonatal intensive care units (NICU) in Tahrir General Hospital and Helwan General Hospital. **Research design:** A descriptive research design was utilized. **Sample:** A Purposive sample composed of 90 preterm infants and their mothers, and 37 nurses. **Tools:** Data were collected by using four tools. **I:** A structured questionnaire sheets that including: Characteristics of preterm infants, mothers and nurses, the preterm infants' physiological state. **II:** Infant driving feeding scales. **III:** Observational checklist for safe bottle feeding. **IV:** Mothers' breast feeding reported practices. **Results**: Less than two thirds of the preterm infants were within the gestational age of 34 to ≤ 36 week and less than one third between age 7 to <14 days. Less than half of the studied mothers' aged from 20 to < 30 years old. More than one-third of them have two children, and all of them have a previous knowledge about breastfeeding. Less than three-quarters of the studied nurses aged' from 20 to < 30 years. As well, nearly to two thirds of them had from 1to < 5 years of experience in NICU, and more than three quarters of them don't receive any training programs about oral feeding of the preterm infants. There were highly statistically significant positive correlations between the studied preterm infants' first oral feeding and full oral feeding and their gestational age, birth weight, diagnosis, duration of feeding, and the caregivers' technique used. Also, there were highly statistically significant positive correlations between the studied preterm infants' full oral feeding and age at first oral feeding. **Conclusion**: The preterm infants' first oral feeding and full oral feeding was influenced by their gestational age, birth weight, diagnosis, duration of feeding, and the caregivers' technique used. Also, the preterm infants' full oral feeding was influenced by age at first oral feeding. **Recommendation:** The NICUs directors should establish official guidelines to measure the preterm infants' readiness level for the initiation of oral feeding and achievement of full oral feeding.

Keywords: Full oral feeding, Time predictors& Preterm infants

Introduction

In recent decades, the number of infants born preterm that needed prolonged hospitalization and specialist care has been increased **(Gutierrez et al., 2022).** The preterm infants are at high risk for several complications following birth, including hypoglycemia, jaundice, temperature instability, sepsis, and can be admitted to the NICU for a variety of barriers to overcome (i.e., respiratory distress, feeding intolerance) as well as having a higher chance of developing developmental delays, neurodevelopmental disabilities that need for special education, and behavior problems on the long term **(Alexander et al., 2022).**

One of the most significant issues facing health care professional is how best to provide early nutritional support for the preterm infants for optimal short and long-term health. In addition, providing adequate and safe nutrition with underdeveloped cardiovascular, respiratory, gastrointestinal, and central nervous systems is a great challenge for health care professional. The preterm infants must receive intravenous (IV) fluids and parenteral nutrition or infant formula or expressed breastmilk via a gastric feeding tube to ensure proper nutritional requirements are met **(El Mashad et al., 2022).**

Most preterm infants frequently experience oral feeding difficulties due to underdeveloped oral motor skills (problems in initiating sucking, having irregular, weak, inefficient sucking) and inability to coordinate suck-swallow-breathe **(Wahyuni et al., 2022).** Furthermore, intensive care unit therapeutic interventions such as endotracheal intubation, suctioning, and orogastric or nasogastric tube feeding may have a negative effect on oral sensory and oral-motor functioning of the infant **(Edwards et al., 2019).**

Oral feeding in preterm infants is a complex and dynamic process involving an interaction between the oral–motor, neurological, cardiorespiratory, and gastrointestinal systems. Preterm infants experience feeding problems due to their physiological and neurological immaturity which leads to difficulty transitioning from tube feeding to oral feeding **(Fathi et al., 2022).** The difficulties with oral feeding leads to increases the length of stay and hospitalization cost, family stress (limits the emotional mother-infant bonding), and may lead to long- term health problems **(Wahyuni et al., 2022).**

Achievement of full oral feeding is an important milestone for preterm infants, since it is a major criterion indicating maturity and health of the preterm infant **(Jadcherla et al., 2019).** Successful oral feeding depends on several factors including; the infant's gestational age (GA) at birth and the birth weight, intrauterine growth status, illness severity, respiratory support, gender and maternal factors such as maternal education, number of other children, socioeconomic status, age of mother, breastfeeding experience, mode of delivery, antenatal visits, influence the development of feeding skills and the length of feeding progression **(Jiménez et al., 2022).**

One of the major tasks for nurses in the NICU involves ensuring that preterm infants receive adequate nutrition and supporting the oral feeding for preterm infant **(Mörelius et al., 2022).** Neonatal nurses play an important role in the safe and successful transition of the preterm infants to oral feeding because there is variability in the times at which each preterm infant be able to start oral feeding and achieve full oral feeding **(Edwards et al., 2019).** Neonatal nurses must be able to assess oral feeding readiness, feeding performance and apply evidence based protocols and therapeutic interventions **(Girgin et al., 2022).**

Significance of the study

Every year an estimated 15 million newborn worldwide are born preterm, more than 1 in 10 live infants born preterm. Approximately one million infants die each year due to complications of preterm birth from all countries in the world **(Lincetto, et al., 2020).**The rate of preterm births in Egypt ranges from 18% - 20% of the percentage of births in Egypt and represents 47% of neonatal deaths **(Algameel, et al.,2020).** An estimated 80% of preterm infants will experience difficulty with oral feeding **(Pineda, et al., 2020).**

Health professionals have difficult to establish the adequate time to start oral feeding in preterm infants. Gestational age, weight are the most common indicators used to assess oral feeding readiness in preterm infants **(Fujinaga, 2015).**There are general guidelines for the management of oral feedings, however there is no specific protocol or tool to determine initiating and advancing oral feeding. Due to lack of objective, evidence-based criteria for determining when preterm infant is ready to begin oral feeding and achieve full oral feeding. This study was carried out to assess time predictors to achieve full oral feeding in preterm infants.

Aim of the study

This study aimed to assess time predictors to achieve full oral feeding in preterm infants.

Research Question:

This study intended to answer the following questions:

1-What are the indicators that predict the timing and age at which preterm infant be able to initiate oral feeding?

2-What are the indicators that predict the timing and age at which preterm infant be able to achieve full oral feeding?

Research design:

A descriptive research design was utilized for conducting this study.

Setting:

The study was carried out at the neonatal intensive care units in Tahrir General Hospital in Giza and Helwan General Hospital from Cairo (Ministry of Health).

Subjects:

A Purposive sample composed of 90 preterm infants and their mothers, and 37 nurses working in NICUs at the previously mentioned settings

Tools for data collection:

Data were collected by using four tools:

Tool I: - Structured questionnaire: It consists of the following parts:

Part 1:- Characteristics of preterm infants such as gender, gestational age, current age, birth weight, current weight, diagnosis, birth order, preterm infant feeding data and the type of feeding.

Part 2:- Characteristics of mothers such as age, educational level, number of children in the family, and previous knowledge about breastfeeding, source of this knowledge.

Part 3:- Characteristics of nurses such as age, educational level, years of experience in neonatal intensive care unit, and previous training program on oral feeding of preterm infants.

Part 4:- Assessment of the preterm infants' physiological state before feeding such as temperature, pulse and respiration.

Tool II:-Infant driving feeding scales:

It was adapted from **(Ludwig &Waitzman, 2007)**, and used to assess the preterm infants' readiness for oral feeding, competence to oral feeding, and the techniques used by nurses or mothers to support preterm infant during oral feeding. It was consisted of three scales that should be utilized together as the following:

Scale A: - Feeding Readiness Scale:

It was used to assess the preterm infants' readiness to initiate oral feeding (breast, or bottle), and consisted of five points.

Scoring system:

Score 5: When the preterm infant is alert before care, roots and /or brings hands to mouth, or takes a pacifier actively and show good muscle tone. **Score 4:** when the preterm infant becomes alert once handled for routine care, the preterm infant has some rooting or taking of pacifier, and exhibits adequate muscle tone. **Score 3:** When the preterm infant briefly alert with care, no hunger behaviors (i.e. rooting, sucking, and taking of pacifier) and no change in muscle tone. **Score 2:** when the preterm infant sleeps during care, no hunger behaviors, and no change in muscle tone. **Score 1:** when preterm infants needs increased oxygen with routine care, demonstrates medical instability (may have apnea and /or bradycardia with care and tachypnea greater than baseline with routine care)

Score 4-5: Ready to oral feeding (bottle or breast)

Score 3: Fair

Score 1-2: Gavage feeding only

Scale B: - Quality of Nippling Scale:

It was used to observe, evaluate and document the preterm infants' feeding behaviors during oral feeding, and consisted of five points.

Score 5: when the preterm infant demonstrates a strong coordinated suck, throughout oral feeding. **Score 4:** when the preterm infants demonstrate a strong coordinated suck initially but fatigues with progression of oral feeding. **Score 3:** when the preterm infant has consistent suck but has

difficulty coordinating suck, swallow, some loss of liquid or difficulty in pacing. **Score 2:** when the preterm infant has a weak /inconsistent suck, little to no rhythm, and may require some rest breaks. **Score 1:** when preterm infant unable to coordinate between suck, swallow, and breathe pattern despite spacing, may result in frequent or significant large amounts of liquid loss, and significant changes in o_2, heart rate and respiratory rate greater than baseline with oral feeding.

Score 5: indicate oral feeding is well, **score (4) and (3)** indicate oral feeding fair, while **score (1-2)** indicate preterm infant unable to take oral feeding.

Scale C: - Caregiver Technique Scale:

It was used to facilitate oral feeding for the preterm infant and used by the nurses or mothers so that, the mothers taught the techniques to use it during breast feeding. The caregiver technique scale was used by letters from A to E are to correspond to the caregiver technique. The caregiver technique scale includes:

- **A- External pacing:** This technique was used if the preterm infant was unable to coordinate, suck, swallow, and breathe independently. This technique was utilized depended on the preterm infants' need.
- **B- Modified side lying:** It was the preferred position for oral feeding in preterm infants as it similar to the breastfeeding position. The position was used to assist the preterm infant to gain more control of the bolus/liquid and decreases the preterm infant's risk of choking.
- **C- Chin support:** Chin support help stabilization of lower jaw and prevent release of the nipple with every suck or to help bring the tongue/chin forward for effective tongue stripping of the nipple, also this technique may assist in removing of the nipple at the end of feeding.
- **D- Cheek support:** Support of cheek was applied to reduce intraoral space to improve intraoral suction/pressure and to improve lip seal, because gravity pulls lower cheek and lip downward.
- **E- Oral stimulation exercises:** The nurse using a gloved finger dipped in milk to put it inside preterm infant's mouth providing firm but gentle pressure with the padded side of the finger on the preterm infant's gums first on the bottom sides and then on the top sides very slowly and followed by a gentle pressure on the roof of the mouth to facilitate coordination between sucking, swallowing and breathing pattern.

Scoring system:

Score (5): When the mother or nurse not used any technique during oral feeding. **Score (4):** When only one technique was used during oral feeding. **Score (3):** When two techniques were used during oral feeding. **Score (2):** when three techniques were used during oral feeding. **Score (1):** When four techniques were used during oral feeding.

Scoring for total scales:

Three scales was used together during oral feeding to enable preterm infant's care provider to evaluate preterm infant feeding readiness for oral feeding and advancement to full oral feeding.

Scoring system:

Score 12 to $\leq$ 15: indicates preterm infant was ready for oral feeding, score 9 to < 12 indicate preterm infant fair readiness for oral feeding, score 1to < 9 indicates preterm infant not ready for oral feeding and take gavage feeding only.

Tool III: - Observational checklists for safe bottle feeding:

It was adapted from **(Family Health Service, 2019),** and used to assess the nurses practices regarding safe bottle feeding for preterm infant. It was consisted 24 steps which contain 4 main steps: A- Preparing equipment, which consisted of 7 specific steps. B- Preparation of formula feeding, which consisted of 8 specific steps to assess how nurses prepare the preterm infants' formula feeding. C- Feeding the preterm infant which consisted of 5 specific steps to assess how

nurses give bottle feeding to preterm infant. D- After feeding, which consisted of 4 specific items to assess what nurse has done after bottle feeding.

Scoring system:

The total score of nurses' practices ranged from 0- 24, each step was evaluated as done was scored one degree and not done was scored zero degree. These scores were summed up and converted into a percentage score. It was classified into 2 categories:

-Competent if score ≥ 80%.

- Incompetent if score < 80%.

Tool IV- Mothers' breast feeding reported practices:

It was adapted from **(Nayak, 2015),** and used to assess the mothers' breastfeeding reported practices. It was consisted of 22 steps which contain 4 main steps: A- Preparation for breastfeeding, which consisted of 7 specific steps. B- Latching on which consisted of 5 specific steps to assess how the preterm infant attaches to the mother's breast for breastfeeding. C- The breastfeeding which consisted of 8 specific steps to assess mother during the breastfeeding. D- After breastfeeding which consisted of 2 specific steps to assess what the mother had done after breastfeeding.

Scoring system: -

The total score of mothers' practices ranged from 0- 22, each step was evaluated as done was scored one degree and not done was scored zero degree. These scores were summed up and converted into a percentage score. It was classified into 2 categories:

- **Competent** if score ≥ 60%.
- **Incompetent** if score < 60%.

II. Operational Design:

The operational design includes a preparatory phase, testing validity, tools reliability, pilot study and field work.

The preparatory phase:

A reviewing of the past, current, national and international related literature of various aspects that assess time predictor to achieve full oral feeding in preterm infants was done using books, articles, internet, periodicals and magazines to get acquainted with the research problem and to develop the tools for data collection.

Tool validity:

The developed tool was ascertained by a jury of three experts in the field of Pediatric Nursing who revised the tools for clarity, relevance, applicability, comprehensiveness and understanding. According to their opinion minor modifications were applied.

Reliability:

Cronbach's Alpha coefficient was used to assess the internal consistency of the tool. Test of reliability for bottle feeding observational checklist was (0.732) and for breastfeeding observational checklist was (0.796).

Ethical Considerations:

Prior study conduction, an official permission to conduct the study was obtained from the Scientific Research Ethics Committee (Committee of the Faculty of Nursing Helwan University. Oral consent for participation of the mothers of preterm infant and nurses was obtained after explanation the aim and nature of the study. The researcher informed the mothers and nurses that participation in the study was voluntary and mothers and nurses were given complete full information about the study and their role. The ethical considerations stated the possibility to withdraw at any time, confidentiality of the information where it will not be accessed by any other party without taking permission of the participant. Ethics, values, culture and beliefs will be respected.

Pilot Study:

The pilot study was conducted on 10% of sample (9 preterm infants and their mothers and 4 nurses) to examine the clarity of questions and time needed to complete the study, and to assess the feasibility, clarity and applicability of the tool. No modification needed after pilot study, so that; sample included in the pilot study was included in the study sample.

Field Work:

The data has been collected over a period of six months. The actual field work was carried out from the beginning of March 2022 to the end of august 2022 for data collection. The researcher was available at each study setting for two days per week by rotation (Saturday & Tuesday) throughout the evening shift from 3:00 PM. to 6:00 PM. The researcher introduced herself to the mothers and nurses then informing about the aim of the study was simply explained to every mother and nurse who agrees to participate in the study prior to any data collection, and assure the nurses and mothers about the anonymity of their answers and that the information will be used for scientific research only. Each mother and nurse was interviewed and assessed individually using the previously mentioned study tools, then the researcher observe the preterm infant before, during and after feeding. As well as observe the actual practice of the mothers before, during and after breastfeeding. Also observe the nurses during preparation of bottle and feeding of the preterm infant. The structured questionnaire sheet was filled by researcher in 15- 30 minutes, while the checklist for assessing nurses and mothers practice regarding oral feeding by bottle or breast was filled by researcher in 30-45 minutes.

III. Administrative Design:

Approval to carry out this study was obtained from the Dean of the Faculty of Nursing, Helwan University and directors of Tahrir General Hospital, Helwan General Hospital and Ministry of Health & Population (Training& Research Sector) at which the study was conducted. The title, aim and expected outcome of the study have been illustrated.

IV. Statistical design:

Data was collected from the studied sample were revised, coded and entered using a personal computer (PC). Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 26 to estimate the statistically significant relation between the variables of the study.

Data were presented using descriptive statistics in the form of frequencies, and percentages. Chi-square test (χ^2) was used for comparisons between qualitative variables. Spearman correlation measures the strength and direction of association between two ranked variables.

Statistically significant relations were considered at p-value < 0.05. Highly significant relations were considered at p-value <0.01.

Results

Table (1): Illustrates that; 55.6% of the preterm infant were males, 60.0% were within the gestational age of 34 to ≤ 36 weeks. In relation to age, 31.1% of them aged 7 to < 14 days with Mean ± SD 12.6 ± 6.9 days, 44.4% their birth weight was 1500 to < 2000g, while 54.4% of them their current weight was 2000 to< 2500g. Also, 72.2% of them were suffering from respiratory distress.

Table (2): Illustrates that; 30.0% of the preterm infants' age at first oral feeding by bottle or breast ranged from 7 to < 14 days, and from 14 to < 21 days with Mean ± SD was 13.47 ± 7.15 days. In relation their age at full oral feeding, 36.7% of the preterm infants' age ranged from 12 to < 21 days with Mean ± SD of 20 ± 8.26 days. Regarding to weight at first oral feeding, 54.4% of the preterm infants' weight ranged from 2000 to < 25000 g, while less than two thirds (60.0%) of the preterm infants' weight at full oral feeding ranged from 2000 to < 25000 g. During the first oral feeding, nearly one-third (32.2%) of the studied preterm infants had choking, while 83.3% had no problems during full oral feeding. Also the study results revealed that, less than half (43.3%) of the studied preterm infants' feeding duration range from 15 to < 19 minutes with Mean ± SD was 18 ± 3.52 minutes.

Table (3): Shows that, 43.3% of the mothers' age ranged from 20 to < 30 years old with Mean ± SD of 29.08 ± 7.85 years, 34.4% had higher education, 100.0% of the mothers have

a previous knowledge about breastfeeding, and 36.0% of the mothers' source of knowledge about breastfeeding was from maternal and child care centers(MCH).

Table (4): Shows that**;** 70.3% of the nurses' age ranged from 20 < 30 years old with Mean ± SD 27.0 ± 4.26 years, 64.9% of the nurses had technical institute of nursing and 64.9% of the nurses had from 1< 5 years of experience in the neonatal intensive care unit with Mean ±SD was12.68±8.21years. Also, 81.1% of the nurses don't receive any training programs about oral feeding of preterm infants.

Figure (1): Reveals that**;** 71.1% of the preterm infants were ready to drive oral feeding and 23.3% of the preterm infants were fair to do it, while 5.6% of them were not ready to take oral feeding (gavage feeding only) during first oral feeding.

Figure (2); Shows that, 97.8% of the preterm infants were ready to drive oral feeding while 2.2% of the preterm infants were fair to do it, during the full oral feeding.

Figure (3): Reveals that, 81.1% of the nurses had competent practices, while18.9% had incompetent practices.

Figure (4): Illustrates that, 71.4% of the mothers had competent practices, while 28.6% had incompetent practices.

Table (5): Shows that**;** There were highly statistically significant positive correlations between the studied preterm infants' first oral feeding and their gestational age, birth weight, diagnosis, duration of feeding, and the caregivers' technique used at (P<0.01).

Table (6): Reveals that**;** there were highly statistically significant positive correlations between the studied preterm infants' full oral feeding and their gestational age, birth weight, diagnosis, age at first oral feeding, duration of feeding, and the caregivers' technique used at (P < 0.01).

Table (1): Distribution of the studied preterm infants according to their characteristics (n=90).

Item	No.	%
Gender		
Male	50	**55.6**
Female	40	44.4
Gestational age		
32<34weeks	36	40.0
34≤ 36weeks	54	**60.0**
Age (days)		
1< 7 days	25	27.8
7 < 14 days	28	**31.1**
14 < 21 days	24	26.7
21 < 28days	13	14.4
Mean± SD=12.6 ± 6.9		
Birth weight		
<1500g	12	13.3
1500 <2000g	40	**44.4**

2000 <2500g	38	42.2
Current weight		
1500 < 2000g	41	45.6
2000 < 2500g	49	**54.4**
Diagnosis		
Respiratory distress syndrome	65	**72.2**
Neonatal jaundice	12	13.3
Low birth weight, lack of growth	10	11.1
Neonatal jaundice with difficulty in feeding	3	3.3

Table (2): Distribution of the studied preterm infants according to their feeding data (n=90).

Item	No.	%
Preterm infants age at first oral feeding by bottle by days		
1< 7days	23	25.6
7 < 14days	27	**30.0**
14<21days	27	**30.0**
21≤ 28 days	13	14.4
Mean ±SD=13.47 ± 7.15		
Preterm infants age at full oral feeding by bottle or breast by days		
3 < 12days	17	18.9
12 < 21days	33	**36.7**
21 < 30days	30	33.3
30 < 39days	10	11.1
Mean ±SD=20± 8.26		
Preterm infants' weight at first oral feeding by bottle		
1500 < 2000g	41	45.6
2000 < 2500g	49	**54.4**
Preterm infant's weight at full oral feeding by bottle or breast		
1500 < 2000g	34	37.8
2000 < 2500g	54	**60.0**
2500 < 3000g	2	2.2
Problems occur during first oral feeding		
No problem	24	26.7
Tachycardia	9	10.0
Bradycardia	6	6.7
Choking	29	**32.2**

Apnea	11	12.2
Desaturation	11	12.2
Problems occur during feeding at full oral feeding		
No problem	75	**83.3**
Tachycardia	5	5.6
Tachypnea	7	7.8
Chocking	2	2.2
Desaturation	1	1.1
Duration of feeding in minutes		
11 < 15minutes	19	21.1
15 < 19minutes	39	**43.3**
19 < 23minutes	27	30
23 ≤ 27 minutes	5	5.6
Mean ±SD=18± 3.52		

Table (3): Distribution of the studied mothers according to their characteristics (n=90).

Item	No.	%
Age (Years)		
Less than 20	10	11.1
20 < 30	39	**43.3**
30 < 40	29	32.2
≥40	12	13.3
Mean± SD = 29.08 ± 7.85		
Educational level of the mother		
Illiterate	10	11.1
Read and write	12	13.3
Primary education	12	13.3
Secondary education	25	27.8
Higher education	**31**	**34.4**
The mother has previous knowledge about breastfeeding		
Yes	90	**100.0**
Mother's source of knowledge about breastfeeding		
Doctor/ Nurse	10	11.0
Internet	32	35.00
Maternal and child health (MCH)	**32**	**36.0**
Relatives	16	18.0

Table (4): Distribution of the studied nurses according to their characteristics (n=37)

Item	No.	%
Age(Years)		
20 < 30	26	**70.3**
30 < 40	11	29.7
Mean± SD = 27.0±4.26		
Educational level		
Nursing diploma	7	18.9
Technical institute of nursing	24	**64.9**
Bachelor's degree in nursing	6	16.2
Years of experience in neonatal intensive care unit		
1< 5	24	**64.9**
5 < 10	9	24.3
10 < 15	4	10.8
Mean± SD=12.68± 8.21		
Receiving training program on oral feeding of preterm infants		
Yes	7	18.9
No	**30**	**81.1**

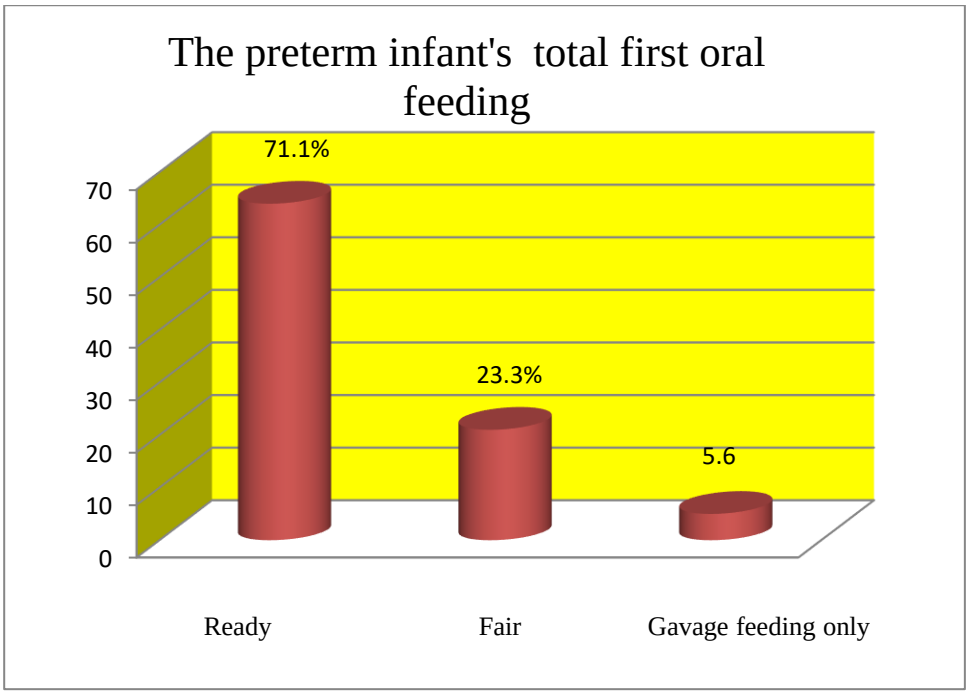

Figure (1): Distribution of the studied preterm infants according to their total first oral feeding score (n=90).

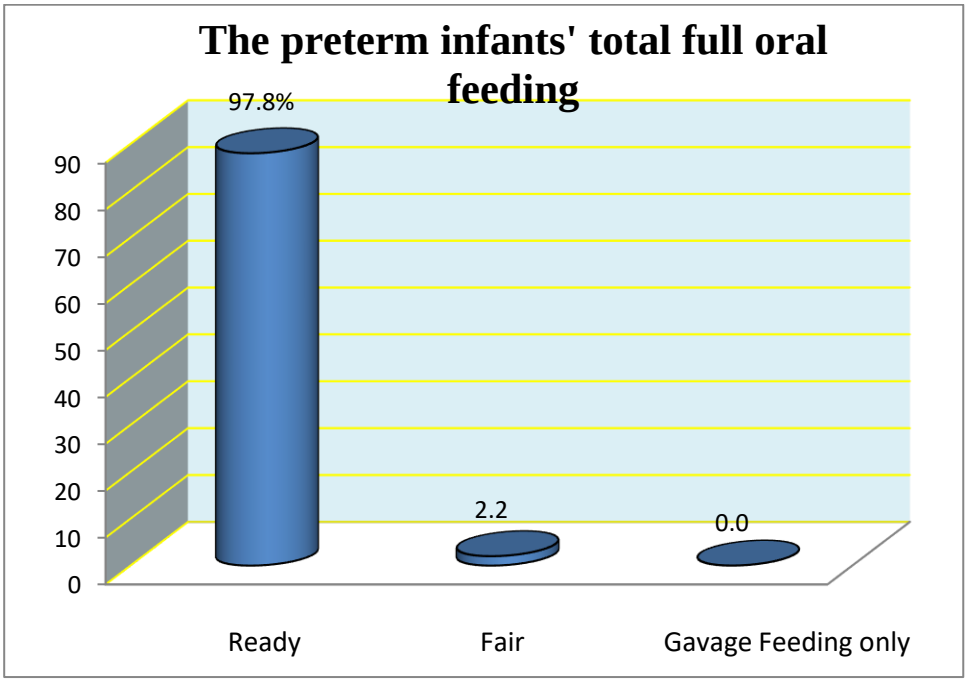

Figure (2): Distribution of the studied preterm infants according to their total full oral feeding score (n=90).

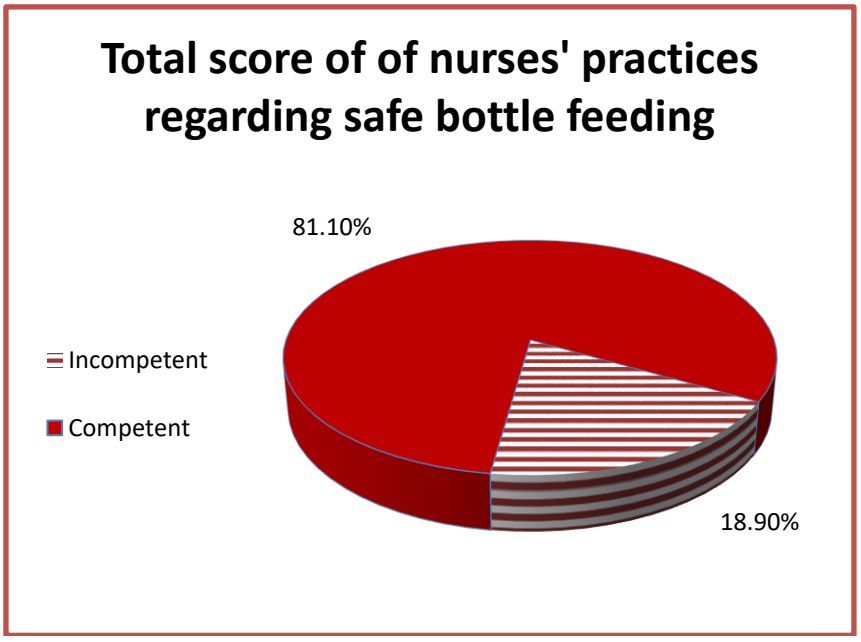

Figure (3): Distribution of the studied nurses' total score of practices regarding safe bottle feeding, (n=37).

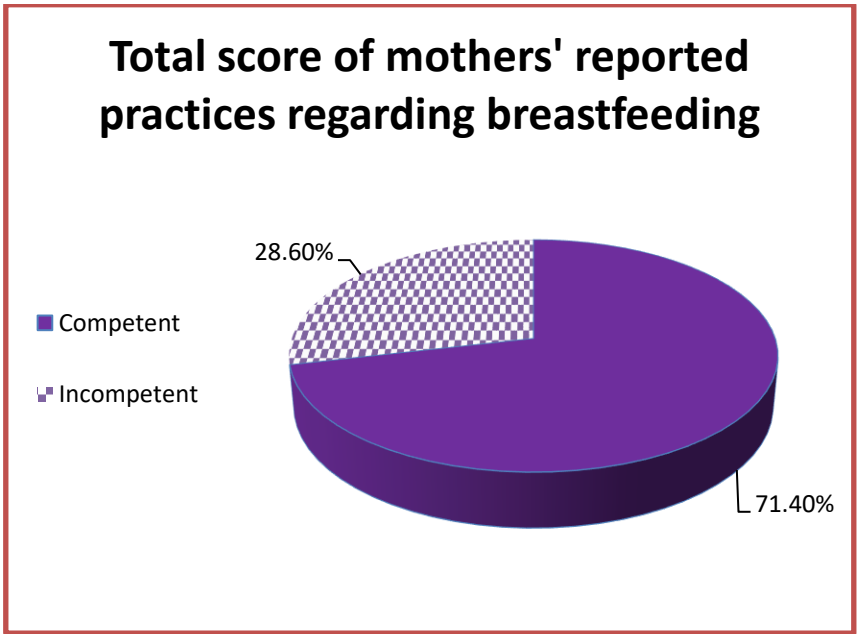

Figure (4): Distribution of the studied mothers' total score of reported practices regarding breastfeeding (n=35).

Table (5): Correlation between the studied preterm infants' first oral feeding and time predictors (n=90).

Items		First oral feeding
Gestational age	*r*	0.699
	p-value	0.001**
Birth weight	*r*	0.850
	p-value	0.001**
Diagnosis	*r*	0.678
	p-value	0.001**
Duration of feeding	*r*	0.568
	p-value	0.001**
Caregivers' technique	*r*	0.759
	p-value	0.001**

Correlation is highly significant at P < 0.001.

Table (6): Correlation between the studied preterm infants' full oral feeding and timing predictors (n=90).

Items		Full oral feeding
Gestational age	r	0.680
	p-value	0.001**
Birth weight	r	0.510
	p-value	0.001**
Diagnosis	r	0.887
	p-value	0.001**
Age at first oral feeding	r	0.965
	p-value	0.001**
Duration of feeding	r	0.918
	p-value	0.001**
Caregivers' technique	r	0.780
	p-value	0.001**

Correlation is highly significant at P < 0.001.

Discussion

Feeding preterm infants is a skilled nursing task which requires assessing how and when to feed the preterm infant. Introduction and achievement of full oral feeding in preterm infants can be a challenge for both preterm infants and caregivers due to the mechanics required and potential dangers of initiating oral feeding before preterm infant is ready. It is important to carefully observe and assess preterm infant readiness behavior in order to preserve energy for growth and avoid aspiration **(Osman et al., 2017).**

Regarding the studied preterm infants' gender; the current study result showed that, more than half of the studied preterm infants were males. This result was in same line with **Nassar et al., (2021),** who performed a study entitled "Effect of Oral Stimulation Technique Application on Promoting Feeding among Preterm Infants, in Egypt", and found that 56.0% and 59.0% of both the study and control group were males respectively. While, this result contradicted with **Jiménez et al., (2022),** who performed a study entitled "Influence of Full Oral Feeding, Acquisition on Growth of Premature Infants, Madrid, Spain" and reported that 55.0% of the studied sample was females. From the researcher point of view, this might be related to most of the hospitalized preterm infants at this time were males

Concerning the studied preterm infants' gestational age; the current study results showed that, less than two thirds of the studied preterm infants gestational age of 34 to ≤ 36 weeks. This result disagreed with **Osman et al., (2017),** who carried out a study entitled "Assessment of Oral Feeding Readiness Among Preterm Infants", in Egypt, and reported that about half (49.3 %) of the

included preterm infants had 32 weeks of gestational age. On other hand, this result supported with **Chang et al., (2022),** who carried out a study entitled "Preterm Oral Feeding Scale to Assist in Deciding Initial Oral Feeding of Preterm Infants in Neonatal Intensive Care Units in Taiwan ", and reported that 69.1%of studied preterm infants were within the gestational age of 34 to < 37 weeks. From the researcher point of view, this might be due to the preterm infants' age is usually less than 37 weeks of gestation.

In relation to the studied preterm infants' age per day and preterm infants' birth weight; the current study result showed that, less than one third of the studied preterm infants' age ranged from 7 to < 14 days and less than half of the studied preterm infants' birth weight was 1500 to < 2000g. This result disagreed with **Ghoneim et al., (2022),** who conducted a study entitled "Effect of Designed Nutritional Guidelines on Nurses' Performance regarding Feeding of Low- Birth- Weight Infants, Egypt" and reported that less than two thirds of the studied preterm infants' age ranged from 10 to < 20 days. Also, this result disagreed with **Alonso-Fernández et al., (2022),** who conducted a study entitled "Psychometric Properties of the Oral Feeding Assessment in Premature Infants Scale" Spain, and reported that 51.9% of the studied preterm infants' birth mean ± SD weight was 1615 ± 499 grams. As well, this study was in the same line with **Ghoneim et al., (2022),** who reported that less than half 45.0% of the studied preterm infants' weight at birth ranged from 1.5 to < 2 kg. From the researcher point of view, this might be because this is the age which the preterm infants cannot achieve full oral feeding and low birth weight might be due to immaturity of the preterm infants.

Concerning the studied preterm infants' diagnosis; the present study showed that, less than three quarters of preterm infants were suffering from respiratory distress syndrome. This result supported by **Hassan et al., (2021),** who performed a study entitled "Study of Feeding Problems in Neonates in the Neonatal Intensive Care Unit in Minya General Hospital ", and reported that the most common morbidity associated with feeding problems were respiratory distress as it represents 68.0% of cases. While, this result disagreed with **Algameel et al., (2020),** who performed a study entitled "Outcome of Late Preterm Newborns in Upper Egypt", and reported that 32.9% of the studied preterm infants diagnosed with respiratory disease. From the researcher point of view, this might be due to the early delivery of the preterm infants as well as incomplete maturation of their internal organs such as lung.

Regarding the studied preterm infants' age at first oral feeding by bottle; the current study results revealed that, less than one third of the studied preterm infants' age ranged from 7 to < 14 days and from 14 to < 21 days with Mean ± SD 13.47 ± 7.15 day. This result supported with **Yamamoto et al., (2017),** who performed a study entitled "Readiness for Oral Feeding and Oral Motor Function in Preterm Infants in Brazil", and reported that the days of life during which the preterm infants start oral feeding had a mean ±SD of 11.4 ± 11.4.

The same results were also similar to **Abd El Aziz and Elewa (2017),** who conducted a study, entitled "Effect of Implementation of Cue Based Feeding Technique on Premature Infant Feeding Outcomes and Parent Satisfaction in Egypt", and reported that the mean preterm infants' age at the first nipple feeding by bottle was 16.9 ±1.5 days in experimental group. While, this result disagreed with **El-Shahat et al., (2018),** who conducted a study entitled "Effect of Pre-feeding Oral Stimulation Technique on Reaching to Full Oral Feeding in Preterm Newborn in Neonatal Intensive Care Units in Ismalia City, Egypt" and reported that more than two fifths of the study group their age was one day postnatal with a mean age of 1.5± 0.5 days, while more than half of the preterm neonates' age in the control group was two days postnatal, with a mean age of 1.6±0.5 days. From the researcher point of view, this might be because this is the age during which the preterm infants develop skills that enhance

suckling as well as the preterm infants having stable medical condition.

Regarding the studied preterm infants' age at full oral feeding by bottle or breast by days; the present study revealed that, more than one thirds of the studied preterm infants' age ranged from 12 to <21 days with Mean ± SD of 20 ± 8.26 days. This result supported with **Abd El Aziz and Elewa (2017),** who reported that the preterm infants' mean age at full oral feedings by breast or bottle was 22.6 ±2.0days among the experimental group and 31.0 ±2.2 days in control group. From the researcher point of view, this might be due to the development of neurological system which makes the preterm infants able to coordinate suck, swallow and breathe as well as expert practices of nurses that provide oral feeding.

In relation to the studied preterm infants' weight at the first oral feeding by bottle; the current study revealed that, more than half of the studied preterm infants' weight ranged from 2000 to < 25000 g. This result was in the same line with **Abed Elrhman et al., (2018),** who carried out a study entitled "The Effect of Oral Motor Stimulation on Short Term Clinical Outcomes for Preterm Neonates in Egypt", and reported that the mean weight at the introduction of first oral feeding among both study and control group was 1915.2±201.28 and 1894.6±188.56gm respectively. From the researcher point of view, this might be related to the preterm infants born with respiratory diseases and they can't initiate oral feeding until their respiratory state became stable.

As regards the studied preterm infants' weight at full oral feeding by bottle or breast; the current study revealed that, less than two thirds of the studied preterm infants' weight ranged from 2000 to < 25000 g. This result was in the same line with **Abed Elrhman et al., (2018),** who reported that, the mean weight at full independent oral feeding among both study and control group was 2207.5±295 and 2103.7±252gm. While, this result contradicted with **Kamran et al., (2020),** who performed a study entitled "Effectiveness of Cue-Based Feeding Versus Scheduled Feeding in Preterm Infants Using Comprehensive Feeding Assessment Scales: A Randomized Clinical Trial in Iranian", and reported that control groups' mean weight at full oral feeding ranged from 1.565 to 1852.10 gram for cue-based feeding group and from 1622.61 to 1863.51gram for scheduled feeding group. From the researcher point view, this might be because the preterm infants need more time to gain weight especially that preterm infants have troubles when initiating oral feeding and be unable to coordinate suck, swallow and breathe.

Concerning the first oral feeding problems among the studied preterm infants; the current study result revealed that, nearly to one third of the studied preterm infants had choking during first oral feeding. This result agreed with **Abd El Aziz and Elewa (2017),** who reported that 38.2% of the studied preterm infants in both experimental and control group had chocking during the first oral feeding pre intervention. From the researcher point of view, this might be due to the preterm infants didn't able to coordinate between suck, swallow and breathe. As well as the preterm infants' dependence on another method of feeding such as (tube feeding).

As regards full oral feeding problems among the studied preterm infants; the current study finding revealed that, majority of the studied preterm infants had no problem occurring after previous feeding. This finding was inconsistent with **Hassan et al., (2021),** who reported that about 42.0% of the studied preterm infants have feeding problems at full oral feeding. From the researcher point of view, this might be because the preterm infants completed their sensory and motor skills of suck, swallow and breathe.

Regarding the duration of feeding; the current study finding revealed that, less than half of the studied preterm infants feeding duration ranged from 15 to < 19 minutes with Mean ± SD of 18 ± 3.52 minute. This finding was disagree with **Abed Elrhman et al., (2018),** who reported that the mean and SD of feeding duration for both study and control group was 5.2± 1.3, and 3.4±0.62 respectively. From the researcher point of view, this long

duration of feeding might be because the preterm infants were newly to start oral feeding which make the nurses or mother to slowly feed the preterm infant to prevent complication.

Regarding the studied mothers' age; the present study result illustrated that, less than half of the studied mothers' age range from 20 to < 30 years old with Mean ± SD of 29.08 ± 7.85 years. This result was consistent with **Aldirawi et al., (2019),** who performed a study entitled "Mothers' Knowledge of Health Caring for Premature Infants after Discharge from Neonatal Intensive Care Units in the Gaza Strip, Palestine", and found that 46.7% of the studied mothers were belonging to the age group of 20 to 30 years. While, this result disagreed with **Abd El-Salam et al., (2018),**who carried out a study entitled "Improving Mother's Care of Low Birth Weight at Home in Egypt", and reported that about half of the studied mother had more than 30 years old. From the researcher point of view, this might be because most of them married after graduation as they had university education as the current study revealed.

Regarding the studied mothers' educational level; the current study result demonstrated that, more than one third of the studied mothers had higher education. This result was congruent with **Aldirawi et al., (2019),** who found that 37.5% of the studied mothers had university education. While, this result was contradicted with **Krishnendu and Devaki (2017),** who carried out a study entitled "Knowledge, Attitude and Practice Towards Breast Feeding Among Lactating Mothers in Rural Areas of Thrissur District of Kerala in India: A Cross- Sectional Study", and reported that more than half 58.3%of the studied mother had secondary education. From the researcher point of view, this might be related to their desire to upgrade their educational level.

Concerning the studied mothers' previous knowledge about breastfeeding; the current study finding illustrated that, all of studied mothers had a previous knowledge about breastfeeding. This result was in the same line with **Mohamed et al., (2019),** who developed a study entitled "Assessment to Primipara Mothers Performance about Breastfeeding in Egypt", and found that all the studied mothers had a previous knowledge about breastfeeding. From the researchers' point of view, this might be due to they had a high educational level which encourage them to read, or might be because they get this knowledge from MCH team as reported in this study.

As regards the studied mothers' source of knowledge about breastfeeding; the current study result denoted that, more than one third of studied mothers' source of knowledge about breastfeeding was from MCH. This result contradicted with **Sultania et al., (2019),** who developed a study entitled " Breastfeeding Knowledge and Behavior Among Women Visiting a Tertiary Care Center in India: A Cross-Sectional Survey, India", and reported that 61% of the studied mothers received information about breastfeeding from family/friends. From the researcher point of view, this might be because the studied mothers acquired this knowledge from the MCH team during their visit at the antenatal period.

According the studied nurses' age; the current study results showed that, less than three quarters of the studied nurses' age ranged from 20 to < 30 years old with Mean ± SD of 27.0 ± 4.26 years. This result supported with **Fathi et al., (2022),**who carried out a study entitled "Nurses' Practices for Sensorimotor Stimulation to Enhance Oral Feeding of preterm Infants: An Assessment Study in Egypt", and reported that 77.5% of the studied nurses their age ranged from 20 to < 30 years old. From the researcher point of view, this result might be related to the workload at neonatal intensive care unit needs young age nurses to bear the pressure of work.

Concerning the educational level of the studied nurses; the present study result showed that, nearly to two thirds of them had a technical institute of nursing. This result was similar to **Arabie et al., (2022),** who carried out a study entitled "Nurses' Knowledge, Perception and Practices Regarding Kangaroo Care for Preterm Infants in Egypt", and found

that 50.0% of the studied nurses had technical institute of nursing. While, this result disagreed with **Ebrah and Yousif (2020),** who conducted a study "The Effect of Intervention on Nurse's Performance Regarding Feeding of Premature Baby in Neonate Care Unit at Public Hospitals in Hodeida City: Yemen", and found that 70.0% of the studied nurses were a diploma nurses. From the researcher point of view, this might be due to that the nurses of technical institute prefer to work rather than complete other studies as a result of poor economic conditions.

According to the studied nurses' years of experience; the current study result showed that, nearly two thirds the studied nurses' years of experience ranged from 1< 5 years of experience in the neonatal intensive care unit. This result supported with **Ebrah and Yousif (2020),** who reported that two third (66.0%) of the studied nurses had from 1-5 years of experience at the neonatal intensive care unit. From the researcher point of view, this might be because of the nurses are young age.

Regarding to the training program that the studied nurses received about oral feeding of preterm infants; the current study results represented that, more than three quarters of the studied nurses don't receive any training programs about oral feeding of preterm infants. This result was similar to **Çelen et al., (2021),** who carried out a study entitled "The Effect of Education on Oral Feeding Supporting Practices in Preterm Babies on Health Professionals in NICU: A quasi-experimental study in Turkey", and reported that 59.1% of the studied sample don't receive any educational programs on preterm infant oral feeding. From the researcher point of view, this might be related to the hospitals where they work don't make training programs or conferences about oral feeding of preterm infants.

According the preterm infants' total first oral feeding score; the current study results described that, more than one-third of the studied preterm infants were completely ready to drive oral feeding. This result agreed with **Osman et al., (2017),** who found that three quarters of the studied preterm infants were completely ready to drive first oral feeding. From the researcher point of view, this result might be related to that the physicians did not start oral feeding until the appropriate time when the preterm infants had demonstrated readiness to oral feeding.

Regarding the preterm infants' total full oral feeding score; the present study results indicated that, more than half of the studied preterm infants were completely ready to drive full oral feeding. This result supported with **Abd El Aziz and Elewa (2017),** who found that 55.9% and 58.9% of the preterm infants in both experimental and control group respectively (pre intervention) were completely ready to drive full oral feeding. From the researcher point of view, this result might be because the preterm infants had completed the neurological system function, and develop motor oral reflexes, or because the physicians introduced the oral feeding at an appropriate time.

Concerning the studied nurses' total score of practices regarding safe bottle feeding; the current study result showed that, majority (81.1%) of the studied nurses had competent total score of practices. This result was congruent with **Ghoneim et al., (2021),** who found that nearly two thirds (66.3) of the studied nurses had competent total level of practices regarding bottle feeding of the preterm infants pre intervention which increased to include 90.0% post intervention. From the researcher point of view, this might be because the studied nurses were experienced in feeding of the preterm infants so that they had competent practices.

Regarding the studied mothers' total score of practices regarding breastfeeding; the present study result demonstrated that, less than three-quarters of them had competent total score of practices. This result contradicted with **El-Talawy et al., (2022),** who carried out a study entitled "Assessment of Mothers' Knowledge, Practice and Attitude Regarding Prevention of Exclusive Breastfeeding Discontinuation in Egypt ", and found more than half of the studied mothers (59%)

performed incompetent breast feeding practice. From the researcher point of view, this might be because of the studied mothers' experience in breastfeeding or due to the knowledge the studied mothers had acquired from the MCH.

According the correlation between the preterm infants' first oral feeding and timing predictors; the current study results indicated that, there were highly statistically significant positive correlations founded between the studied preterm infants' first oral feeding and their gestational age, birth weight, diagnosis, duration of feeding, and the caregivers' technique used. These results were consistent with **Brumbaugh et al., (2018),** who performed a study entitled "Oral Feeding Practices and Discharge Timing for Moderately Preterm Infants in India", and reported that there were highly statistically significant correlations found between the preterm infants' first oral feeding and their gestational age and birth weight. While, these results contradicted with **Pereira et al., (2020),** who performed a study entitled "Impact of a Pre-feeding Oral Stimulation Program on First Feed Attempt in Preterm Infants: Double-blind controlled clinical trial in Brazil", and found that there were no statistically significant correlations between the preterm infants' first oral feeding and their gestational age, and birth weight for control group.

Concerning the correlation between the preterm infants' full oral feeding and timing predictors; the current study represented that, there was a highly statistically significant correlation between the preterm infants' full oral feeding and their gestational age. This result disagreed with **Majoli et al., (2019),** who developed a study entitled "A key Developmental Step for Preterm Babies: Achievement of Full Oral Feeding", and found that the introduction of full oral feeding significantly influenced by the preterm infants' gestational age.

Also the study revealed that, there was a highly statistically significant positive correlation between the studied preterm infants' full oral feeding and their age at first oral feeding. This result was in conformity with **Majoliet al., (2019),** who concluded that the earlier introduced oral feeding, the earlier reached full oral feeding. From the researcher point of view, this might be due to the nurses' more trials to initiate oral feeding, as well as the preterm' response.

Furthermore, the current study results represented that, there were highly statistically significant positive correlations between the preterm infants' full oral feeding and their birth weight, diagnosis, age at first oral feeding, duration of feeding and the caregivers' technique. These results disagreed with **Patra and Greene (2019),** who performed a study entitled "Impact of Feeding Difficulties in the NICU on Neurodevelopmental Outcomes at 8 and 20 Months Corrected age in Extremely Low Gestational Age Infants in Rush", and reported that the postmenstrual age was the only predictor at the start of full oral feeding among the studied preterm infants. From the researcher point of view, this might be because all these factors are essential for the preterm infant to achieve full oral feeding.

Conclusion

Based on the results of the current study it was concluded that, less than one-third of the preterm infants their age at the first oral feeding by bottle ranged from seven to less than fourteen days, and from fourteen to less than twenty one days. While, more than one-third of them their age at full oral feeding ranged from twelve to less than twenty one days. Moreover, the preterm infants' first oral feeding was influenced by their gestational age, birth weight, diagnosis, duration of feeding, and the caregivers' technique used. As well, the preterm infants' full oral feeding was influenced by their gestational age, birth weight, diagnosis, age at first oral feeding, duration of feeding, and the caregivers' technique used. So that the study answering of the research question.

Recommendations

In the light of the present study findings the following recommendations can be suggested:

The initiation and achievement of full oral feeding among preterm infants should be decided with careful consideration of their gestational age, birth weight, diagnosis, age at

first oral feeding, duration of feeding, and the caregivers' technique.

The NICUs directors should establish official guidelines to measure the preterm infants' readiness level for the initiation of full oral feeding.

The study should be replicated to include a large sample size to determine the other readiness predictors to achieve full oral feeding among preterm infants.

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