Nurses' Knowledge and Practices toward Enteral Feeding and its effect on selected High-Risk Neonates' Outcomes

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Abstract

Background: Enteral feeding is the prioritized method of administrating nutrients in high-risk neonates. The current study **aims** to assess nurses' knowledge and practices toward enteral feeding and its effect on selected high-risk neonates' outcomes. **Subjects and Method:** A descriptive exploratory research design was conducted in Neonatal intensive care unit at Beni-Suef University and general Hospitals in Beni-Suef city, Egypt**.** A purposeful sample of neonatal pediatric nurses responsible for providing direct care for high-risk neonates (70 nurses) at Beni-Suef University and general hospitals during data collection and neonates were utilized in this study. Three data collection tools were utilized in this study**:** Tool I: Nurses' knowledge questionnaire**,** Tool II: Nurses practice checklist**, and** Tool III: neonatal outcomes**. Results:** nearly two-thirds and nearly half of the studied nurses had unsatisfactory knowledge and practice regarding enteral feeding of high-risk neonates. Also, moderate effect between acute increase of abdominal girth after 2 hours in the 3rd day of the study with nurses' knowledge and practice toward enteral feeding of high-risk neonates and hospital duration of high-risk neonates at the 3rd and 4th days of the study with nurses' practice. **Conclusion**: nurses' knowledge and practices about enteral feeding of high-risk neonates had a moderate effect on the acute increase of abdominal girth after 2 hours in the 3rd day. **Recommendation**: periodically implementing of health education training toward enteral feeding high-risk neonates to enhance their knowledge and practices and reduce effects on high-risk neonates' outcomes.

Keywords: **Enteral Feeding, High-Risk Neonates' Outcomes, Nurses' Knowledge, Practices**

Introduction

The first 28 days of a newborn's existence are the neonatal period. High-risk newborns have elevated morbidity and mortality rates, regardless of birth weight, size, or gestational age. These neonates require special care and are admitted to a neonatal intensive care unit (NICU) because of their condition. It is not until approximately 32 weeks gestation that certain reflexes, such as sucking and swallowing in conjunction with breathing, mature. Therefore, it is not typical for premature infants to have the coordination necessary to meet their nutritional requirements through oral feeding without the need for help. Nasogastric tubes are routinely used to supply patients with the necessary nutrients **(Bass, Gartley, Lyczkowski, & Kleinman, 2018)**.

Nutrition is an essential component of health, healing, and life itself. Nurses are in the unique position of monitoring their patients' dietary consumption, weight, and response to prescribed diets to make accurate assessments of their nutritional status. The enteral nutrition skill set focuses on nutritional assessment, recognizing nutritional problems, and serving the needs of patients with changed nutrition. Preterm infants face particular challenges when it comes to getting the nourishment they need. The behavioral states of each newborn determine feeding readiness in preterm neonates. Assessment of the baby's alertness around feeding time is used to identify his or her readiness for feeding. Preterm babies sleep for a shorter period of time than their full-term counterparts **(Harding, Cormack, Alexander, Alsweiler, & Bloomfield, 2017)**.

High-risk infants are more vulnerable to dietary deficiencies. Nasogastric tube feeding is the best approach to ensure enough nourishment via the nose to the stomach. A gastrostomy tube may be used if the tube enters the stomach through the skin and provides nutritional support for preterm and high-risk newborns that cannot eat through their mouths. In addition to reducing body storage losses, this improves feeding requirements for babies in order to enhance their growth and development **(Hay, 2018)**.

The dietary requirements of the preterm baby are complex for three reasons: They have not had the time in utero to build up nutritional stores; they have extra-uterine problems such as respiratory distress syndrome (RDS), which raises their metabolic expenditure; and they should be gaining weight daily at rates double those of a full-term infant. Furthermore, the premature newborn may be unable to feed due to regurgitation, loss of weight, or a cold. If a newborn is not ready to feed by mouth, the nurse will utilize different methods to guarantee sufficient nourishment, such as intravenous or enteral feeding **(Embleton & van den Akker, 2019)**.

In high-risk infants, enteral feeding is the preferred technique of nutrient administration. This provides a healthy opportunity for the intestinal membrane and has strengthened the intestinal membrane's immunity rather than the parental diet. On the other hand, parental nutrition is both safer and less expensive than nasogastric tube feeding. The nasogastric tube is the preferred feeding method for newborns with gastrointestinal problems, comatose infants, infants whose breathing is faster than normal or requires mechanical ventilation, and premature infants **(Harding et al., 2017)**.

In order to prevent newborn problems, nurses must be knowledgeable and skilled in the application of enteral feeding. Effective enteral feeding necessitates careful monitoring of the chemistry and nursing care provided. Enteral feeding is a complex intervention requiring nurses to evaluate infants, monitor their hydration levels and weights,

record fluid balances, and check N.G. instructions. They must also monitor neonates' responses to tube feeding to ensure that complications associated with this type of therapy are kept to a minimum **(Verklan, Walden, & Forest, 2020)**.

Neonatal outcomes have a greater impact on the quality of nursing care. As a result, good nursing practices can help improve neonatal integrity. A nurse's role in neonatal care is defined by various factors, including the knowledge, skills, and experiences of the staff. Because of their expertise in nursing principles, nurses can better spread the word about appropriate nursing practices **(Zaki, El-Sayed, Said, & Ali, 2018)**.

Operational definition

High-risk neonates' outcomes refer to hospital stay duration, signs of necrotizing enterocolitis and feeding intolerance, abdominal girth, and C. reactive protein at admission and discharge.

Significance of the Study

As neonatal care nurses, the researchers noticed some nursing noncompliance with the enteral feeding instructions and protocols regarding enteral nutrition, such as check placement, document date of nasogastric tube insertion, preparation of enteral feeding, and many other observations. At the same time, relations between nurses' knowledge & practices toward enteral feeding of high-risk neonates and their outcomes are unknown; moreover, few studies handled the daily nursing knowledge and practices toward enteral nutrition in neonatal intensive care units, especially in Egypt.

A recent study done by **Al-Jalil et al. (2019)** determined enteral nutrition nursing care conformity rate with standards in the neonatal critical care units in Iran and concluded that enteral nutrition nursing care is far from standards in the pre- and post-feeding fields. Lack of clear clinical guidelines, nursing staff and equipment shortage, and inadequate training are related factors.

The effectiveness of the educational program on nurses' knowledge of nasogastric tube feeding practices in neonatal intensive care units was also examined by **Mohamme and Abou Zed (2018),** who conducted their research at Banha Specialized Pediatric Hospital and Banha University Hospital and revealed inadequacies in practitioner nurses' knowledge and skill regarding nasogastric tube feeding in neonatal intensive care units

As the basic knowledge and nursing activities regarding enteral feeding can vary from one health care institution to another and even within the same institution, special studies should be conducted to assess nurses' knowledge & practices regarding enteral feeding and its effect on the outcomes of selected high-risk neonates in order to identify the gaps, deficits, and work required to overcome the deficiencies.

Aim of the study:

The current study aims to assess nurses' knowledge & practices toward enteral feeding and its effect on selected high-risk neonates' outcomes

Research questions:

1. What are the levels of nurses' knowledge and practices toward enteral feeding of high-risk neonates?
2. Are nurses' knowledge & practices toward enteral feeding effect on selected high-risk neonates' outcomes?

Subjects and Method

Research Design:

A descriptive exploratory research design was used in this study to meet the aim of this study.

Setting:

The study was conducted in NICU at Beni-Suef University and general Hospitals in Beni-Suef city, Egypt.

Subjects:

A purposeful sample of neonatal and pediatric nurses responsible for providing direct care for high-risk neonates (70 nurses) at Beni-Suef University and general hospitals during data collection and neonates were utilized in this study. The sample size was 60 neonates according to the following formula:

$$N = \frac{t^2 \times p(1-p)}{m^2}$$

$$N = \frac{(1.96)^2 \times 0.05(1-0.05)}{0.05^2} = 60 \text{ neonates}$$

Description:

N = required sample size.
t = Confidence level at 95 % (standard value of 1.960).
p = Prevalence of neonates at previous setting ٢٠١٨ (0.05).
m = Margin of error at 5 % (standard value of 0.050).

Inclusion criteria of high-risk neonates

- High-risk neonate delivered in the same hospital.
- High-risk neonates weighed more than 1.200 kg.
- High-risk neonates with nasogastric tube feeding
- Full-term and preterm (more than 32 weeks of gestational age) neonates are free from any congenital anomalies.

Exclusion criteria of nurses

- Nurses experienced less than one year in NICU.
- Head nurses
- Nurse supervisors
- Administrative nurses.

Tools of data collection:

Three data collection tools were utilized in this study:

Tool I: Nurses' knowledge questionnaire sheet:

Researchers developed this tool after reviewing the related literature. It consisted of two parts.

Part1: Demographic characteristics such as code, age, residence, marital status, level of education, qualifications, years of experience, years of experience in the neonatal intensive care unit, and attending the training program.

Part 2: Nurse's knowledge questionnaire sheet

This part aims to assess nurses' knowledge regarding the feeding of the high-risk neonate through asking the related

questions, which include the time of start feeding, indication and contraindication for early feeding, strategies of early feeding, advantages of early feeding, indication, and contraindication for late feeding, the composition of high-risk neonate feeding, and methods of feeding, and symptoms of feeding intolerance.

Scoring system

Each correct response took two scores, an incomplete one took one score, and the wrong answer or the not known response took no score (zero). The total level score of nurses' knowledge of less than 60 % was considered unsatisfactory, while ≥ 60 % was considered satisfactory knowledge **(Shahin et al., 2012).**

Tool II: Nurses' practice checklist: Observational checklist to assess nurses practice about enteral feeding

This tool was adopted from the **United States Agency for international development (USAID) & the Ministry of Health (MOH) (2010)** to assess the practice of nurses who provide feeding to high-risk neonates. However, observation of them on different occasions, which included hand washing (19 steps), applying personal protective equipment (23 steps), measuring abdominal girth (12 steps), placement of the naso/orogastric feeding tube (6 steps), checking nasogastric tube placement (6 steps), nasogastric gavage (24 steps), also, cleaning and sterilization of feeding equipment (10 steps).

Scoring system

Each done correctly practice took one score, and not done was took no score (zero). The total score of nurses' practices less than 70% was considered unsatisfactory, while ≥ 70% was considered satisfactory practice **(Berhe et al., 2017).**

Tool III: neonatal outcomes:

It was designed by the researcher to collect data about gender, neonate diagnosis, hospital stay duration, signs of necrotizing enterocolitis and feeding intolerance, abdominal girth, and C. reactive protein at admission and discharge.

Validity and reliability

The revision of the tools for clarity, relevance, comprehensiveness, understanding, and applicability was done by a panel of five experts from the faculty of nursing to measure the content validity of the tools, and the necessary modification was done accordingly. Reliability coefficients were calculated for the study tools (nurses' knowledge, practice, and neonatal outcomes) were 0.910, 0.942, and 0.814, respectively.

Pilot Study

It was conducted on 10 % (7 nurses) of the study subjects to examine the tools' clarity, feasibility, and applicability and estimate the time needed for filling the sheets. Subjects included in the pilot study were selected randomly from the study setting and included in the study sample. The pilot study was collected from 2 January 2021 to 23 January 2021.

Ethical Consideration

For ethical consideration, official permission was obtained from the authorities in the mentioned hospitals and written or oral consent was obtained from the study subjects; the study's purpose and nature were explained to them before conducting the study. The investigators emphasized that the study's participation was voluntary; anonymity and confidentiality were assured by coding the data.

Method of Data Collection

The procedure of data collection

The researcher reviewed current and past, local, and international related literature and theoretical knowledge of various aspects of the study using books, articles, journals, and the internet to prepare the data collection tools.

After taking approval to conduct the study, the researcher met the director of Beni-Suef university hospital and the director of Beni-Suef general hospital to explain the aim of the study and take his approval, then determine a suitable time to collect the data and confirm days, times suitable to conduct the study. After that, the researcher meets the study subjects and arranges them to complete the study tools. Data were coded and analyzed to answer the research questions.

Before study conduction, approval was obtained from the scientific research ethical committee of the faculty of nursing, Minia University. The researcher met the director of Beni-Suef University and general hospitals, and official letters were issued from the faculty of nursing, Minia University, to get permission from the director. The study's purpose and procedure were explained to them to get their consent and cooperation.

Nurses' knowledge and practice regarding the high-risk neonate's feeding were assessed using the structured interview questionnaire and observational checklist (tool I part 2 and tool II). The interview took place in the pediatric and emergency departments at NICU at Beni-Suef University and general Hospitals in Beni-Suef city. The interview was conducted for all nurses to fill in their personal data and assess their knowledge regarding enteral feeding for high-risk neonates using a structured interview questionnaire. The time taken to conduct the structured interview questionnaire for each nurse was ranged from 25 to 30 minutes, and nurses' practice done by an observational checklist and consumed 25-40 minutes at a rate of 4 to 6 nurses/ week. Data collection was conducted over three months extending from 30 January 2021 to the end of April 2021.

During the duration of observed nurses' practice regarding the feeding of the high-risk neonate, collected neonatal outcomes data (Tool III) as gender, neonate diagnosis, and hospital stay duration. Signs of necrotizing enterocolitis and feeding intolerance, abdominal girth were measured daily twice before and after one hour of feeding for seven days, and mean results were calculated C. reactive protein was recorded at admission, after three days of admission, and before discharge according to hospital policy. The time taken to conduct the neonatal outcomes sheet for each neonate ranged from 15 to 20 minutes at a rate of 4 to 6 neonates/ week.

Statistical Design:

The data entry was completed using a compatible personal computer. The statistical analysis was carried out with the assistance of the statistical program for social science (SPSS) version 28 and excel was utilized for the figures. Following the analysis, the contents of each tool were arranged into categories and then coded. For qualitative factors, the data were presented using descriptive statistics,

such as frequencies and percentages; for quantitative variables, the presentation included means and standard deviations. P-values less than 0.05 were considered statistically significant. The Chi-square or Fisher exact test was utilized in order to ascertain whether or not there was a relationship between the nurses' knowledge and practices in connection to the demographic characteristics of their choices. In order to discover the correlations between quantitative variables, correlation analysis was carried out. **Also, the eta square test was used to determine the effect of nurses' knowledge and practice on neonatal outcomes.**

Results

Table (1): Demographic characteristics of the studied nurses (n= 70)

Items	No.	%
Gender		
Male	15	21.4
Female	55	78.6
Age/ years		
20-	48	68.6
30-	15	21.4
40- 50	7	10.0
Mean ± SD	28.6 ± 6.7 years	
Residence		
Urban	22	31.4
Rural	48	68.6
Marital status		
Single	15	21.4
Married	52	74.3
Widow	3	4.3
Level of education		
B. Sc	2	2.8
Nursing institution	55	78.6
Diploma nursing	13	18.6
Years of experience in the nursing field		
1-	33	47.2
5-	15	21.4
10-	15	21.4
15 - 20	7	10.0
Mean ± SD	7.45 ± 5.0 years	
Years of experience in the NICU (n= 60)		
1-	28	40.0
5-	12	17.2
10-	13	18.6
15 - 20	7	10.0
Mean ± SD	7.65 ± 5.2 years	
Previous training about nutrition for high-risk neonates		
Yes	0	0.0
No	70	100.0

Table (1): shows that 78.6% of the studied nurses were female, 68.6% were aged between 20 - < and 30 years, with a mean age of 28.6 ± 6.7 years, and 74.3% were married. Regarding the level of education, 78.6% of the studied nurses had a nursing institution degree, 47.2% and 40.0% their years of experience ranged from one to < five year in the nursing field and the neonatal intensive care unit, respectively. Also, none of them not had previous training in nutrition for high-risk neonates.

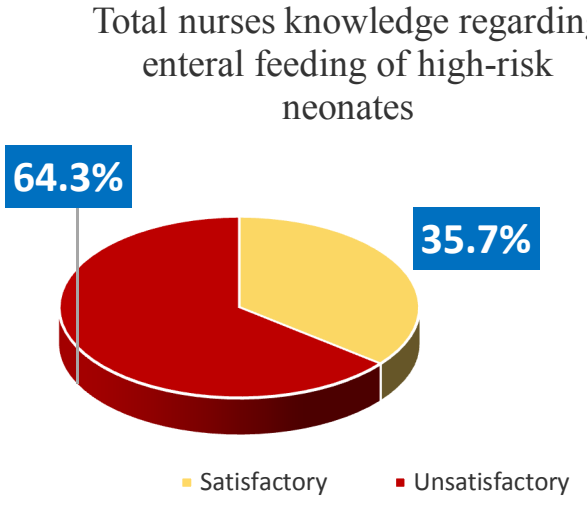

Figure (1): Percentage distribution of total nurses' knowledge regarding enteral feeding of high-risk neonates among the studied nurses (n= 70)

Figure (1): illustrates that 64.3% of the studied nurses had unsatisfactory knowledge regarding enteral feeding of high-risk neonates, and 35.7% had satisfactory knowledge.

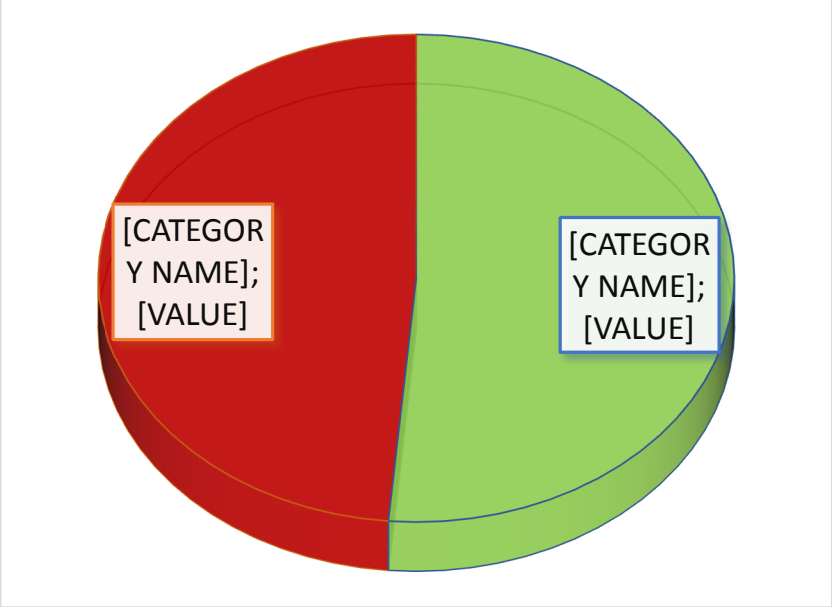

Figure (2): Percentage distribution of total nurses' practice regarding enteral feeding of high-risk neonates (n= 70)

Figure (2): illustrates that 48.6% of the studied nurses had unsatisfactory practice regarding enteral feeding of high-risk neonates, and 51.4% had satisfactory practice.

Table (2): Demographic characteristics of the studied high-risk neonates (n= 60).

Items	No.	%
Gender		
Male	38	63.3
Female	22	36.7
Gestational age		
Full-term	19	31.7
Preterm	41	68.3
Neonate's diagnosis		
Respiratory distress	27	45.0
Neonatal jaundice	8	13.3
Low birth weight	25	41.7
Hospital duration/ day		
Three days	17	28.3
3- 5	23	38.3
5- 7	20	33.4

Table (2): presents that 63.3% of the studied high-risk neonates were male neonates, 68.3% were preterm neonates, and 45.0% had respiratory distress.

Table (3): Percentage distribution of high-risk neonates regarding systematic abdominal signs of necrotizing enterocolitis and symptoms of feeding intolerance (n = 60).

Signs	1st day		2nd day		3rd day		4th day	
	No.	%	No.	%	No.	%	No.	%
Systemic signs								
Respiratory distress	28	46.7	26	43.3	20	33.3	5	8.3
Temperature instability	8	13.3	6	10.0	2	3.3	0	0.0
Poor feeding	39	65.0	28	46.7	17	28.3	0	0.0
Decrease peripheral perfusion	5	8.3	3	5.0	2	3.3	0	0.0
Oliguria	6	10.0	4	6.7	0	0.0	0	0.0
Abdominal (enteric) signs								
Delayed gastric emptying	12	20.0	8	13.3	4	6.7	1	1.7
Abdominal distention	15	25.0	11	18.3	7	11.7	1	1.7
Vomiting	5	8.3	4	6.7	1	1.7	0	0.0
Symptoms of feeding intolerance								

Signs	1st day		2nd day		3rd day		4th day	
	No.	%	No.	%	No.	%	No.	%
Blood in the gastric aspirate	0	0.0	2	3.3	2	3.3	0	0.0
Acute increase of abdominal girth (>2 cm).	5	8.3	4	6.7	1	1.7	0	0.0
Watery stool with reducing substances greater than 0.5%.	8	13.3	7	11.7	4	6.7	1	1.7

Table (3): reveals that 46.7% of the studied high-risk neonates had respiratory distress, 65.0% had poor feeding, 20.0% had delayed gastric emptying, and 25.0% had abdominal distension.

Table (4): Percentage distribution of high-risk neonates regarding C- reactive protein investigation (n = 60).

C. reactive protein	No.	%
At admission		
Normal	60	100.0
Positive	0	0.0
After 3 days		
Normal	58	96.7
Positive	2	3.3

Table (4): shows that 0.0% of the studied high-risk neonates had positive C-reactive protein at admission, and 3.3% had positive C-reactive protein after three days.

Table (5): Percentage distribution of high-risk neonates regarding abdominal girth measurement (n= 60).

Abdominal girth	1st day		2nd day		3rd day		4th day	
	No.	%	No.	%	No.	%	No.	%
Before feeding								
Normal	58	96.7	59	98.3	60	100.0	60	100.0
>2cm	2	3.3	1	1.7	0	0.0	0	0.0
After 2 hours								
Normal	55	91.7	56	93.3	59	98.3	60	100.0
>2cm	5	8.3	4	6.7	1	1.7	0	0.0

Table (5): presents that 8.3% of the studied high-risk neonates had an abdominal girth more than two cm than normal in the first day, decreased to 6.7% in the second day and 0.0% at the fourth day after admission.

Table (6): Eta square test between total nurses' knowledge toward enteral feeding of high-risk neonates and neonatal outcome

Neonatal outcomes	Nurses' knowledge			
	1st day	2nd day	3rd day	4th day
	Eta square	Eta square	Eta square	Eta square
Systemic signs				
Respiratory distress	0.0803	0.0861	0.0861	0.0889
Temperature instability	0.0756	0.0889	0.1054	……
Poor feeding	0.1183	0.110	0.1274	……
Decrease peripheral perfusion	0.07	0.0649	0.0649	……
Oliguria	0.0702	0.0702	……	……
Abdominal (enteric) signs				
Delayed gastric emptying	0.07	0.0649	0.0649	0.072
Abdominal distention	0.1259	0.1151	0.0967	0.0967
Vomiting	0.0720	0.0649	0.0776	……
Symptoms of feeding intolerance				
Blood in the gastric aspirate	……	0.756	0.70	……
Acute increase of abdominal girth (>2 cm).	0.1054	0.1151	**0.2182**	……
Watery stool	0.0889	0.0861	0.0756	0.0756
C. reactive protein	……	……		……
Abdominal girth				
Before feeding	0.1379	0.1477	……	……
After 2 hours	0.1054	0.1151	**0.2182**	……
Hospital duration/ day	……	…….	0.0889	0.0756

Table (6): shows that moderate effect between acute increase of abdominal girth after 2 hours in the 3rd day of the study and nurses' knowledge toward enteral feeding of high-risk neonates (($\eta 2 < 0.2182$).

Table (7): Eta square test between total nurses' practice toward enteral feeding of high-risk neonates and neonatal outcome

Neonatal outcomes	Nurses' practice			
	1st day	2nd day	3rd day	4th day
	Eta square (η^2)	Eta square (η^2)	Eta square (η^2)	Eta square (η^2)
Systemic signs				
Respiratory distress	0.175	0.1714	0.1476	0.0814
Temperature instability	0.0927	0.085	0.0715	……

Neonatal outcomes	Nurses' practice			
	1st day	2nd day	3rd day	4th day
	Eta square (η^2)	Eta square (η^2)	Eta square (η^2)	Eta square (η^2)
Poor feeding	0.1542	0.1834	0.1347	……
Decrease peripheral perfusion	0.1018	0.0944	0.0871	……
Oliguria	0.1069	0.0994	……	……
Abdominal (enteric) signs				
Delayed gastric emptying	0.1652	0.1187	0.0927	0.0802
Abdominal distention	0.1955	0.1462	0.1022	0.0787
Vomiting	0.1087	0.1037	0.0771	……
Symptoms of feeding intolerance				
Blood in the gastric aspirate	……	0.0979	0.0841	……
Acute increase of abdominal girth (>2 cm).	0.1096	0.1037	**0.2208**	……
Watery stool	0.1289	0.1148	0.0979	0.0829
C. reactive protein	……	……	0.0925	……
Abdominal girth				
Before feeding	0.0937	0.0889	……	……
After 2 hours	0.1132	0.1071	**0.2208**	……
Hospital duration/ day	……	…….	**0.2066**	**0.3519**

Table (7): shows that moderate effect between acute increase of abdominal girth after 2 hours with nurses' practice toward enteral feeding of high-risk neonates ($\eta 2 < 0.2208$) and hospital duration of high-risk neonates at 3rd and 4th days of the study with nurses' practice ($\eta 2 < 0.2066$ and 0.3519 respectively)

Discussion

Nurses are considered an important link to care for pediatric patients with enteral feeding. However, minimal attention has been paid to how nurses administer enteral feedings. There are wide variations in the management of nutritional support, which may be related to knowledge gaps, or the use of multiple sources of information, or a lack of standardization in the care environment. Maintaining consistency in feeding for critically ill children has been identified as a problem secondary to the inadequate knowledge of the nurses **(Yi, 2018).**

The present findings illustrated that less than two-thirds of the studied nurses had unsatisfactory knowledge regarding enteral feeding of high-risk neonates, while more than one-third of them had satisfactory knowledge. From the researcher's point of view, that could be due to a lack of attending to nurses' training courses about enteral feeding, which help them to improve their total level of knowledge about enteral feeding.

This result is congruent with a study done by **Abukari& Acheampong (2021)** and entitled "Feeding the critically ill child in intensive care units: a descriptive qualitative study in two tertiary hospitals" in Ghana, who found that the majority of nurses had inadequate total knowledge score regarding enteral feeding. But this result is different from **Abo Elezz et al. (2021),** who proved that slightly more than half of the studied nurses had satisfactory knowledge related to enteral feeding.

According to total nurses' practice regarding enteral feeding of high-risk neonates, the current study's findings demonstrated that more than half of the studied nurses had satisfactory practice regarding enteral feeding of high-risk neonates, and less than half had unsatisfactory practice. This result could be due to studied nurses having knowledge and expertise to ensure satisfactory outcomes and provide high-quality nursing care for infants with enteral feeding.

This result agrees with a study achieved by **Abo Elezz et al. (2021),** who found that less than three-quarters of the studied nurses had a competent total level of practice regarding enteral feeding in the pediatric critical care unit. This finding is un-similar with **Mahmoud et al. (2018),** who represented that more than two-thirds of the studied nurses had incompetent in their total performance score for enteral feeding.

For demographic characteristics of the studied high-risk neonates, the present study revealed that less than two-thirds of the studied high-risk neonates were males, more than two-thirds of them were preterm neonates, and less than half of them had respiratory distress. Along the same line, **Hendy et al. (2020)**, in an Egyptian study entitled "Nursing competency for caring of high-risk neonates at neonatal intensive care unit"، discussed that less than half of the studied high-risk neonates were boys, and more than half of them were premature babies and half of them had respiratory distress syndrome.

Regarding systematic abdominal signs of necrotizing enterocolitis and symptoms of feeding intolerance among the studied nurses, the current findings illustrated that less than half of the studied high-risk neonates had respiratory distress, more than half of them had poor feeding, and less than one-quarter of them had delayed gastric emptying while more than half of the studied nurses had abdominal distension.

That may be attributed to the high-risk neonates having abdominal disturbance due to their medical condition, and enteral feeding increase the risk for poor feeding delayed gastric emptying, and abdominal distension.

These results are similar to the results of the study conducted in Egypt by **Zaki et al. (2018)** entitled "Assessment of nurses' performance regarding care for neonates with necrotizing enterocolitis at intensive care units"، which illustrated that most high-risk neonates complained of signs of necrotizing enterocolitis due to their health problems and feeding intolerance.

Concerning C-reactive protein investigation for high-risk neonates, the current study revealed that none of the studied high-risk neonates had positive C-reactive protein at admission, and the minority of them had positive C-reactive protein after three days. That's maybe due to low immunity among the high-risk neonates, making them more at risk for exposure to infection or nosocomial infection.

This result is on the same line as **Macallister et al. (2019)** study entitled "Serial C-reactive protein measurements in newborn infants without evidence of early-onset infection"، which represented that most newborns with medical problems

are exposed to infection after admission and reported positive C-reactive protein.

Regarding abdominal girth measurement among the studied high-risk neonates, the present study findings clarified that the minority of the studied high-risk neonates had an abdominal girth more than two cm than normal in the first day, which decreased in the second day became known at the fourth day after admission. From the researcher's point of view, this result might be due to the body function of the neonates starting to cope with the feeding methods and decreased feeding intolerance.

This finding is in accordance with a study by **Thomas et al. (2018),** who stated that a decrease in abdominal girth was obvious in the studied sample, which the assessment of feed tolerance results in earlier full enteral feeds in preterm neonates.

The current study proved a moderate effect between acute increase of abdominal girth after 2 hours in the 3rd day of the study and nurses' knowledge and practiced toward enteral feeding high-risk neonates. This finding might be that abdominal girth monitoring is a better marker of feed intolerance, and nurses' knowledge toward monitoring continuously leads to infants' improvement and feeding tolerance. This result agrees with **Thomas et al. (2018),** who showed that improved nurses' knowledge toward enteral feeding help to improve the infant outcome for feeding.

Also, a study entitled "Abdominal circumference or gastric residual volume as measure of feed intolerance in VLBW infants" by **Kaur et al. (2015)** stated that correct practice from health care providers for enteral nutrition leads to a decrease in food intolerance among the studied infants.

Conclusion: Nearly two-thirds and nearly half of the studied nurses had unsatisfactory knowledge and practice regarding enteral feeding of high-risk neonates, respectively. Nurses' knowledge and practices regarding enteral feeding of high-risk neonates had a moderate effect on the acute increase of abdominal girth after 2 hours in the 3rd day.

Recommendation: Periodically implementing of health education training program toward enteral feeding high-risk neonates enhances their knowledge, practices and reduces the effects on high-risk neonates' outcomes.

References

1. Abo Elezz, H. M., Adly, R. M., & Tantawi, H. R. (2021). Assessment of Nursing Performance toward Enteral Feeding at Pediatric Critical Care Units. Egyptian Journal of Health Care, 12(4), 1159-1178.
2. Abukari, A. S., & Acheampong, A. K. (2021). Feeding the critically ill child in intensive care units: a descriptive qualitative study in two tertiary hospitals in Ghana. BMC pediatrics, 21(1), 1-8.
3. Al-Jalil, T., Gray, G., Rasouli, M., Hoseini Azizi, T., & Hejazi, S.-S. (2019). Auditing of enteral nutrition nursing care in critical care patients. Journal of Nursing Practice Today, 6(1), 25-18 .
4. Bass, J. L., Gartley, T., Lyczkowski, D. A., & Kleinman, R. (2018). Trends in the incidence of sudden unexpected infant death in the newborn: 1995-2014. The Journal of Pediatrics, 196, 104-108 .
5. Berhe A.K., Tinsae F., and Gebreegziabher G. (2017). Knowledge and practice of immediate newborn care among health care providers in eastern zone public health facilities, Tigray, Ethiopia, 2016. BMC pediatrics: 17- 157.
6. Embleton, N. D., & van den Akker, C. H. (2019). Protein intakes to optimize outcomes for preterm infants. Paper presented at the Seminars in perinatology.
7. Harding, J. E., Cormack, B. E., Alexander, T., Alsweiler, J. M., & Bloomfield, F. H. (2017). Advances in the nutrition of the newborn infant. The Lancet, 389(10079), 1660-1668.
8. Harding, J. E., Cormack, B. E., Alexander, T., Alsweiler, J. M., & Bloomfield, F. H. (2017). Advances in the nutrition of the newborn infant. The Lancet, 389(10079), 1660-1668.
9. 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 .
10. Hendy, A. S., Al-Sharkawi, S. S., & Abd Al-Moniem, I. I. (2020). Nursing Competency for Caring of High-Risk Neonates at Neonatal Intensive Care Unit. Egyptian Journal of Health Care, 11(2), 200-213.
11. Kaur, A., Kler, N., Saluja, S., Modi, M., Soni, A., Thakur, A., & Garg, P. (2015). Abdominal circumference or gastric residual volume as measure of feed intolerance in VLBW infants. Journal of pediatric gastroenterology and nutrition, 60(2), 259-263.
12. Macallister, K., Smith-Collins, A., Gillet, H., Hamilton, L., & Davis, J. (2019). Serial C-reactive protein measurements in newborn infants without evidence of early-onset infection. Neonatology, 116(1), 85-91.
13. Mahmoud, N. A., Mahmoud, F. Sh., & Khalaf, S.M. (2018). Quality of Nurses' Performance Regarding Parenteral Nutrition at Neonatal Intensive Care Units. Egyptian Journal of health care, 9(2), 116-128.
14. Mohamme A.A., and Abou Zed S.A. (2018). The effect of educational program on nurse's knowledge and practices about nasogastric tube feeding at neonatal intensive care units. Journal of Nursing Education and Practice; 8 (8): 21-27
15. Shahin M.A., Mohamed W.Y., and Sayed M. (2012). Nurses' Knowledge and Practices regarding Enteral Nutrition at the Critical Care Department of Al- Manial University Hospital in Egypt: Impact of a Designed Instructional Program. J Am Sci; 8(11):397-405].
16. Thomas, S., Nesargi, S., Roshan, P., Raju, R., Mathew, S., Sheeja, P., & Rao, S. (2018). Gastric residual volumes versus abdominal girth measurement in assessment of feed tolerance in preterm neonates: a randomized controlled trial. Advances in Neonatal Care, 18(4), E13-E19.
17. United States Agency for international development (USAID) & Ministry of Health (MOH). (2010). Neonatal Care. Protocol for hospital physicians. Chapter 21: hyperbilirubinemia. Pp. 219: 21.
18. Verklan, M. T., Walden, M., & Forest, S. (2020). Core curriculum for neonatal intensive care nursing e-book: Elsevier Health Sciences.
19. Yi, D. Y. (2018). Enteral nutrition in pediatric patients. Pediatric gastroenterology, hepatology & nutrition, 21(1), 12-19.
20. Zaki, A., El-Sayed, E., Said, K., & Ali, R. (2018). Assessment of Nurses' Performance Regarding Care for Neonates with Necrotizing Enterocolitis at Intensive Care Units. Egyptian Journal of Health Care, 9(3), 111-124