

Nurses' Competent Practices Regarding Early Detection and Management of Early Onset Neonatal Hypocalcaemia

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Abstract: Early onset neonatal hypocalcaemia is a frequently observed clinical and laboratory abnormality in neonates. Ionic calcium is crucial for many biochemical processes including blood coagulation, neuromuscular excitability, cell membrane integrity and many of the cellular enzymatic activities. Whereas, it presents within 72 hours and requires treatment with calcium supplementation. **Aim:** The present study aimed to evaluate the effect of training program on nurses' competent practices regarding early detection and management of early onset neonatal hypocalcaemia. **Design:** A quasi-experimental design was utilized to conduct this study. **Settings:** The study was carried out the neonatal intensive care units at Benha University Hospital and Benha Teaching Hospital affiliated to Ministry of Health **Sample:** A convenient sample included all the available nurses (65), who were working at the previously mentioned settings and a convenient sample of all neonates (100) suffering from early onset hypocalcaemia. **Tools:** Tools of data collection included; **Tool (I):** A structured interviewing questionnaire schedule; to explore neonates' characteristics, nurses' personal data and their knowledge regarding early detection and management of early onset neonatal hypocalcaemia. **Tool (II):** Observational checklist to assess the actual nurses' practices regarding early detection and management of early onset neonatal hypocalcaemia. **Results:** The present study results revealed that, the mean age of nurses was 30.76 ± 7.00 years and nearly three quarter of them had not attended training programs related to NICU. There were highly statistical significant differences ($P < 0.001$) concerning nurses' knowledge and practice pre/post-implementation of the training program regarding early detection and management of early onset neonatal hypocalcaemia and there was a positive correlation between total nurses' knowledge and practice regarding early detection and management of early onset neonatal hypocalcaemia post-implementation of the training program. **Conclusion:** Nurses' total knowledge and practice scores regarding early detection and management of early onset neonatal hypocalcaemia were improved post-implementation of the training program than pre-program implementation. **Recommendation:** The study, emphasized on the importance of continuing in-service training for nurses regarding early detection and management of early onset neonatal hypocalcaemia

Keywords: Competent, Practices, Early Detection, Management & Early Onset Neonatal Hypocalcaemia.

1. INTRODUCTION

Calcium is actively transferred from mother to the fetus during the last trimester, as demonstrated by a significantly high level of total calcium concentration in cord blood compared to maternal serum. On the other hand, parathyroid hormone (PTH) and calcitonin (CT) do not cross the placental barrier. Whereas, the PTH related peptide (PTHrP) is the main regulator of the positive calcium balance across the placenta. In this condition serum calcium (SCa) in the fetus reached 10-11 mg/dL at term (1-2 mg higher as compared to mother) (Son et al., 2010).

During the post natal period, the SCa levels in newborns depend on the PTH secretion, dietary calcium intake, renal calcium reabsorption, skeletal calcium stores, and vitamin D status. Hence, after delivery, calcium levels start decreasing (the rate and extent of decrease is inversely proportional to the gestation) and reaches a nadir of 7.5-8.5 mg/dL in healthy term babies by day 2 of life. This drop in postnatal SCa may be related to hypoparathyroidism, end organ unresponsiveness to parathyroid hormone, abnormalities of vitamin D metabolism, hyper phosphatemia, hypomagnesaemia and hypercalcitonemia which occur by 12-24 h of age. PTH levels increase gradually in the first 48 h of life and normal levels of SCa are regained by 3rd day of life. The efficacy of the intestinal absorption of calcium and the renal handling matures by 2-4 wks. This transition phase is responsible for the increased risk of early onset hypocalcemia in high-risk neonates (Abrams, 2012).

Hypocalcaemia is defined as total serum calcium of less than 7 mg/dL (1.75 mmol/L) or ionized calcium less than 4 mg/dL (1 mmol/L) in preterm infants and less than 8 mg/dL (2 mmol/L; total) or <1.2 mmol/L (ionic) in term neonates.. This condition is fairly common and seen within the first 3-4 days of life (Newman et al.,2014)

Neonates who are at increased risk of hypocalcemia are those with; Prematurity, mothers in preeclampsia sick infants of diabetic mothers and those with severe perinatal asphyxia, Maternal intake of anticonvulsants (phenobarbitone, phenytoin sodium) Maternal hyperparathyroidism and other maternal conditions related to Iatrogenic (alkalosis, use of blood products, diuretics, phototherapy, lipid infusions (Son et al.,2010).

Early neonatal hypocalcemia is usually asymptomatic unlike the late onset variety and is incidentally detected. Meanwhile, the symptoms may be of neuromuscular irritability - myoclonic jerks, jitteriness, exaggerated startle, and seizures. They may represent the cardiac involvement like- tachycardia, heart failure, prolonged QT interval, decreased contractibility. More often they are non-specific and not related to the severity of hypocalcemia. Apnea, cyanosis, tachypnea, vomiting and laryngospasm are other symptoms that are noted (Yilmaz et al., 2018).

Diagnosis of hypocalcemia in newborn infants based only on ECG criteria is likely to yield a high false positive rate. Although these parameters have good correlation with hypocalcemia in low birth weight infants (sensitivity of 77% and specificity of 94.7%). Rather more, neonates suspected to have hypocalcemia by ECG criteria should have the diagnosis confirmed by measurement of serum calcium levels should receive 40 mg/kg/day of elemental calcium (4 mL/kg/day of 10% calcium gluconate) for prevention of early onset hypocalcemia. However, there is not sufficient evidence for this practice. Infants tolerating oral feeds may receive this calcium orally q 6 hourly. Therapy should be continued for 3 days. Oral calcium preparations have high osmolality and should be avoided in babies at higher risk of necrotizing enterocolitis (Samrat & Ankola, 2012).

Neonates diagnosed to have symptomatic hypocalcemia should receive a bolus dose of 2 mL/kg/dose diluted 1:1 with 5% dextrose over 10 min under cardiac monitoring. When there is severe hypocalcaemia with poor cardiac function, calcium chlorides 20 mg/kg may be given through a central line over 10-30 min (as chloride in comparison to gluconate does not require the metabolism by the liver for the release of free calcium). This should be followed by a continuous IV infusion of 80 mg/kg/day elemental calcium for 48 h. Continuous infusion is preferred to IV bolus doses (1 mL/kg/dose q 6 hourly)(Son et al.,2010).

Calcium infusion should be dropped to 50% of the original dose for the next 24 h and then discontinued. The infusion may be replaced with oral calcium therapy on the last day. Normal calcium values should be documented at 48 h before weaning the infusion. Additionally, all categories of hypocalcemia should be treated for at least 72 h. Rather more, continuous infusion is preferred to IV bolus doses. Also, symptomatic hypocalcemia should be treated with a continuous infusion for at least 48hours (Abrams, 2012).

Significance of the study:

Hypocalcemia is a common metabolic manifestation in neonates. It is a potentially life-threatening condition, with reported prevalence varying by gestational age, maternal and infant comorbidities, and perinatal factors. Neonatal hypocalcemia is classified according to its onset to; early onset which manifests within the first 72 hours of birth and delayed onset after 3 days of birth. Calcium is the most abundant mineral in the human body. Early onset Hypocalcemia is usually asymptomatic disease but may present with lethargy, vomiting, abdominal distension, poor muscle tone, or poor

feeding, and irritability. Approximately one-third of preterm infants and most of the very low birth weight infants have low serum calcium levels during the first 48 h of life (Vuralli, 2019). So, it is important to detect early manifestations and calcium levels should be measured at 12, 24, and 48 h of birth. Thus, monitoring of calcium levels should continue until values return to normal and calcium intake is adequate. This help in preventing progressive complications. Furthermore nurses have a crucial role in early detection and management of neonatal early onset hypocalcemia. Thus nurses should have adequate knowledge and competent practice regarding care of those neonates (World Health Organization, 2017).

Aim of the study:

The aim of this study was to evaluate nurses' competent practices regarding early detection and management of early onset neonatal hypocalcaemia through:

- 1-Assessing nurses' knowledge & practice regarding early detection and management of early onset neonatal hypocalcaemia.
- 2-Designing and implementing a training program based on nurses' actual needs regarding early detection and management of early onset neonatal hypocalcaemia.
- 3- Evaluating the effect of the training program on nurses' knowledge, practice regarding early detection and management of early onset neonatal hypocalcaemia.

Research Hypotheses:

Level of nurses' knowledge and practice regarding early detection and management of early onset neonatal hypocalcaemia significantly will be improved after implementation of the training program.

2. SUBJECTS AND METHOD

Research Design:

A quasi- experimental research design was utilized.

Settings:

The study was carried out at the neonatal intensive care units (NICU) in Benha University Hospital and Benha Teaching Hospital affiliated to Ministry of Health. Whereas, NICU at Benha University Hospital, found in the fourth floor and it contains 8 incubators and NICU at Benha Teaching Hospital, found also in the fourth floor and consisted of 15 incubators.

Subjects:

A convenient sample included all the available nurses (65), who were working at the previously mentioned settings and a convenient sample of all available neonates (100) suffering from early onset hypocalcaemia.

Tools of Data Collection:

In order to fulfill the aim of the present study, two tools were used for data collection:

Tool I: A structured interviewing schedule: It was developed by the researchers after reviewing the related literatures (Abrams,(2012),Newman, et al., (2014) and Yilmaz et al.,(2018). It was written in Arabic language to suit the nature of the studied nurses and in a form of multiple choice questions. It composed of four parts as following:

Part (1): Nurses' personal data, such as; age, gender, level of education, years of experience.

Part (2): Neonates' characteristics such as; gestational age, current age, current weight, gender.

Part (3): Nurses' knowledge regarding early onset neonatal hypocalcaemia (EOH) and related concepts. This includes; types of neonatal hypocalcemia, definition of EOH, the normal blood calcium level in newborn and prognosis. The total questions were (14 questions)

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Part (4): Nurses' knowledge regarding prevention of early onset neonatal hypocalcaemia such as; proper prenatal care, adequate maternal calcium and magnesium intake, management of premature labor, provision of Immediate post natal proper feeding. The total questions were (6questions).

Part (5): Nurses' knowledge regarding nursing management of neonates with early onset neonatal hypocalcaemia, such as; Treatment for all categories of hypocalcaemia, time for initiation of continuous calcium bolus infusion dosage of calcium bolus infusion. The total questions were (7 questions).

Scoring system for nurses' knowledge:

For each knowledge items, the scoring system consisted of giving score (2) for the complete correct answer, while the correct incomplete answer was scored (1) and don't know or incorrect answer, was scored (0).Total scoring was classified as less than (75%) considered inadequate, while more than(75%) considered adequate knowledge.

Tool II: Observational Checklist for nurses' practices:

It was adopted from **Sarkar, (2018)** to assess nurses' practice regarding early detection and management of early onset neonatal hypocalcaemia. It included; hand washing (7 steps), vital Signs (23 steps),IV therapy (13),Obtaining blood sample(10) I.V- Calcium Gluconate injection dosage and administration (12 steps).

The total practices were (5practices)which included (65 steps).

-Scoring system for nurses` practices was as follows :

Done was scored (1)

Not done was scored (zero)

The total score of practices' steps was 100%, accordingly more than 85%was considered competent practices and less than 85% was considered incompetent practices.

Preparatory phase:

Validity and Reliability

The researchers reviewed the past, current regional and international related literatures covering all aspects of the study using textbooks, articles, journal and scientific magazines. This helped the researchers to be acquainted with the research problem and guided them in developing the study tools. To measure content validity of the study tools, the researchers assure that items of the tools were adequately represent what are supposed to measure by presented it to three experts including; two in Pediatric nursing at Ain Shams Faculty of Nursing Ain Shams University, and one in neonatal and pediatric medicine at Benha Faculty of medicine, Benha University, to test the content validity. Modifications of the tools were done according to the experts' judgment on clarity of sentences, appropriateness of contents and sequence of items. The experts' agreed on the content, but recommended minor language changes that would make the information clearer and more precise. The suggested changes were made. Internal consistency reliability of all items of the tools was assessed using Chronbach's Alpha test. It was 0.83for the structured interviewing schedule, and 0.86 for nurses' observational checklist.

Method:

Exploratory phase:

Ethical considerations and human rights:

Participation in the study was voluntary whereas, each nurse was informed about the purpose, procedure, benefits, and nature of the study and each nurse informed that she had the right to withdraw from the study at any time without any rationale and then oral/written consent obtained from them. Subjects were informed that the obtained data will not be included in any further researches. Confidentiality and anonymity of each subject was assured through coding of all data and all information has taken was protected.

Pilot Study:

It was conducted on 10 % of the total study sample (6 nurses) to evaluate the feasibility, reliability, and clarity of the tools. It was conducted to test the applicability of the tools, find out the possible obstacles and problems that might face the researchers and interfere with data collection. Additionally, to detect any problems peculiar to the statements as sequence of questions and clarity. It was also helped to estimate the time needed for data collection.

Field of Work:

Data were collected from the beginning of January 2019 to the end of June 2019. Immediately after the ethical approval was obtained; the researchers obtained oral consents from the studied nurses who were included in the study after an explanation of the aim, tools, benefits and the duration of the study to gain their cooperation. The researchers then started to interview each nurse individually and this took about 20-25 minutes for assessing knowledge. The researchers then started to assess care provided by nurses during their care for each infant 3days / week. The researchers were available 3 days per week: Sunday, Monday and Tuesday in the studied settings. At the beginning of the first session, an orientation of the contents was listed and then explanation, demonstration and re demonstration were done. After finishing data collection the actual nursing care was assessed and practices applied to nurses about care for infants.

-This study was carried out in five separate steps: developing an interview questionnaire sheet, pilot study, assessment of baseline nurses' knowledge and practice (pre-test), implementation of training program and evaluation of nurses' knowledge and practice after training program.

Procedure:
Preparation phase:

It was concerned with designing and testing different data collection tools, in addition, the administrative arrangements to carry out the study as well as to conduct the pilot study. In the beginning, the researchers introduced themselves to the nurses. Nurses who accept to participate in the study individually interviewed by the researchers to explain the nature, purposes, and the desired outcomes of the study and an oral consent were obtained from these nurses.

I. Assessment phase:

It was carried out using tool one & two to collect baseline data and to detect nurses' knowledge/practice needs.

Objectives of the training program:

At the end of the training program the studied nurses were able to:

- Define related concepts of neonatal hypocalcaemia.
- List types of neonatal hypocalcaemia.
- Identify causes of EOH.
- Explain clinical symptoms of EOH.
- List methods treatment of EOH.
- Identify complications of EOH.
- Recognize the prognosis of EOH.
- List methods of prevention for early onset neonatal hypocalcaemia.
- Recognize nursing management of neonates with early onset neonatal hypocalcaemia:
- Demonstrate hand washing steps.
- Demonstrate vital signs measurement steps.
- Demonstrate IV therapy steps.

-Demonstrate blood sampling steps.

-Demonstrate calcium Gluconate Injection dosage and administration.

II. Planning phase:

The training program was planned based on assessment phase and recent review of literature. It included goals & contents.

Each session was started by a summary about what has been discussed in the previous one and presenting the objectives of the new session, using simple Arabic language, also the session ended by a summary of its content and feedback from the nurses was obtained to ensure that they got the maximum benefit.

Implementation Phase:

The training program was conducted through six sessions; theoretical part was performed through lectures and group discussions which were done in 3 sessions for theoretical contents (each session lasted for 20-25 minutes) according the nurses' needs and condition in groups (place and time). At the beginning of the first session, the training program contents and its aim were explained to the nurses. Then conduction of practical part began at the previously mentioned settings. It was taken 5 sessions (each session lasted for 30- 45-minutes) and covers the training programs items.

Each session was started by a summary about what has been conversed in the previous one and presenting the objectives of the new session using simple Arabic language, also the session was finished by a summary of its content and feedback was gained to ensure that they got the maximal benefit.

The total number of the subjects was 65 nurses; they were divided into 13 groups, 5 nurses in each group. The training program was presented to each group separately.

Different teaching strategies were used for implementation of the training program such as; lectures, small group discussion, brain storming, role play, demonstration and re-demonstration using real objects. Suitable teaching aids as booklet, colored posters, doll and real objects and practical video tabs were prepared especially for practice. Nurses were motivated to cooperate and participate actively in different stages of the study.

The training program was carried out in the following eight sessions

The first session was about; the aim of the training program, importance and related terms to early onset neonatal hypocalcaemia; types of neonatal hypocalcaemia, definition of EOH, the normal blood calcium level in newborn causes of EOH, clinical symptoms, treatment, complications, and prognosis.

The second session was about; prevention of early onset neonatal hypocalcaemia: which included; proper prenatal care, adequate maternal calcium and magnesium intake, management of premature labor, proper Management of diabetic mother, Provision of Immediate post natal proper feeding, and proper management of mothers with hyperparathyroidism

The third session was about management of neonates with early onset neonatal hypocalcaemia: Which include; treatment for all categories of hypocalcaemia, time for initiation of continuous calcium bolus infusion, dosage of calcium bolus infusion and dilution of bolus calcium doses

The fourth session was about. Nursing practices in relation to hand washing

The fifth session was about vital signs measurement

The sixth session was about; IV therapy

The seventh session was about ; Calcium Gluconate Injection dosage and administration)

The eighth session about blood sampling procedure

VI. Training program evaluation

The effect of the program on the study subjects was carried out through comparing the pre and posttest immediately assessment score of nurses knowledge& practice

Administrative design

An official permission for data collection was obtained from the hospitals' managers through submission of official letters issued from the dean of Benha faculty of nursing. The title, objectives, and outcomes of the study were illustrated as well as the main data items to be covered, and the study was carried out after gaining the necessary permission. The study was carried out during the period from beginning of January 2019 to the end of June 2019.

Statistical design

The collected data were revised, organized, tabulated and analyzed by using SPSS (Statistical Package for the social Science Software) statistical package version 20 on IBM compatible computer. Numerical data (Quantitative data) was presented in tables by using Mean, Standard deviation ($X \pm SD$). While qualitative data were expressed as frequency and percentage and chi-square was used. Additionally, Pearson correlation (r) was used to measure the correlation between quantitative variables.

3. RESULTS

Table (1): Shows the nurses' personal data; it was observed that, the mean age of the studied nurse's was 30.76 ± 7.00 years and the vast majority (95.4%) of them was females. In relation to nurses' education few less than two third (66.1%) of them had secondary school of nursing. Additionally, it was noticed that, more than half (55.4%) of nurses had an experience 5-<10 years. Also, more than three quarter of them (75.4%) had not attended training programs related to NICU.

Table (2): Shows the neonates' personal characteristics; it was represents that, more than half (53.8%) of them had current age in days of 1 <10 days, the mean gestational age of them was 33.18 ± 4.14 weeks with a mean current age at the study time was 10.38 ± 7.41 days. Regarding their weight on admission it was found that, the mean weight was 2196.61 ± 549.76 grams. While their mean weight at the time of the study was 2449.45 ± 868.05 grams.

Table (3): Shows nurses' knowledge regarding early onset neonatal hypocalcaemia and related concepts. It was found that, there was a highly statistically significant pre and post training program implementation.

Table (4): Reveals nurses' knowledge regarding prevention of early onset neonatal hypocalcaemia. It was found that, there was a highly statistically significant pre and post training program implementation

Table (5): Illustrates nurses' knowledge regarding nursing management of neonates with early onset neonatal hypocalcaemia. It was found that, there was a highly statistically significant pre and post training program implementation

Table (6): Shows highly statistical significance relations between the studied nurses' knowledge and their academic qualification, years of experiences and training courses regarding neonatal care in pre and post training program implementation ($P < 0.001$).

Table (7): Shows highly statistical significance relations between the studied nurses' practice and their academic qualification, years of experiences and training courses regarding neonatal care in pre and post training program implementation ($P < 0.001$).

Table (8): Demonstrates that, there is a positive correlation between nurses' knowledge and practice score in pre and post training program implementation ($P < 0.001$).

Figure (1): Illustrates that, more than three quarter (75.6%) of the studied nurses not attended any previous training courses regarding neonatal care, while less than one quarter (24.6%) of them attended any previous training courses.

Figure (2): Reveals that more than two thirds (69.2%) of the studied nurses had inadequate knowledge pre training program. While, the most (96.9) of them had adequate knowledge post training program.

Figure (3): Reveals that more than three quarter (78.5%) of the studied nurses had incompetent practice pre training program. While, the most (92.3) of them had competent practice post training program.

Table (1): Distribution of the studied nurses according to their personal data (n=65).

Items	Number(65)	%
Age in years		
20<25	16	24.6
25<30	16	24.6
30<35	20	30.8
≥35	13	20.0
Mean ±S.D 30.76±7.00		
Gender		
Male	3	4.6
Female	62	95.4
Educational qualification		
Bachelor of nursing	10	15.4
Technical Institute of nursing	12	18.5
Secondary School of nursing	43	66.1
Years of experience		
one year< 5 years	16	24,6
5 years<10 years	36	55,4
>10 years	13	20.0
Mean ±S.D 7.56±4.36		

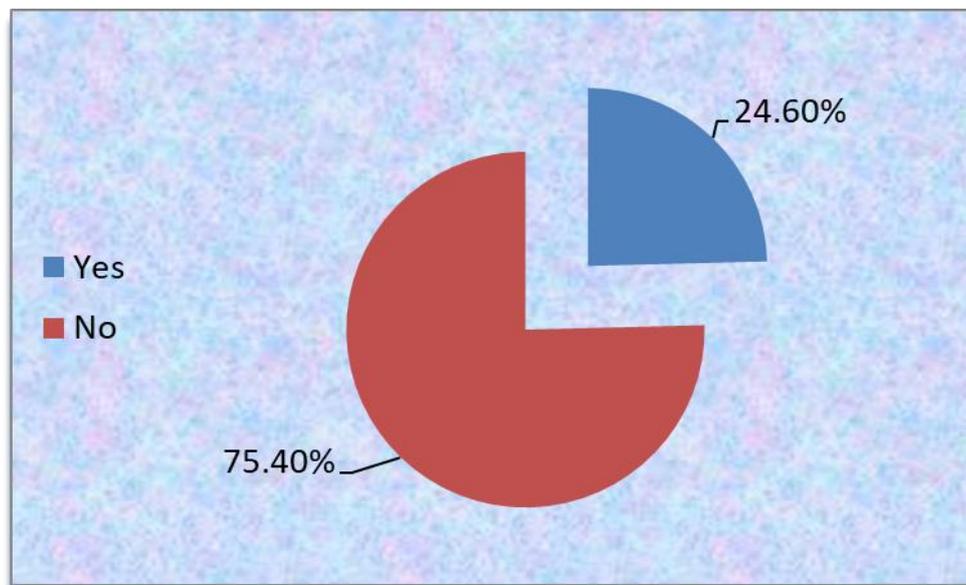


Figure (1): Distribution of the studied nurses according to their attendance to training courses regarding neonatal care.

Table (2): Distribution of the neonates according their characteristics (n=100)

Items	No(100)	%
Gestational age		
>28 weeks	16	16.0
28>32weeks	30	30.0
32>36weeks	16	16.0
36≤40weeks	38	38.0
Mean±St.D33.18±4.14		
Current age in days		
1>3days	53	53.0
4>7days	38	38.0
8-≥15day	9	9.0
Mean± St.D 10.38±7.41		
Weight of admission		
<1500g	17	17.0
1500<2000g	27	27.0
2000<2500g	18	18.0
2500<3000g	38	38.0
Mean± St.D 2196.61±549.76		
Current weight		
>1500g	12	12.0
1500-2000g	26	26.0
2000-2500g	23	23.0
2500-3000g	24	24.0
3000-≤3500g	15	15.0
Mean± St.D 2449.450±868.05		

Table (3): Distribution of the studied nurses according to their knowledge regarding early onset neonatal hypocalcaemia (EOH) and related concepts (n=65).

Nurses' knowledge	Pre- training program implementation						Post- training program Implementation						X ²	P value
	Correct complete		Correct Incomplete		Don't know		Correct complete		Correct incomplete		Don't know			
	No	%	No	%	No	%	No	%	No	%	No	%		
Types of neonatal hypocalcemia	10	15.4	16	24.6	39	60.0	50	76.9	9	13.8	6	9.2	46.77	<0.001
Definition of EOH	17	26.2	4	6.1	44	67.7	55	84.6	8	12.3	2	3.1	51.20	<0.001
The normal blood calcium level in newborn	13	20.0	15	23.1	37	56.9	53	81.5	8	12.3	4	6.2	38.87	<0.001
Causes of EOH	4	6.1	10	15.4	51	78.5	54	83.1	7	10.8	4	6.2	72.85	<0.001
Categories of hypocalcemia	3	4.6	9	13.8	53	81.6	55	84.8	8	12.3	2	3.1	77.75	<0.001
Infants at increased risk of hypocalcemia	2	3.1	8	12.3	55	84.6	57	87.7	5	7.7	3	4.6	86.52	<0.001
Neonates at risk who are in need for Screening	0	0.0	5	7.7	60	92.3	57	87.7	5	7.7	3	4.6	86.52	<0.001
Time schedule for screening	2	3.1	7	10.7	56	86.2	51	78.5	10	15.4	4	6.2	60.40	<0.001
Clinical presentation	16	24.6	20	30.8	29	44.6	60	92.3	3	4.6	2	3.1	101.75	<0.001
Signs and symptoms of Symptomatic EOH	16	24.6	21	32.3	28	43.1	60	92.3	3	4.6	2	3.1	101.75	<0.001
Diagnosis	20	30.8	20	30.8	25	38.4	60	92.3	4	6.2	1	1.5	101.92	<0.001
Treatment of early onset hypocalcemia	21	32.3	17	26.2	27	41.5	63	96.9	2	3.1	0	0.0	57.24	<0.001
Complications	5	7.7	9	13.8	51	78.5	58	89.2	5	7.7	2	3.1	91.60	<0.001
Prognosis	4	6.1	8	12.3	53	81.5	50	76.9	10	15.4	5	7.7	56.15	<0.001

Table (4): Distribution of the studied nurses according to their knowledge regarding prevention of early onset neonatal hypocalcaemia (n=65).

Nurses' knowledge	Pre – training program implementation						Post – training program Implementation						X ²	P value
	Correct complete		Correct incomplete		Don't know		Correct complete		Correct incomplete		Don't know			
	No	%	No	%	No	%	No	%	No	%	No	%		
Proper prenatal care	5	7.7	15	23.1	45	69.2	55	84.6	8	12.3	2	3.1	77.75	<0.001
Adequate maternal calcium and Magnesium intake	6	9.2	10	15.4	49	75.4	60	92.3	3	4.6	2	3.1	101.75	<0.001
Management of Premature labor	2	3.1	10	15.4	53	81.5	50	76.9	10	15.4	5	7.7	69.44	<0.001
Proper Management of diabetic mother	4	6.2	8	12.3	53	81.5	52	80.0	10	15.4	3	4.6	132.33	<0.001
Provision of Immediate post natal proper feeding	7	10.8	12	18.4	46	70.8	54	83.1	7	10.8	4	6.2	72.65	<0.001
Proper management of mothers with hyperparathyroidism	3	4.6	12	18.4	50	77.0	53	81.5	9	13.8	3	4.6	110.44	<0.001

Table (5): Distribution of the studied nurses according to their knowledge regarding nursing management of neonates with early onset neonatal hypocalcaemia(n=65).

Nurses' knowledge	Pre - training program implementation						Post – training program Implementation						X ²	P value
	Correct complete		Correct incomplete		Don't know		Correct complete		Correct incomplete		Don't know			
	No	%	No	%	No	%	No	%	No	%	No	%		
Treatment for all categories of hypocalcemia	21	32.3	14	21.5	30	46.2	60	92.3	3	4.6	2	3.1	101.75	<0.001
Time for initiation of continuous calcium bolus infusion	25	38.5	25	38.5	15	23.0	61	93.8	4	6.2	0	0.0	52.85	<0.001
Dosage of calcium bolus infusion	20	30.8	15	23.0	30	46.2	61	93.8	4	6.2	0	0.0	54.89	<0.001
bolus doses of calcium should be diluted	31	47.7	19	29.3	15	23.0	56	86.2	7	10.8	2	3.1	82.18	<0.001
Precautions of calcium bolus infusion	10	15.4	15	23.0	40	61.6	60	92.3	4	6.2	1	1.5	101.93	<0.001
Side effects of calcium bolus infusion	8	12.3	12	18.5	45	69.2	59	90.8	3	4.6	3	4.6	96.49	<0.001
Management of side effects	7	10.8	11	16.9	47	72.3	58	89.2	5	7.7	2	3.1	91.60	<0.001

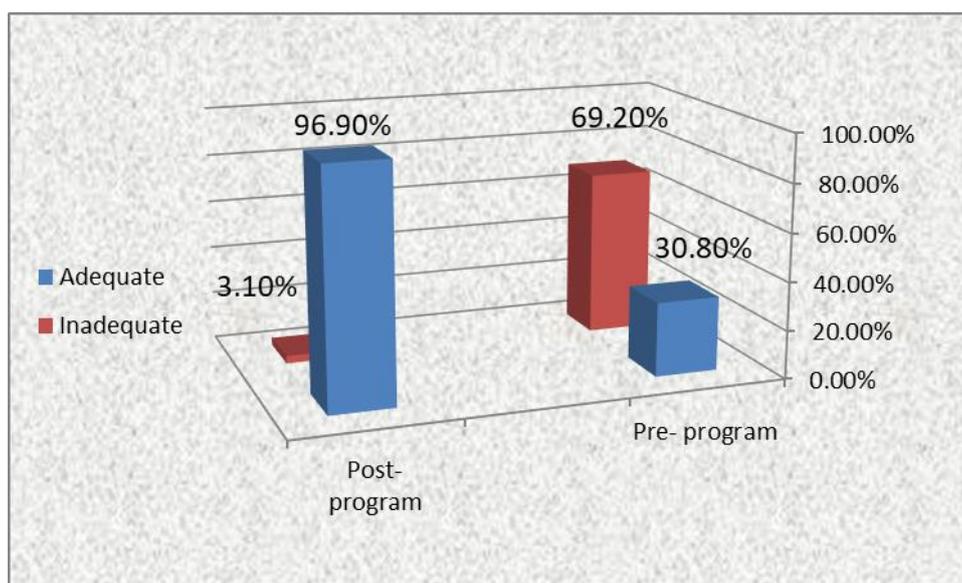


Figure (2): Distribution of the studied nurses according to their total knowledge level pre and post the training program.

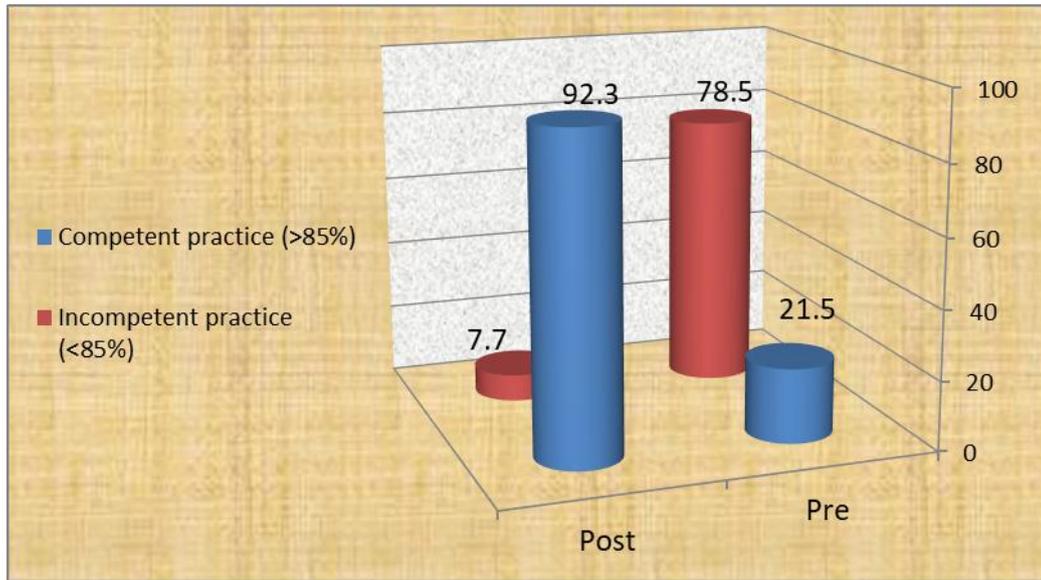


Figure (3): Distribution of the studied nurses according to their total practices level pre and post the training program.

Table (6): Relation between studied nurses' knowledge and their characteristics (no=65).

Nurses' characteristics	Nurses' knowledge								X ²	P value
	Pre- program implementation(No=65)				Post- program implementation(No=65)					
	Adequate		Inadequate		Adequate		Inadequate			
No	%	No	%	No	%	No	%			
Age in years										
20<25	3	4.6	13	16.9	15	23.1	1	1.5	31.40	>0.05
25<30	5	7.6	11	16.9	15	23.1	1	1.5		
30<35	4	6.1	16	24.6	20	30.8	0	0.0		
≥35	8	12.3	5	7.6	13	20.0	0	0.0		
Educational qualification										
Bachelor of nursing	8	12.3	2	3.0	9	13.8	1	1.5	67.60	<0.001
Technical Institute of nursing	7	10.7	5	7.6	11	16.9	1	1.5		
Secondary School of nursing	5	7.6	38	58.4	41	36.1	2	3.0		
Years of experience										
one year< 5 years	6	9.2	10	15.3	16	24.6	0	0.0	68.84	<0.001
5 years<10 years	6	9.2	30	46.1	35	53.8	1	1.5		
>10 years	8	12.3	5	7.6	12	18.4	1	1.5		
Training courses regarding neonatal care										
Yes	13	20.0	3	4.6	16	24.7	0	0.0	96.58	<0.001
No	7	10.7	42	64.6	47	72.3	2	3.0		

Table (7): Relation between studied nurses' practice and their characteristics (no=65).

Nurses' characteristics	Nurses' practice								X ²	P value
	Pre- program implementation(No=65)				Post- program implementation(No=65)					
	Competent		Incompetent		Competent		Incompetent			
No	%	No	%	No	%	No	%			
Age in years										
20<25	3	4.6	13	20.0	14	21.5	2	3.0	31.40	>0.05
25<30	5	7.6	11	16.9	15	23.1	1	1.5		
30<35	2	3.0	18	27.6	19	29.2	1	1.5		
≥35	4	6.0	9	13.8	12	18.4	1	1.5		
Educational qualification										
Bachelor of nursing	3	4.6	7	10.7	9	13.8	1	1.5	52.60	<0.001
Technical Institute of nursing	5	7.6	7	10.7	11	16.9	1	1.5		
Secondary School of nursing	6	9.2	37	56.9	40	61.5	3	4.6		
Years of experience										
one year< 5 years	3	4.6	13	20.0	14	21.5	2	3.0	68.84	<0.001
5 years<10 years	4	6.0	32	49.2	34	52.3	2	3.0		
>10 years	7	10.7	6	9.2	12	18.4	1	1.5		
Training courses regarding neonatal care										
Yes	7	10.7	9	13.8	14	21.5	2	3.0	62.75	<0.001
No	7	10.7	42	64.6	46	70.7	3	4.6		

Table (8): Correlation between total knowledge score and total practice score of the studied nurses pre and post training program implementation

Variables	Pearson correlation coefficient			
	Total knowledge score			
	Pre intervention		Post intervention	
	r	P	r	P
Total practice score	0.880	0.000**	0.755	0.000**

Highly statistical significant at P value <0.001**,A statistically significant difference (P <0.05)*,no statistically significant difference (P> 0.05).

4. DISCUSSION

Hypocalcemia is a common metabolic manifestation in neonates. It is a potentially life-threatening condition, with reported prevalence varying by gestational age, maternal and infant comorbidities, and perinatal factors. Neonatal hypocalcemia is classified according to its onset to early onset which manifests within the first 72 hours of birth and delayed onset after 3 days of birth (Büşra et al., 2017).

Hypocalcemia is a common metabolic problem in newborn period and infancy. There is consensus on the treatment of the symptomatic cases while the calcium level at which the treatment will be initiated and the treatment options are still controversial in asymptomatic hypocalcemia, early-onset hypocalcemia is generally asymptomatic; therefore, screening for hypocalcemia at the 24th and 48th hour after birth is warranted for infants with high risk of developing hypocalcemia(Kaskel,2019).

Regarding neonatal characteristics, the finding of the current study found that more than half of them had age from 1-10 days and more than one third of them had 2500-3000grams at birth weight, more than half of the studied neonates were females. As for the gestational age, more than one third of them were full term. This agrees with the results of Taha et al., (2018) who conducted a study of" Neonatal hypocalcemia and its relation to vitamin D and calcium supplementation" who found that more than half of them had age from 1-10 days and more than one third of them had 2500-3000grams at birth weight,. As for the gestational age, more than one third of them were full term.

Concerning the personal data of the studied nurses, it was noted that the slightly one third of them had age between thirty to thirty five years, Also, the majority of the studied nurses were females. Meanwhile, nearly two thirds of them had secondary school diploma in five to less than ten years, in addition to; more than three quarters of them didn't receive previous training courses in the NICU. These findings supported by Abdel Rasoul et al.,(2017), who conducted a study about" Effect of Designed Guidelines on Nurses' Performance to Prevent Preterm Infants' Hypothermia" who found that more than half of them had secondary school diploma in nursing and nearly more than two third of them had more than ten years of experience. In addition, none of them receive training courses NICU

Regarding distribution of the studied nurses in relation to, their knowledge about early onset neonatal hypocalcaemia and related concepts. It was found that, there was a highly statistically significant pre and post intervention implementation. This is in accordance with Abo-Zaid et al., (2012) in a study entitled: "Early Neonatal Assessment with Detection of Cases of Hypocalcemia and Nursing Implication" Who found that, highly significant improvements in nurses' knowledge about newborn assessment and detection of hypocalcaemia at the post-test P <0.001

Regarding distribution of the studied nurses in relation to, their knowledge about early onset neonatal hypocalcaemia and related early detection. It was found that, there was a highly statistically significant pre and post intervention implementation. In agreement with the present results Al-Zwaini, (2009) in a study entitled "C-reactive protein: a useful marker for guiding duration of antibiotic therapy in suspected neonatal septicemia" who reported that, significant improvement in nurses' knowledge and practice at the post test about neonatal assessment and detection of early hypocalcaemia.

On the other hand Kliegman et al., (2016) stated that,. After birth healthy term babies undergo a physiological decline in serum calcium level in first 2 days of life. Thus calcium level starts decreasing after delivery and reaches a nadir of 7.5-8.5 mg/dl in healthy term babies by 24-48 hours of life.67 In preterm babies, infants of diabetic mothers and infants with

perinatal asphyxia, this nadir of serum calcium may reach hypocalcaemia levels and cause severe symptoms like seizures. In infants of diabetic mother, incidence of hypocalcaemia ranges from 4% to high as 50% with an average incidence of 22%. So that the nurses should be awareness and qualified regarding neonatal assessment to detection early hypocalcaemia and beginning treatment provide for this neonates to prevent sever complications.

Rather more, **Kaskel, 2019**) added that, Early-Onset Hypocalcaemia generally presents within the first 72 h of life. It is caused by an increased reduction in the serum calcium level that physiologically occurs within the first three days in newborns, and delayed PTH secretion to hypocalcemia. Early-onset neonatal hypocalcemia is more common in infants with intrauterine growth retardation, infants with perinatal asphyxia, and the infants of diabetic mothers.

Regarding distribution of the studied nurses in relation to, their knowledge about prevention early onset neonatal hypocalcaemia. It was found that, there was a highly statistically significant pre and post intervention implementation. This result is supported by **Anupama et al.,(2017)** who stated that, A detailed history including pregnancy and family his-tory should be obtained in cases of hypocalcaemia in the newborn period and infancy. Pregnancy history should be questioned, especially in cases of gestational diabetes, toxemia of pregnancy, and maternal deficiency of vitaminD. Furthermore, questioning should include conditions that may be associated with early-onset hypocalcaemia such as prematurity, low birth weight, asphyxia, neonatal sepsis, history of using medication for the mother and the infant, formula feeding status, phosphate load of the formula (if used), blood transfusion history, and presence of maternal hyperparathyroidism. The family history should be obtained for genetic diseases causing hypocalcaemia in the newborn period and infancy.

Regarding distribution of the studied nurses in relation to, their knowledge about treatment early onset neonatal hypocalcaemia. It was found that, there was a highly statistically significant pre and post intervention implementation. This result supported by **Soliman et al.,(2014)** who reported that, the cornerstone of treatment of hypocalcaemia is calcium replacement and the treatment options may vary by symptoms and the extent of hypocalcaemia. Early-onset hypocalcaemia is usually asymptomatic and treatment is recommended when the serum calcium level is <6mg/dL in preterm and 7 mg/dL in term infants. It is recommended administering 40 to 80 mg/kg/d elemental calcium replacement for asymptomatic newborns. calcium can be added as 10%calcium gluconate (500 mg/kg/d, 50 mg/kg/d of elemental calcium) and given in continuous infusion. If parenteral calcium is administered for >2 days, phosphorus should also be replaced based on serum phosphate levels. In newborns with symptoms such as tetany or convulsion, intravenous 10 to 20 mg/kg of elemental calcium (1–2 mL/kg/dose 10%calcium gluconate) is administered by slow infusion for about 10 min under cardiac monitoring for the acute treatment of hypocalcaemia.

Concerning nurses' knowledge about early onset neonatal hypocalcaemia, the findings of the current study reflected that, the minority of the studied nurses had good knowledge pre intervention this increased to the majority of them had good knowledge post intervention. This finding was consistent with **Abo-Zaid et al., (2012)**, who found that, highly significant improvements in nurses knowledge about newborn assessment and detection of hypocalcaemia at the post-test the percent of the satisfactory knowledge scores for the newborn assessment at the pre-test was less than half at the post test. Also, the total knowledge score for the detection of hypocalcaemia was only one quarter at the pre-test versus more than three quarters at the post- test.

Additionally this is in accordance with **Aslam et al., (2017)** in a study entitled The "Assessment of Nurses' Knowledge and Practices about Fluid and Electrolytes Monitoring and Administration among Cardiac Surgery Patients " The nurse should have a proper training to assess the newborn. In many cases of hypocalcemia there is a lack of knowledge of what is needed for optimal newborn care, and neglect the basic needs of newborns. Interventions that improve nurse skills and knowledge will have a major impact on the health of newborns, the nurse must be able to perform essential basic interventions and to take care of the hypokalemic infant. Skilled care and early identification of problems could reduce the incidence of death and disability.

Regarding distribution of the studied nurses according to their practice regarding nursing management of neonates with early onset neonatal hypocalcaemia in relation to calcium gluconate injection dosage and administration. It was found that, there was a highly statistically significant pre and post intervention implementation. This result is supported by **Nassrin et al.,(2015)** who found that, cardiac arrhythmias such as bradycardia may occur and even cardiac arrest may develop during calcium gluconate infusion; therefore, intravenous administration should be performed slowly for 10 to 30

min under cardiac monitoring. If an umbilical venous catheter is used for calcium administration, then the catheter tip should be in the inferior vena cava; a catheter tip in the portal vein may cause hepatic necrosis.

Regarding the studied nurses' practice pre and post program implementation. It was noticed a highly improvement in their performance on post program phase compared with preprogram phase. This is attributed to the conduction of training programs are considered as means for providing nurses with theoretical and technical information needed to acquire new skills. This is in accordance with **Abo-Zaid et al., 2012**, who found that there was a significant improvement in nurses' practice after the program regarding their skills that should be practiced in relation to the assessment of the high risk newborn and detection of hypocalcaemia.

5. CONCLUSION

Based on the study findings, it can be concluded that, nurses' total knowledge and practice scores regarding early detection and management of early onset neonatal hypocalcaemia were improved post-implementation of the training program than pre-program implementation.

6. RECOMMENDATION

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

- 1-Continuous educational programs should be organized for critical care nurses regarding early detection and management of early onset neonatal hypocalcaemia to enhance their performance, and consequently improve the outcome of care.
- 2- Continuous in-service training for nurses regarding early detection and management of early onset neonatal hypocalcaemia
- 3- Future, educational studies aiming to improve the overall management of early onset neonatal hypocalcaemia.
- 4- Future replication of studies is needed to investigate the effectiveness of the proposed early detection and management of early onset neonatal hypocalcaemia and investigate its effect on neonate's outcome.

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