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Abstract: Background: Hypoxic Ischemic Encephalopathy (HIE) is a leading cause of neurological impairment and newborn death, accounting for more than a million neonatal deaths globally each year. The condition requires prompt medical intervention and one of the therapeutic approaches is cooling therapy. Purpose: To assess the effect of on-the-job training on neonatal nurses' performance related to cooling therapy for HIE. Method: A quasi-experimental research design was utilized. A convenient sample of 47 nurses at the Neonatal Intensive Care Unit (NICU) affiliated to Mansoura University Children's Hospital (MUCH) was included. Neonatal Nurses' Structured Questionnaire, Nurses' Practices Observation Checklist, and Nurses' Attitude Scale were used to collect the data. Results: The studied neonatal nurses' who had satisfactory knowledge regarding HIE and cooling therapy increased from more than one-third preintervention to the vast majority post-intervention. Furthermore, pre-intervention, more than two-fifths of the surveyed neonatal nurses demonstrated competent practices, compared to the vast majority of them post-intervention. Also, more than two-thirds of studied neonatal nurses had negative attitudes toward cooling therapy for HIE preintervention, while the majority of them had positive attitudes post-intervention. Conclusion: The comprehensive on-the-job training program demonstrated significant positive outcomes across multiple dimensions within the nursing cohort. The findings reveal a substantial improvement in neonatal nurses' knowledge, attitudes, and practical competencies related to HIE and cooling therapy following the intervention. Recommendations: On-the-job training programs related to cooling therapy for HIE should be conducted for nurses in NICUs.

**Keywords:** Cooling therapy, Hypoxic ischemic encephalopathy, Neonatal nurses, Onthe-job training, and Performance.

#### Introduction

Hypoxic Ischemic Encephalopathy (HIE), also referred to as perinatal

asphyxia, is distinguished by clinical and laboratory evidence of acute or

brain sub-acute damage due to asphyxia. Systemic hypoxemia and/or decreased cerebral blood flow are the main causes of this condition (Bellos et al., 2022; de Havilland & Hariharan, 2022). With a frequency of 1 to 3 per births in 1,000 live developed countries and up to 26 per 1,000 live births in resource-limited countries. HIE is the most common cause of neurological impairment in both term and preterm newborns (Mohammad et al., 2020). It is the leading cause of neonatal mortality with almost a million neonatal deaths worldwide each year (Ranjan & Gulati, 2023). While 25% of newborns with HIE die within the first two years of life, about of them develop long-term 35% neurodevelopmental sequelae such as palsy, epilepsy, cerebral mental retardation, and learning disabilities (Bruschettini et al., 2020).

The current standard of care for moderate to severe HIE is Therapeutic Hypothermia (TH) or cooling therapy, with strong evidence showing that it reduces the risk of disability and death (Pavel et al., 2023). However, cooling therapy has strict protocols and is complex, requiring specialized training for providers. As frontline caregivers, neonatal nurses play a pivotal role in effective cooling therapy safe. implementation (Garvey et al., 2022). A wide range of detrimental cell processes are inhibited by mild TH, which is thought to be its multifactorial protective mechanism (Labat et al., 2023). Mild hypothermia has several positive effects, such as decreased loss of high-energy reduced phosphates, oxygen

consumption, amelioration of apoptosis, induction of genes that lessen neuronal death, as well as reduced release of excitatory amino acid neurotransmitters, glutamate, free radicals, and nitric oxide (Spencer et al., 2023; Ballot et al., 2021).

Therapeutic hypothermia involves cooling the infant's temperature down below homeostasis so that the brain can heal from a hypoxic-ischemic injury. Typically, the target temperature is about 33.5 degrees Celsius (92.3 degrees Fahrenheit) (O'Sullivan et al., 2023). For the purpose of managing newborns with HIE, cooling therapy can be applied in two efficient ways: either by cooling the baby's entire body ("whole-body cooling") or by utilizing a cooling cap "selective brain cooling" for (Kalogeropoulou et al., 2023). Induced hypothermia consists of deliberately lowering the newborn's core temperature between 3 and 4 °C using cooling equipment (Atia et al., 2023).

Three distinct phases can be identified: down. cooling maintenance. and warming up. In the cooling down phase, a mild cooling down to the target temperature of 33-34 °C is produced. It is necessary to begin this phase before 6 hours of life, as experimental research has shown that this is the therapeutic window for beginning HIE treatment. Once the target temperature has been reached, the newborn's body temperature is strictly controlled throughout the 72maintenance hour phase. Subsequently, to reduce the appearance of complications, such as seizures, a gradual and progressive

warming-up phase would start at a pace of less than 5 °C per hour (Sakr et al., 2022; Solaz-García et al., 2021). The process of teaching nurses new skills, competencies, and knowledge while they are really carrying out their job responsibilities is known as "onthe-job training." The ability to learn in a real-world setting and apply newly acquired skills to job duties while gaining hands-on experience is one of the main benefits of on-the-job training for nurses (Shafea et al., 2023). Because this type of training enables nurses to gain experience and proficiency by direct application, it can be especially useful for professions that demand a high level of technical or practical expertise. Additionally, receiving guidance and corrections in real-time during on-the-job training allows for instant support and feedback. which promotes more performance improvement and effective skill development (Hendy et al., 2024; Hassan, Elshemy & Saad, 2019).

Neonatal nurses play a crucial role in ensuring the effective implementation of cooling therapy. Their responsibilities encompass monitoring physiological parameters like blood pressure, oxygen saturation, heart rate, and respiratory rate. While also carefully managing the baby's body temperature within the prescribed therapeutic range using cooling blankets or devices. Additionally, nurses conduct regular neurological assessments to gauge the neonate's response to the therapy and detect any signs of improvement or deterioration (Fang et al., 2023; Solaz-García et al., 2021).

In addition, attention to skin care is paramount to prevent irritation or breakdown due to the cooling devices. Fluid management, administration of prescribed medications. and meticulous documentation of vital signs and interventions are all integral of components the nurse's responsibilities (Polise & Newberry, 2023). Collaborating with the interdisciplinary healthcare team. providing family support through education and emotional assistance, and participating in care planning meetings contribute to а comprehensive and coordinated approach to the care of neonates undergoing cooling therapy (de Havilland & Hariharan, 2022). This multifaceted role underscores the importance of neonatal nurses in optimizing the well-being and outcomes of neonates experiencing HIE (Arnautovic et al., 2022).

## Significance of the study

Enhancing neonatal nurses' skills in cooling therapy yields a spectrum of benefits. including heightened through neonates' safety precise temperature management and early recognition of complications. Proficient nursing care leads to optimized therapeutic efficacy, reduced risk of adverse events, and efficient collaboration within the healthcare team, ensuring а coordinated approach to neonatal care (Talus et al., 2023; Kelly, 2021; Glass & Rowitch, 2016).

To our knowledge, there is a lack of Arab, and international Egyptian, studies about neonatal nurses' performance related to cooling therapy for neonates with HIE also, there is a lack of educational programs provided to them regarding this care approach but there are many focusing only on medical care. This study reaffirms the value of ongoing education and training in healthcare, emphasizing its pivotal role in shaping the competencies of nursing professionals and, consequently, enhancing the quality of patient care. So, this study evaluates the effect of on-the-job training neonatal nurses' on performance related to cooling therapy for HIE.

## Purpose of the study

To assess the effect of on-the-job training on neonatal nurses' performance related to cooling therapy for hypoxic ischemic encephalopathy.

## Study hypothesis

**H1:** On-the-job training is expected to positively affect neonatal nurses' performance related to cooling therapy for hypoxic ischemic encephalopathy.

#### Method

## **Research design**

A quasi-experimental research design with one group pre and post-tests was utilized.

#### Setting

This study was carried out at the Neonatal Intensive Care Unit (NICU) affiliated to Mansoura University Children's Hospital (MUCH). It is located on the 6th floor and consists of six rooms, including two ordinary rooms and four intensive care units. The unit provides care for full-term and high-risk neonates from all over the Delta Governorates. It is wellequipped with 33 incubators and 14 beds.

## Sampling

The study participants involved 47 neonatal nurses who were conveniently selected from the aforementioned setting during the time of the study regardless of their characteristics.

## Sample size

The rates of 71% and 93% can be converted to probabilities of 0.71 and 0.93 (Mahmoud et al., 2023). To calculate the sample size for a proportion in a pre-post design, we can use the formula:

n =  $[(Z\alpha/2 + Z\beta) 2 * (P1*(1-P1) + P2*(1-P2))] / (P1-P2)2$ Where:

**n** = required sample size per group

P1 = Pre-intervention proportion (0.71)

P2 = Post-intervention proportion(0.93)

 $Z\alpha/2 = Z$  score for alpha, here 1.96 for 95% CI

 $Z\beta = Z$  score for power, here 0.84 for 80% power

Plugging the values into the formula:

$$\begin{split} n &= \left[ (1.96 + 0.84) 2 * (0.71*(1-0.71) + \\ 0.93*(1-0.93)) \right] / (0.71-0.93) 2 n = 47 \end{split}$$

Therefore, with a pre-intervention competence rate of 71%, a post-intervention rate of 93%, 95% CI, and 80% power, the required sample size is 47 participants.

A purposive sample of 20 neonates who were available during the study period and were selected from the aforementioned setting after meeting the following inclusion criteria:

- Within 6 hours of birth.
- With moderate or severe HIE.
- Gestational age  $\geq$ 36 weeks.
- Birth weight  $\geq 1800$  grams.
- Apgar score of  $\leq 5$  at 10 minutes.

- Need assisted ventilation for at least 10 minutes after birth.
- Free from major congenital anomalies, significant active bleeding, neurologically significant head trauma or skull fracture, and neonatal sepsis.

#### Instruments of data collection

#### Instrument one: Neonatal Nurses'

#### Structured Questionnaire;

After reviewing the relevant literature, the researchers developed it in Arabic (Holtmoen et al., 2023; Gill, 2022; Sakr et al., 2022; Kelly, 2021; Queensland Clinical Guidelines, 2021) and included the following parts:

- **Part I:** Characteristics of the Studied Neonatal Nurses; such as sex, age, years of experience, educational level, previous training courses about cooling therapy, and working hours.
- **Part II:** Characteristics of the Studied Neonates; such as gender, gestational age, Apgar score, type of delivery, HIE clinical stage, and birth weight, length and head circumference.
- Part Neonatal Nurses' III: Knowledge about HIE and Cooling Therapy: It included 15 MCQs questions and included data regarding the definition, causes, risk factors. clinical presentations, complications, and management of HIE, moreover definition, types, uses and complications of cooling therapy and nurses' role during cooling therapy.

#### Scoring system

Two degrees were provided for complete correct answers, one degree for incomplete correct answers while the wrong or don't know answers were scored zero. The overall knowledge score was considered satisfactory if the score was >70% and unsatisfactory if the score was 70% or less.

#### Instrument two: Nurses' Practices

#### **Observation Checklist:**

It was derived from Chiang et al., (2017) and Mosalli, (2012). It was used to assess the neonatal nurses' practices regarding caring for neonates with HIE and cooling therapy. This assessment instrument included 23 items. It was divided into three domains; protocol for active cooling (8 items), general care support (10 items), and rewarming procedure (5 items).

#### Scoring system

Each item of neonatal nurses' practice was given a score of one degree for "done" or zero for "not done". The overall practice score was categorized as competent (score  $\ge 80\%$ ) or incompetent (score < 80%).

# Instrument three: Nurses' Attitude

#### Scale:

It was adopted from Arnaez et al., (2018) and Browning et al., (2016) to evaluate the nurses' attitudes regarding caring for neonates with HIE and cooling therapy. It included nine items such as staying updated with the latest research and guidelines of cooling therapy, early recognition and intervention for managing neonates with HIE...etc.

#### Scoring system

Each item of nurses' attitude was scored on a three-point Likert scale as follows: agree (3), disagree (2), uncertain or neutral (1). The overall attitude score was categorized as positive if the score was >60% and negative if the score was 60% or less.

#### **Content validity**

The content validity of the study instruments was assessed and amended

by a panel of five pediatric nursing experts from the Faculty of Nursing, Mansoura University. After their recommended modifications, the instruments became ready for use.

## Reliability

The internal consistency of the study instruments was assessed using the Cronbach's alpha coefficient test: knowledge (0.834), attitudes (0.799), and practices (0.912).

## Pilot study

To ensure the study instruments' understandability, practicality, and potential data collection issues, a pilot study was conducted with a randomly selected group of five neonatal nurses, representing 10% of the main study sample. This pilot allowed for instruments adjustments and refinement. The pilot participants were excluded from the main study sample.

## Ethical considerations

The Faculty of Nursing's Research Ethics Committee granted ethical permission with approval number (Ref. No. p. 0560). The director of MUCH and the head of the NICU granted official permissions after a thorough explanation of the study's nature, purpose, and anticipated outcomes was provided. Before commencing the study, neonatal nurses offered formal written consent for their participation and parents gave their informed assent for their newborns' participation following a full explanation of the nature and purpose of the study. The study's participants were given the assurance that their participation was entirely voluntary, all information gathered would be treated with the utmost confidentiality, and they could leave the study at any time if they so choose.

## Procedure of data collection

Data collection started in December 2023 to February 2024. The nurses who were in charge of caring for newborns with HIE and undergoing cooling therapy were trained by the researchers. This was made possible by an educational program designed to improve the performance of neonatal nurses by combining theoretical knowledge with on-the-job training.

## Assessment phase:

The researchers discussed the study's purpose for the neonatal nurses. The researchers gave the nurses а structured questionnaire to collect their characteristics and test their knowledge. Afterward. nurses' practices were observed by the researchers using an observation checklist. Also, nurses' attitudes were assessed by a Likert scale. The researchers collected the studied neonatal characteristics from their medical records. Based on the results of the pretest, the educational program was designed taking into account the needs of neonatal nurses.

## Intervention phase:

The neonatal nurses were divided into four groups by the researchers. Three one-hour lectures and three thirtyminute practical sessions pertaining to on-the-job training were given to each group. The participants were informed about their groups as well as the training's schedule and place. The practical sessions were held on-site at the NICU on Saturdays, Wednesdays, and Thursdays for eight continuous weeks. The theoretical sessions were conducted in the NICU conference hall. The weekly one-hour session was held from 10:00 to 11:00 a.m. The researchers thoroughly reviewed the relevant literature before designing the training program for neonatal nurses.

The purpose of the program was to improve the knowledge, attitudes, and practical skills of nurses so they can provide the best care possible for newborns with HIE undergoing cooling therapy.

The educational program included three theoretical sessions as follows: Session 1 (60 minutes): It included an understanding of HIE and cooling therapy; an overview of HIE, causes, risk factors, clinical presentations, complications. management, and Introduction to cooling therapy: mechanism, purpose, and evidencebased benefits. Session 2 (60 minutes): It contained nursing care during cooling therapy; a detailed explanation cooling procedures, of therapy monitoring vital signs, neurological assessments, potential complications, and their management. Session 3 (60 minutes): It contained comprehensive neonatal care during and post-cooling therapy, case studies, and group discussions on recognizing early signs of HIE, the importance of prompt intervention, and the role of nursing care.

on-the-job Furthermore, training included three practical sessions as Practical Session 1 (30 follows: minutes): Rotational hands-on training in small groups at the NICU and application of active cooling therapy supervision and feedback. under Practical Session 2 (30 minutes): Application of general care support such as skin care, cardiovascular support, and GIT support. Practical Session 3 (30 minutes): Rotational hands-on training in small groups at NICU and application the of rewarming of neonates, post active under supervision cooling and feedback. The researchers used a variety of teaching strategies throughout the program, such as reflective thinking, brainstorming, and

discussions. То further group emphasize the content presented throughout the session. several illustrative teaching materials were also employed, including PowerPoint, colored handouts, colored booklets, and videos

#### **Evaluation phase:**

Following the completion of the training program, the researchers provided a summary of its contents and asked for any queries or comments from the neonatal nurses. Neonatal nurses were given the opportunity to share their opinions and experiences on the program and on-the-job training during an open discussion. A week later, a posttest was administered using the same data collection instruments. A posttest questionnaire was given to nurses in order to assess their knowledge and attitude. Additionally, the researchers used an observation checklist to observe nurses practices

#### Statistical analysis

The study's data were entered into SPSS and were coded in preparation for analysis. The data were checked for outliers and errors before to analysis. The mean and standard deviation were employed as suitable metrics to interpret numerical data. The chisquare test was used to look into disparities between categorical variables. The correlation coefficient was used to measure the statistical strength of a linear relationship between two variables. A statistically significant p-value was defined as  $\leq$ 0.05.

## Results

**Table 1** shows characteristics of the studied neonatal nurses; 38.3% of nurses were between 25 and less than 30 years, with a mean age of 32.8±5.33 years. Moreover, 72.3% of them were females. In terms of educational

background, 70.2% had technical education. Regarding professional experience, 34% of the nurses reported having 5 to less than 10 years of experience, with mean experience duration of  $8.9\pm3.4$  years. Moreover, the majority (80.9%) of nurses worked full-time, and 78.7% of participants reported that they hadn't attended any cooling therapy training courses.

Table 2 presents characteristics of the studied newborns, indicating a mean gestational age of 36.42±1.99 weeks, with 60% of them being boys. The mean birth weight was 2.913±0.654 kg, the mean length was  $47.8\pm2.5$ , and the mean head circumference was 32.3±1.6. Additionally, 80% of the neonates underwent vaginal delivery. Furthermore, the mean Apgar score at 1 minute was 3.7±0.59, at 5 minutes was  $4.2\pm0.42$ , and at 10 minutes was 4.5±0.45. More than two-thirds of studied neonates (70%) had moderate (stage II) HIE and 30% of them had severe (stage III) HIE.

Table 3 reveals that 34.1% and 29.8% of the surveyed neonatal nurses had satisfactory knowledge about the definition of HIE, and its causes and risk factors, respectively on prepost-intervention, intervention. On these percentages significantly increased to 93.6% and 89.4%, respectively. Similarly, the table that pre-intervention, demonstrates 38.3% of the nurses had satisfactory knowledge about the definition and types of cooling therapy and the nurse's contrast role, in these percentages significantly increased to 95.7% and 97.9%, respectively, after the intervention. Furthermore, there was a notable improvement in the levels of nurses' knowledge of HIE and cooling therapy post-intervention, with

a statistically significant difference between pre and post-intervention at a p-value <0.01.

Table 4 indicates that pre-intervention, 42.6% and 46.8% of the surveyed neonatal nurses demonstrated competent practices regarding the protocol for active cooling and general care support. Post-intervention, these percentages significantly increased to 93.6% and 95.7%, respectively. Furthermore, the table illustrates that pre-intervention, 40.4% of the nurses exhibited competent practices related to the rewarming procedure, compared with 93.6% post-intervention. In terms of total practices, 44.7% of the surveyed nurses demonstrated competent practices pre-intervention, while post-intervention, this percentage significantly improved to 93.6%. Additionally, there was a notable improvement in the overall practice level post-intervention, with a statistically significant difference between pre and post-intervention at a p-value < 0.01.

Figure 1 shows that 72.3% of the studied neonatal nurses had negative attitudes related to cooling therapy for HIE pre-intervention, while 85.1% of them had positive attitudes postintervention, with a statistically significant difference at p-value <0.01. Table 5 indicates that there were statistically significant positive correlations between the studied neonatal nurses' knowledge, attitudes, and practices (r = 0.682 & 0.410, p < 0.01) respectively. Also, there was a statistically significant positive correlation between nurses' attitudes and practices (r = 0.547, p < 0.01) which provides valuable insights into the interplay between these elements in the context of the studied intervention.

Nurses' characteristics	n	%	
Age (years):			
20 - <25	7	14.9	
25-<30	18	38.3	
30- <35	13	27.7	
≥35	9	19.1	
Mean ±SD	32.8±	5.33	
Sex:			
Male	13	27.7	
Female	34	72.3	
Educational level:			
Technical	33	70.2	
Bachelor	11	23.4	
Postgraduate	3	6.4	
Years of experience:			
1 - <5	10	21.3	
5 - <10	16	34.0	
10 - <15	13	27.7	
≥15	8	17.0	
Mean ±SD	8.9±3.4		
Working hours:			
Full time	38	80.9	
Part time	9	19.1	
Attendance of training courses about			
cooling therapy:			
Yes	10	21.3	
No	37	78.7	

Table 1: Distribution of Characteristics of the Studied Neonatal Nurses (n=47)

Table 2: Distribution o	f Characteristics o	f the Studied Newborns (	(n=20)
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Newborns' characteristics	n	%		
Gestational age (weeks):				
35 - <36	7	35.0		
36 - 37	9	45.0		
>37	4	20.0		
Mean ±SD	36.42 ± 1.99			
Gender:				
Boy	12	60.0		
Girl	8	40.0		
Birth weight:	$2.012 \pm 0.654$			
Mean ±SD	$2.915 \pm 0.054$			
Length: Mean ±SD	$47.8 \pm 2.6$			
Head circumference:				
Mean ±SD	$32.3 \pm 1.6$			
Type of delivery:				
Vaginal	16	80.0		
Cesarean section	4	20.0		
Apgar score at:	$27 \pm 0.50$			
1 <sup>st</sup> minute	$3.7 \pm 0.39$			
5 <sup>th</sup> minute	$4.2 \pm 0.42$ $4.5 \pm 0.45$			
10 <sup>th</sup> minute	4.5 1 0.45			
HIE clinical stage:				
Stage II (Moderate)	14	70.0		
Stage III (Severe)	6	30.0		

Nurses' knowledge	Pre intervention				Post intervention				Test of significance	
Turses moneuge	Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory			
	n	%	n	%	n	%	n	%	Chi-square	<i>p</i> -value
Definition of HIE	16	34.1	31	65.9	44	93.6	3	6.4	12.666	< 0.01*
Causes and risk factors of HIE	14	29.8	33	70.2	42	89.4	5	10.6	11.824	< 0.01*
Clinical presentations of HIE	17	36.2	30	63.8	45	95.7	2	4.3	13.011	< 0.01*
Complications and management of HIE	15	31.9	32	68.1	43	91.4	4	8.6	14.156	< 0.01*
Definition and types of cooling therapy	18	38.3	29	61.7	45	95.7	2	4.3	13.444	< 0.01*
Uses and complications of cooling therapy	16	34.0	31	66.0	43	91.5	4	8.5	12.603	< 0.01*
Nurse's role during cooling therapy	18	38.3	29	61.7	46	97.9	1	2.1	11.705	< 0.01*
Total knowledge	17	36.2	30	63.8	44	93.6	3	6.4	14.509	<0.01*

#### Table 3: Distribution of Studied Neonatal Nurses According to their Knowledge about HIE and Cooling Therapy Pre and Post Intervention (n=47)

\*Significant at  $p \leq 0.05$ .

 Table 4: Distribution of Studied Neonatal Nurses According to their Practices about Cooling

 Therapy for HIE Pre and Post Intervention (n=47)

Practices		Pre intervention			Post intervention				Tost of significance	
	Com	petent	Incompetent		Competent		Incompetent		rest of significance	
	n	%	n	%	n	%	n	%	Chi-square	<i>p</i> -value
Protocol for active cooling	20	42.6	27	57.4	44	93.6	3	6.4	12.714	<0.01*
General care support	22	46.8	25	53.2	45	95.7	2	4.3	13.051	<0.01*
Rewarming procedure	19	40.4	28	59.6	43	91.5	4	8.5	12.270	< 0.01*
Total practices	21	44.7	26	55.3	44	93.6	3	6.4	14.461	< 0.01*

\*Significant at  $p \leq 0.05$ .





χ2: 15.173, *p* <0.01\*

\*Significant at  $p \leq 0.05$ ,  $\chi 2$ : Chi-square

Predictor		Total knowledge	Total practices						
Total practices	r	0.682							
	р	<0.01*							
Total attitudes	r	0.410	0.547						
	р	<0.01*	<0.01*						

 Table (5): Correlation between Studied Neonatal Nurses' Levels of Knowledge, Attitudes, and

 Practices at Post Intervention

\*Significant at  $p \leq 0.05$ , r: Correlation coefficient

#### Discussion

Neonatal nurses have many responsibilities while caring for newborns with HIE and undergoing cooling therapy. They need to be knowledgeable and skilled enough to handle the complexity of these tasks. Furthermore, nurses need to be knowledgeable about the several clinical observations and evaluations that are relevant to the beginning of passive cooling for newborns with moderate to severe HIE and ensure that unnecessary delays are prevented. They also need to understand and prevent the possible complications of overcooling (Holtmoen, Aagaard & Solevåg, 2023).

The current study revealed that more than three-quarters of neonatal nurses did not receive any training courses about cooling therapy for HIE. Similarly, Mahmoud et al., (2023) conducted an Egyptian study on 60 to assess the effect of nurses educational nurses' programs on performance regarding infants with HIE and mentioned that 70.0% of them didn't attend any training courses regarding HIE.

From the researchers' point of view, the preprogram results (unsatisfactory knowledge, negative attitudes, and incompetent practices) may be due to a lack of nurses' training regarding this issue. Furthermore, this is a significant predictor and may play a role in shaping nurses' performance. The importance of receiving continuous education and training is evidenced in the present study by substantial improvements that were observed in overall performance level in the postintervention period that emphasized the positive impact of the intervention and the potential for enhancing the practical skills of nurses through targeted training initiatives as well as reinforce the notion that ongoing education and training play a pivotal role in elevating the quality of patient care, particularly in critical areas such as neonatal care.

The results of the current study highlight the effectiveness of the intervention in significantly improving the neonatal nurses' knowledge. attitudes, and practices about HIE and cooling therapy. The pre-intervention data revealed a notable deficit in knowledge, negative attitudes, and incompetent practices about HIE and cooling therapy. While postintervention results demonstrated a remarkable increase in the percentage of nurses with satisfactory knowledge, positive attitudes, competent and

practices across all these domains. These results may be due to the combination of effective educational strategies, practical training, a collaborative learning environment, and a supportive organizational culture likely contributed to the observed improvement in nurses' performance. The substantial improvement observed

in nurses' performance emphasizes the significance of targeted training programs in enhancing their understanding of critical aspects related to neonatal care. By addressing knowledge gaps and promoting a more comprehensive grasp of HIE and cooling therapy, such interventions contribute to the professional development of nursing staff. ultimately benefiting neonatal care. These findings hold implications for healthcare organizations and educational institutions, emphasizing the value of ongoing training and interventions to keep neonatal nurses abreast of advancements in their field.

As the relevant literature supports the results. current study the study hypothesis is confirmed, as on-the-job training positively affects neonatal nurses' performance related to cooling therapy for HIE. According to a study by Mohammad et al., (2020), a team including nurses delivered 85 specialized training in neuroprotective simulation-based care using kev interventions at local hospitals. Early detection of HIE symptoms, stabilization, and transfer to tertiary care were all covered in the practical training. Following the specialized training, the participants noted that the learning environment was supportive, the skills were applicable in real-world situations, and they felt at ease applying their newly gained knowledge and abilities in clinical settings. Following simulation training, nurses feel more competent in providing patient care since it helps to integrate theory and practice.

In line with Huang et al., (2020) who conducted regular care training programs and scenario-based simulations to help nurses obtain related knowledge and become more familiar with TH, reported that the of nurses' knowledge accuracy regarding TH in the NICU was improved from 82.0% 94.5% to resulting in a safer and morestandardized procedure for neonates undergoing TH. Furthermore. Mahmoud et al., (2023) discovered that the majority of nurses had good knowledge, competent practices, and positive attitude levels post-program implementation, while less than half, less than one-third, and more than onethird, respectively of nurses had poor knowledge, incompetent practices, and negative attitude levels before program Additionally, implementation. following program implementation, there was a highly statistically significant positive correlation found between the total ratings for nurses' practices, knowledge, and attitudes. Furthermore. Goldstein, (2013)conducted a study using a staff education program and evidence based protocol to improve knowledge of TH and nurse satisfaction. Goldstein mentioned that education programs improved nurses' knowledge of TH and satisfaction. On top of that Zhang

&Wang, (2022) study examines the application effect analysis of the clinical nursing pathway (CNP) in the management of newborns with HIE and stated that CNP is beneficial to provide new cognition for the management of neonatal HIE and fresh insights into nursing techniques.

Our study's findings are in line with those of Solaz-García et al., (2021), who examined scientific literature stored in several databases to determine nursing care for newborns treated with active TH and suffering from severe to moderate HIE. They found that nursing care is crucial for early identification of the infant's complications as well as for providing psychological support for the parents during the treatment process. It is imperative that nurses have this kind of care training. Furthermore, Tabalya, (2023) conducted a study to assess how training affected health care workers' knowledge in assessing neonatal HIE at the Kenyatta National Hospital; of the 85 participants, 69 were nurses, and they reported а significant improvement in their overall knowledge score following the training.

Likewise Craig et al., (2017)conducted a survey with 219 neonatal nurses to determine their attitude about the provision of TH in terms of infant pain and sedation, the need for nurse and parent education, the decisionmaking process surrounding the initiation of TH, and barriers to providing the best care possible and stated that nurses had poor attitudes related to TH treatment and recommended conducting a training

program for nurses. We think these findings hold considerable significance for healthcare education and training programs, highlighting the malleability attitudes targeted of through interventions. A positive shift in attitude is crucial for the acceptance and application of evidence-based practices, ultimately contributing to improved patient care outcomes. This noteworthy shift in attitude signifies the potential influence of targeted educational interventions in reshaping perceptions and fostering a more positive outlook among healthcare professionals.

In the same way, according to Peloquin et al., (2016), specialized training in recognition and appropriate management of the at-risk neurocritical care patient is essential for the neonatal nurses participating in neonatal neurocritical care practice. To build proficiency and confidence in this crucial care role, didactic courses and practical practice opportunities that impart crucial knowledge and facilitate the learning of clinical skills are crucial. Furthermore, nurses can play a significant role promoting in comprehensive care practice if they receive specialized education and training in the care demands and approaches for at-risk therapeutic neurocritical care patients.

As well, Avery et al., (2015) agreed with us as they conducted a study using a checklist to help nurses carry out the TH protocol during the various intervention phases (initiation, maintenance, rewarming, and normothermia) in the ICU and found that the intervention had a positive

effect on nurses' performance as evidenced by practice observations and feedback from nursing staff across all units. The time it takes to achieve the target temperature and begin continuous electroencephalographic monitoring in the ICU has been shortened with the use of the checklist that confirms its utility.

On top of that in Holtmoen, Aagaard & Solevåg systematic review from 2023 highlighted the importance of neonatal nurses having specialized training and clinical competence in the early identification, stabilization, and transfer of at-risk patients to tertiary care in the context of neonatal HIE. Following recommendations and recording evaluations are essential for identifying newborns who met the criteria for TH. Research has also demonstrated that receiving specialized training can enhance patient care standards and outcomes.

In 2015. Fernández Tuñas et al. concluded that protocols should be made available to medical and nursing staff to provide nursing care during cooling therapy for neonates suffering from HIE. These professionals must be trained and have specialized knowledge to carry out treatment and prevent complications. The success of cooling therapy treatment needs efforts by an interdisciplinary team with strict vigilance and monitoring, especially from nurses, according to a 2013 study conducted in Spain by Estévez, Boy & Casanueva. In addition, the nurse must possess specific expertise, be trained, familiar with and be the complementary tests. Thus, to achieve excellent outcomes, it is crucial to

establish training programs and nursing care protocols.

Finally, when treating TH, nursing care is crucial. Nurses provide allencompassing care that includes the newborns and their family. The goal of care neonatal is to maintain hemodynamic stability during the prepare procedure, any materials needed, administer treatments, and follow clinical recommendations. To achieve this, these professionals' training and specialization, as well as the development of protocols and clinical guidelines, are crucial for ensuring the greatest level of efficacy when and safety carrying out hypothermia. Hence our study findings have significant implications for healthcare organizations, educators, and policymakers, highlighting the positive correlation between educational interventions and practical among nursing staff. competence Continuous efforts in designing and implementing tailored educational programs can contribute to sustained improvements in nursing practice, ultimately benefiting patient outcomes in neonatal healthcare settings.

## Conclusion

The comprehensive on-the-job training implemented in this study has demonstrated significant and positive outcomes across multiple dimensions within the nursing cohort. The findings reveal a substantial improvement in knowledge levels. attitudes. and practical competencies related to cooling therapy for HIE following the intervention. Also, there were positive correlations between knowledge,

attitudes, and practices which provide valuable insights into the interplay between these elements in the context of the studied intervention.

## Recommendations

- On-the-job training programs related to cooling therapy for HIE should be conducted for nurses in NICUs.
- Neonatal nurses should receive specialized training and possess clinical competence in the early identification, stabilization and transfer of at-risk patients to tertiary care.
- Following protocols and recording evaluations are essential to determine newborns who meet the criteria for TH.
- Long-term follow-up studies are required in the future to evaluate the sustainability of the noted improvements and the possible impact of external factors on nurses' performance.
- A larger probability sample should be studied in the future to obtain data that may be applied to other neonatal settings.

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