EFFECT OF TRAINING ON THE KNOWLEDGE OF HEALTH CARE WORKERS IN THE ASSESSMENT OF NEONATAL HYPOXIC-ISCHEMIC ENCEPHALOPATHY AT THE KENYATTA NATIONAL HOSPITAL- A quasi-experimental study

PRINCIPAL INVESTIGATOR:
DR. ESTHER TABALYA
H58/34200/2019
DEPARTMENT OF PAEDIATRICS AND CHILD HEALTH

A RESEARCH DISSERTATION IN PARTIAL FULFILLMENT FOR THE DEGREE OF MASTER OF MEDICINE, PAEDIATRICS AND CHILD HEALTH, FACULTY OF HEALTH SCIENCES, UNIVERSITY OF NAIROBI.

2023

DECLARATION

This dissertation is my original work and has not been submitted for any academic award or published in any other university or any other institution of higher learning for the award of a degree.

Signature:  **Date:** 9th Agust,2023

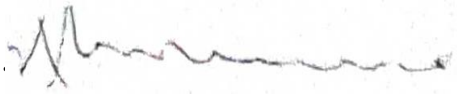
Dr. Esther Tabalya

APPROVAL FROM SUPERVISORS

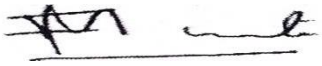
SUPERVISOR APPROVAL

This dissertation has been submitted for examination with our approval as University Supervisors.

Professor Aggrey Wasunna, MBChB, MMed (Paed)
Professor of Neonatal Medicine, Department of Paediatrics and Child Health, Faculty of Health Sciences, University of Nairobi.

Signature:  **Date:** 9th August,2023

Dr. Florence Murila,
Lecturer, Department of Paediatrics and Child Health, Faculty of Health Sciences, University of Nairobi.

Signature:  **Date:** 9/08/2023

Dr. Edna Ojee, **MBChB, MMed (Pead)**
Tutorial Fellow, Department of Paediatrics and Child Health, Faculty of Health Sciences, University of Nairobi.

Signature:  **Date:** 09th August, 2023

ACKNOWLEDGEMENTS

I would like to thank the Almighty God for His never-ending grace, love and provision that enabled me come this far despite all the challenges faced during my post graduate studies.

I wish to express my sincere gratitude to my mentor and supervisor, Dr. Florence Murila for her patience, guidance and encouragement during this entire time. I would also like to thank Prof.Wasunna for his invaluable knowledge, and never wavering support whenever called upon. Dr. Edna Ojee for holding my hand through moments of doubt, her constant encouragement and vast knowledge in research aided the completion of my dissertation.

I wish to thank the faculty of Department of Paediatrics and Child Health who offered significant guidance towards the improvement of this study.

I wish to acknowledge the hardworking and dedicated healthcare workers at the Kenyatta National Hospital's, Newborn unit whose participation made this work possible as well as my research assistants.

Last but not least I am extremely grateful for the continued support, love and encouragement that I have received from my family and friends. God bless you all.

ABBREVIATIONS

KDHS - Kenya Demographic Health Survey

KNH - Kenyatta National Hospital

NBU- New Born Unit

HCW- Health Care Workers

NE- Neonatal Encephalopathy

BA- Birth Asphyxia

HIE - Hypoxic ischemic encephalopathy

ICU- Intensive Care Unit

PPV- Positive pressure ventilation

TH- Therapeutic hypothermia

PCM- phase-changing material

KNH- UON ERC - Kenyatta Hospital- University of Nairobi Ethics and Research Committee

CASE DEFINITIONS AND OPERATIONAL TERMS

Assessment-The act of judging or deciding the amount, value, quality or importance of something (Cambridge Dictionary)

Knowledge- refers to a set of understanding or one's way of perception.

Hypoxic ischemia-Reduced amount of oxygen and inadequate amount of blood delivered to tissues and can cause brain injury if their delivery falls below critical values.

Perinatal asphyxia-a lack of blood flow or oxygen to or from the foetus in the period before, during or shortly after birth.

Metabolic acidosis- Low PH in the blood due to an increase in lactic acid that reflects the severity of asphyxia and hypoxic ischemia

Neonate -An infant less than 28 days of life.

Neonatal encephalopathy -A clinically defined syndrome of disturbed neurological function in the earliest days of life in an infant born at or >35weeks gestation.

Neonatal hypoxic-ischemic encephalopathy- the neurological sequelae of perinatal asphyxia.

LIST OF TABLES

LIST OF FIGURES

Table of Contents

ABSTRAC**T**

Background: Neonatal encephalopathy describes neonates (born at 35 weeks gestation or beyond) displaying subnormal level of consciousness or seizures which may be accompanied by difficulty initiating and maintain respiration and abnormal tone and reflexes. 50-80% of neonatal encephalopathy is attributed to hypoxic-ischemic encephalopathy that has many complications such as cerebral palsy. Good knowledge and proper assessment are therefore important for timely intervention using proven neuroprotective measures (therapeutic hypothermia) alongside supportive treatment.

Objective: To determine the effect of training healthcare workers on their knowledge of the assessment of neonatal hypoxic-ischemic encephalopathy at the Kenyatta National Hospital's newborn unit.

Study design and setting: A quasi-experimental study design conducted at the Kenyatta National Hospital's newborn unit.

Intervention- 15 minutes power point training with content derived from the 2018 Kenyan newborn guidelines on neonatal hypoxic ischemia.

Methodology: Census method was employed and demographic and knowledge scores (before and after training) collected using a validated 25 structured questionnaire. Knowledge on the diagnosis, neurological assessment and treatment of HIE was tested. A score above 60% was considered good.

Data analysis: Descriptive and inferential analysis was done. A chi-square test assessed the association between categorical variables in the study. McNemar's test assessed the difference in assessment performance (pass/fail). A paired t-test was also used to compare the knowledge scores pre-training and post-training. Multiple linear regression was used to

assess factors associated with the knowledge level of HCWs in assessment of HIE. Statistical significance was evaluated at 0.05 significance level.

Results: 85 participants were enrolled of whom 69 were nurses,10 paediatric residents. 4 medical officers and 2consultants. Overall knowledge scores improved significantly after the training, p-values <0.001 and in some specific areas p values <0.001namely; the definition of neonatal encephalopathy, appropriate post resuscitation management for a newly born baby with suspected HIE, and grading score systems used in HIE. Prior training was significantly associated with knowledge score, OR 0.23 (0.09, 0.59), p-value 0.02. Cadre and years of experience were not associated with knowledge scores, p-values >0.05.

Conclusion: There was a statistically significant improvement in the overall knowledge scores after training. Previous training was statistically significantly associated with good knowledge scores.

Recommendations: Continuous training of healthcare workers to improve their knowledge and performance in the care of patients and multisite studies of the same type to allow generalizability.

Utility: The impact of training on healthcare workers' knowledge levels on HIE assessment and management was determined, problem areas identified and hence useful in enhancing efficacy and change processe

CHAPTER ONE: INTRODUCTION

1.1 Background

According to the American college of obstetricians and gynaecologists, neonatal encephalopathy (NE) is a term used to describe neonates (born at 35 weeks of gestation or beyond) displaying a subnormal level of consciousness or seizures which may be accompanied by difficulty initiating and maintaining respiration and abnormal tone and reflexes.[1] Approximately 50-80% of NE can be attributable to hypoxic-ischemic encephalopathy (HIE), the neurological sequelae of perinatal asphyxia.[2] Other causes of NE include inborn errors of metabolism, neonatal infections, and placental abnormalities among others.[2] The current recommended treatment for NE is therapeutic hypothermia (TH) regardless of aetiology although further evaluation of the underlying cause either through metabolic or sepsis workup will guide the formulation of adjunct treatment and preventive measures.[2] A neonate meets the case definition of NE through clinical assessment by a trained clinician based on measurable parameters such as respiration, tone, reflexes and level of consciousness.[1] These parameters are incorporated in standard neurological assessment tools such as the Sanart and Sarnat and Thompson scores that are routinely used in the assessment of NE.[3,4] Additional clinical evidence of circulatory compromise and evidence of acidaemia supports the diagnosis of HIE in a neonate with features of NE.[1]

NE is classified into mild, moderate or severe. Moderate encephalopathy carries a 10% risk of death and 30% risk of disabilities while 60% of babies with severe encephalopathy die and many, if not all survivors become handicapped.[5] The assessment and classification of encephalopathy guide the initiation of therapeutic hypothermia for those with moderate or severe encephalopathy and is best initiated at the closest time to birth for the greatest benefit in terms of reduced morbidity and mortality.[6]

Studies show poor neurological assessment and documentation of newborns on the first day of life by doctors.[7] Other studies show good documentation of HIE diagnosis (76%) but poor grading (45%) as evidenced by a South African study on 450 babies affected by perinatal asphyxia.[8] Grading of encephalopathy helps determine treatment options as well as serves as a prognostic indicator.[9] Neurological monitoring during the first six hours of life is also critical to detect those with mild encephalopathy that may progress to moderate encephalopathy thereby necessitating TH.[1] A study done in Spain by Arnaez et al in 2012-2013 showed that 14% of babies with NE met the criteria for TH but failed to receive treatment.[10] One of the main reasons cited was delayed diagnosis.[10] A different study in South Africa evaluating opinions and practices on therapeutic hypothermia for HIE among paediatricians showed that the majority (76%) agreed that there were cooling benefits but only 51% offered it or referred to centres equipped to do so.[11] The study concluded that there was poor uptake of this evidence-based practice pointing to a need for further training and ongoing continuing medical education in this area.[11]

In Kenya, no study had been done to evaluate the impact of training healthcare workers (HCWs) in the assessment of HIE. However, closely related studies do exist and mainly involve neonatal resuscitation and its impact on the healthcare workers' skills or its effect on neonatal mortality and morbidity. A systematic review and meta-analysis by Archana Patel et al showed that training has been associated with a significant impact in terms of a reduction in stillbirths (21%) and early neonatal deaths (47%).[12] The Helping Babies Breathe initiative in Tanzania also had a great impact on the level of knowledge and skills of health workers in neonatal resuscitation resulting in a significant drop in neonatal mortality rate.[13]

Despite advances in obstetric care, the overall incidence of HIE remains high particularly in low- and middle-income countries[14] with reported high mortality and disability rates

associated with moderate and severe encephalopathy.[5] Furthermore, there is evidence of poor neurological documentation and grading of NE from other countries[7,8] but no studies in Kenya to support or refute this. With these factors in mind, our study will seek to determine the HCW pre-training knowledge of the level of HIE, provide training then re-evaluate the impact of this training on their knowledge level.

CHAPTER TWO: LITERATURE REVIEW

2.1 Pathogenesis of asphyxia

HIE is an evolving neurological injury process that starts after an acute impairment in blood supply and oxygenation to the brain.[15] When the cause of injury cannot be ascertained it is referred to as neonatal encephalopathy.[15] HIE follows four phases, a primary energy failure, a latent phase, a secondary energy failure 6 -24 hours later and a tertiary phase lasting from 24 hours to weeks, characterized by pronounced inflammation impeding neuronal cell recovery.[15]

Primary energy failure occurs following an acute cerebral hypoperfusion event where the lack of oxygen and glucose leads to anaerobic glycolysis, lactic acidosis, sodium-potassium-ATPase pump failure, and build-up of sodium within the cell.[16] Water follows sodium which leads to cell oedema and eventual cell lysis.[16]

This primary energy failure is usually shortly followed by the latent phase after the restoration of cerebral circulation and energy state during resuscitation.[16] Cytotoxic oedema may resolve over approximately 30 to 60 minutes, with a partial recovery of cerebral oxidative metabolism.[16]

However, approximately 6 to 24 hours later, the infant may further deteriorate.[16] This so-called “secondary phase” of energy failure may last several days and is likely to involve multiple pathophysiologic processes such as a further release of excitatory amino acids, free radical formation, a parallel rise in intracerebral lactate, induction of apoptosis, and inflammatory activation, leading to delayed onset of seizures (secondary cytotoxic oedema).[16] Glutamate one of the neuroexcitatory neurotransmitters that frequently accumulates during

hypoxic injury is used in a variety of neuronal pathways including; vision, somatosensory function, learning and memory which can account for the disruptive effects of HIE on subsequent neurodevelopment. The existence of a latent phase before secondary energy failure is a target for initiating treatment for neuroprotection.[16]

HIE, the neurological complication of perinatal asphyxia has no definitive diagnosis but relies on a collaborative history of perinatal compromise (a poor APGAR score, need for resuscitation), clinical examination, biochemical evidence of circulatory compromise and amplitude-integrated EEG findings or presence of seizures.[1,14] The Kenyan 2018 neonatal guidelines describe HIE as the manifestation of asphyxia injury characterized in the early neonatal period by an altered level of consciousness, seizures within 12 hours of birth or coma and altered tone.[17]

2.2 Neonatal resuscitation

All newborns with hypoxic-ischemic encephalopathy should receive initial management that includes good neonatal resuscitation and supportive management.[1]

Delayed cord clamping is not practised as in the case of newborns with no complications. They should be stimulated by wiping with dry warm towels and ventilated with 21% oxygen within the golden minute.[14] Normothermia should be maintained during resuscitation and for those requiring cardiopulmonary resuscitation, 100% of oxygen should be administered according to the American Heart Association.[14] To avoid hyperoxic injury, oxygen should be titrated to achieve targeted preductal saturations after the return of spontaneous circulation.[14] Passive hypothermia should be offered by turning off the radiant heater. Prolonged passive cooling such as the use of ice packs is discouraged even in resource-limited areas due to the risk of overcooling which has been associated with higher morbidity and mortality.[14]

Investigations should then be carried out to help determine the cause of NE and TH should be offered within 6 hours for those who have hypoxic events supported by history and laboratory investigations.[14]

2.3 Perinatal events and biochemical evidence of hypoxia

Following stabilization with effective ventilation and CPR (if indicated), the newborn showing evidence of encephalopathy should then be evaluated for suspected hypoxic injury through history taking and supported by biochemical evidence of metabolic acidosis.[1]

Perinatal events that may cause HIE include a history of neonatal distress, cord prolapse, failure to initiate or sustain breathing at 1 min of life, a poor APGAR score, or a need for resuscitation beyond 10 minutes.[1]

The APGAR score is an expression of an infant's physiological condition at a certain point in time. The score is taken at 1,5 and 10 minutes of life and a score of 7-10 at 5 min is considered reassuring, 4-6 is considered moderately abnormal whereas 0-3 at 5 or more minutes is very low. A very low APGAR score is a nonspecific indicator of illness and may be the first indicator of NE.[1] According to the Kenyan 2018 newborn guidelines, a persistent APGAR score of <3 at 5 minutes supports the diagnosis of perinatal asphyxia.[17] Factors that may influence the APGAR score include maternal sedation, congenital abnormalities, cardiorespiratory conditions and interpersonal variability in the assessment of the baby.[1]

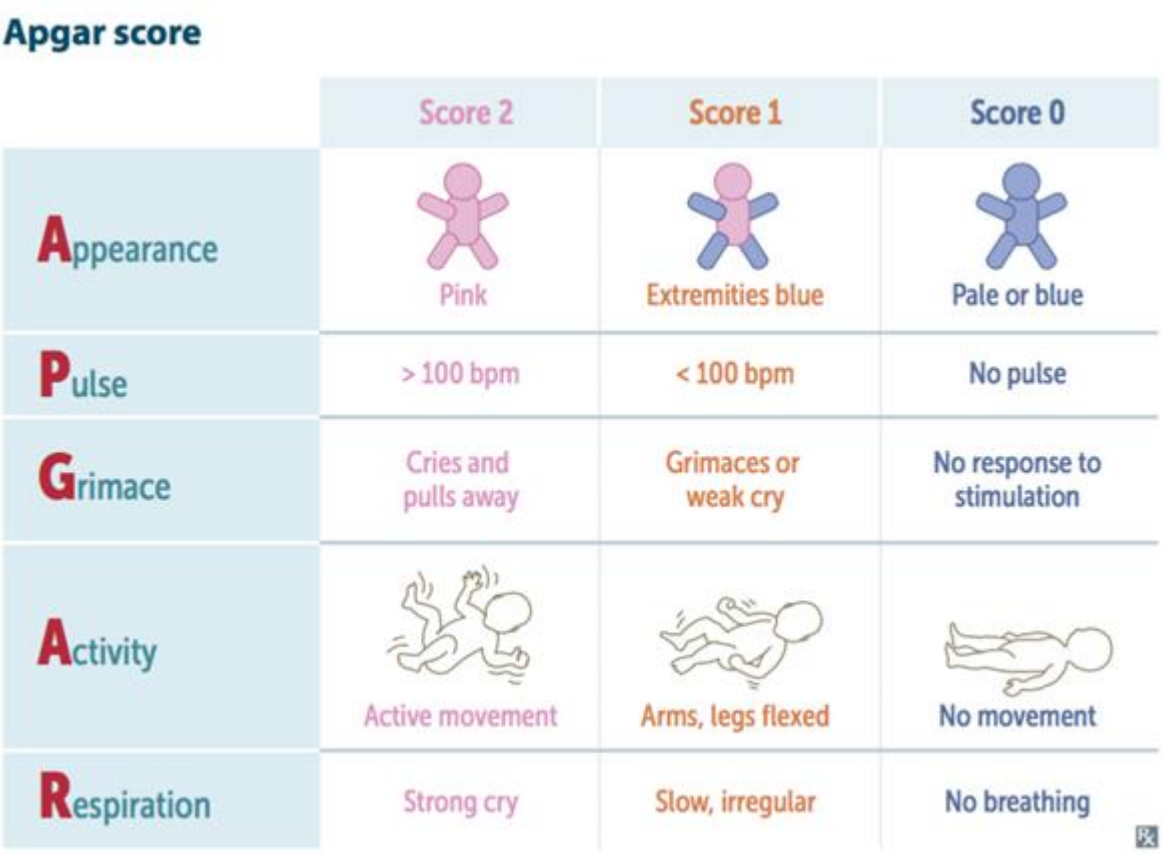


Figure 1:Apgar score (Adapted from GrepMed).[18]

Biochemical evidence of impaired circulation includes evidence of metabolic acidosis with pH <7 from the umbilical cord or arterial blood sample taken within an hour of birth (14). A 1-hour arterial PH of <7 is substantially associated with neonatal morbidity, mortality and cerebral palsy in childhood.[19]

2.4 Neurological evidence of encephalopathy

Several neurological assessment tools exist for the diagnosis of NE with the two commonest ones being the modified Sarnat and Sarnat score and the Thompson Score. A neurological assessment using the Sarnat and Sarnat score is one of the requirements that the Kenyan newborn guidelines cite as a criterion for determining the need for TH.[17] TH is of benefit to those with moderate to severe HIE.[14] The Sarnat and Sarnat score was first described by

Harvey B. Sanart and Margaret S. Sanart who clinically observed stages of clinical progression of babies who suffered birth asphyxia. These babies were initially noted to be hyper-alert for a few hours then obtunded, mildly hypotonic and finally lapsed into a stuporous stage with depressed reflexes.[3]

HIE is graded into mild (grade I), moderate (grade II), or severe (grade III) and this grading determines treatment and is also a measure of prognosis. Neonates with mild HIE usually make a full recovery while those with moderate and severe HIE often have long-term complications in terms of visual and auditory impairment, cerebral palsy and cognitive dysfunction.[3]

Sanart Stage 1(Mild NE): The neonate has a generalized sympathetic tone and may be hyper-alert with prolonged periods of wakefulness. Pupils are dilated and deep tendon reflexes increased.[3]

Stage 2. (Moderate NE): The neonate may be lethargic or obtunded.[3] Strong distal flexion and generalized parasympathetic tone such as bradycardia, and miosis are observed. Seizures are common in stage 2.[3]

Stage 3. (Severe NE): In this stage, there is a profound decrease in the level of consciousness and the baby has a flaccid or rigid tone. Deep tendon reflexes are reduced and have very abnormal EEG findings. Clinical seizures are less common due to profound injury in the brain preventing the propagation of clinical seizures.[3]

Clinical criteria require the presence of one or more signs in at least three of the following six categories: level of consciousness, spontaneous activity, posture, tone, primitive reflexes (suck or Moro), and autonomic function (pupils, heart rate, or respiration).[3]

Close and repeated neurological assessment of 1 -2 hours is recommended to monitor those babies who may appear to be mildly encephalopathic and who may progress to moderate encephalopathy within the therapeutic 6-hour window period.[14]

Table 1:The Modified Sanart and Sanart score for Staging of HIE (Adapted from Dalili et al. 2015).[20]

Severity	Stage 1 (Mild)	Stage 2 (Moderate)	Stage 3 (Severe)
Level of consciousness	Hyperalert	Lethargic or Obtunded	Stupor or coma
Activity	Normal	Decreased	Absent
Neuromuscular Control			
Muscle Tone	Normal	Mild hypotonia	Flaccid
Posture	Mild distal flexion	Strong distal flexion	Intermittent decerebration
Stretch Reflexes	Overactive	Overactive	Decreased or absent
Complex or primitive reflexes			
Suck	Weak	Weak or absent	Absent
Moro (Startle)	Strong	Weak	Absent
Tonic neck	Slight	Strong	Absent
Autonomic Function			
Pupils	Mydriasis	Miosis	Variable
Heart Rate	Tachycardia	Bradycardia	Variable
Seizures	None	Common	Uncommon

doi:10.1371/journal.pone.0122116.t002

The Thompson score is a numerical based neurological score that is a much simpler tool to use than the Sarnat and Sarnat Score.[21]It requires no specific training and requires no equipment to perform and its components include a neurological examination and assessment of respiration and fontanelle tension.[21] The neurological component assesses the baby's level

of consciousness, tone, posture, presence of fits and three reflexes (Moro, Sucking and Grasp) making a total of nine parameters further described below.[21]

- **Tone:** The tone progresses from normal to slightly increased in the mildly affected infant. Hypotonia or complete flaccidity is observed in the severely affected infant.

- **Consciousness:** Mildly affected infants are hyper-alert and may have a stare while the moderate ones are lethargic with coma being observed in the severely affected ones.

- **Fits:** The score increases with an increase in the number of fits.

- **Posture:** Intermittent cycling is observed in the mildly affected neonate while severely affected ones have a decerebrate posture.

- **Primitive reflexes:** Moro, grasp and suck reflexes each form a separate component of the Thompson score. Mildly affected infants have normal reflexes and moderately affected have poor or partial with absent reflexes observed in the severely affected infants.

- **Respiratory pattern:** Breathing is normal or increased in mildly affected infants while severely affected infants have apnoeic episodes.

- **Fontanelle:** Infants with mild HIE may have a full fontanelle while severely affected ones have a tense fontanelle.

Table 2: Thompson score (Adapted from Thompson Score for Hypoxic Ischaemic Encephalopathy).[22]

Sign	0	1	2	3
Tone	Normal	Hypertonia	Hyportonia	Flaccid
Consciousness	Normal	Hyperalert , stare	Lethargic	Comatosed
Fits	Normal	infrequent < 3day	frequent > 2/day	
Posture	Normal	Fisting / cycling	Strong, distal flexion	Decerebrate
Moro	Normal	Partial	Absent	
Grasp	Normal	Poor	Absent	
Suck	Normal	Poor	Absent± bites	
Respiration	Normal	Hyperventilation	Brief apnea	(Apnoea)
Fontanelle	Normal	Full not tense	Tense	

The Thompson score equates to the Sarnat and Sarnat stages with a score of 0-10 being mild encephalopathy(stage1), 11-14 being moderate encephalopathy and a score>14 as severe encephalopathy (stage 3) (3). The Kenyan newborn 2018 guidelines cite a score less than 10 as normal,11-14 as moderate and above 15 as severe HIE.[17]

According to Thompson et al, babies with a maximum score of less than or equal to 10 have been found to have a normal neurological outcome at 1yr while 65% of those with a score of more than 10 and 92% of those with a score of greater than 15 have an abnormal score at 1 year [4]. A daily Thompson score is useful in assessing the clinical progression of brain injury and the adequacy of treatment. It also serves as a prognostic tool.[4]

2.5 Therapeutic Hypothermia

Neonates with moderate to severe HIE benefit from therapeutic hypothermia which is the recommended modality of treatment.[23] It works by minimizing the cerebral injury that occurs after cerebral hypoperfusion and it is best initiated within 6 hours after the initial ischemic insult to reduce mortality and morbidity.[23] When initiated closest to birth, studies have shown a better outcome in terms of neurodevelopmental outcomes.[4] Some centres practice TH for mild HIE.[24] There is no sufficient evidence to support or refute this, hence more studies are needed in this area.[24]

The requirements for TH according to the Kenyan newborn guidelines are;[17]

- Gestation more than or equal to 36 weeks
- APGAR of less than or equal to 3 at 5min and need for resuscitation beyond 10mins after birth
- Acidosis with cord arterial blood pH of < 7.0 in the first hour of life (where available)
- Neurological signs – hypotonia, hypertonia, weak/absent suck, seizures, coma
- Age ≤ 6 hours from birth
- Abnormal amplified EEG pattern (where available)
- Sarnat staging of moderate or severe asphyxia
- Ability to provide adequate supportive care and monitoring
- Absence of major congenital abnormalities

Once the criteria are met the baby is exposed to hypothermia levels with a rectal temperature of 33-34 degrees Celsius maintained for 72 hours followed by slow rewarming at a rate of no more than 0.5 degrees Celsius per hour until the rectal temperature of 37^0c plus or minus 0.5^0C is reached.[23] This is done through the use of devices that provide either whole or

selective head cooling. Whole-body cooling is easier to manage and provides marginally better results than selective head cooling.[23]

Supportive measures during cooling include nutrition, fluid management, prevention of hypoglycaemia and treatment of convulsions.[21] Due to the reduction in metabolic rate fluids are restricted to 40-60ml/kg per day. Complications may rarely occur but should also be anticipated and corrected.[21]

Several TH devices exist in the market, the Micradle ™, Tecotherm and Cool cap. The Micradle is relatively cheaper since it requires no electricity to power, is easier to use and avoids extreme temperature fluctuations hence a better safety profile.[25]

The technology behind the Miracle TM device

Phase-changing material (PCM) is a specialized thermal emergency storage material that stores and releases heat at a particular temperature. The thermal energy transfer occurs when the material changes phase from solid to liquid or vice versa. When a baby is placed on the PCM, heat from the baby is transferred to the PCM which absorbs the heat.[25]

The Micradle Neonate Cooler has 4 components. A cradle, two types of phase-changing material blocks (FS 21 and FS 29) and a conducting mattress.[25] The PCM is usually stored in the fridge at 2-8 degrees Celsius and should be solid when taken out.[25]

The Cradle is made of plastic and forms the framework of the structure onto which the FS 29 is placed. Form stable 29 has a melting point of 29 degrees Celsius.[23] In the solid state it passively extracts heat from the neonate.[23] The FS 21 is placed above the FS 29 and it has a melting point of 21 degrees Celsius. Above it is placed the conducting mattress onto which the baby is directly placed.[25]

The device works in two phases, the induction phase and the maintenance phase. During the induction phase, both the FS21 and FS 29 are used to rapidly lower the baby's core temperature to the desired target. Once this is achieved the FS21 is removed leaving only the FS29 block which is used in the maintenance phase, it can maintain the temperature for long hours.[26]

An upper and lower target temperature is usually set such that if the temperature is seen to be raised beyond 34^0 Celsius the FS21 block is returned to lower the temperature once more. If the temperature goes below the lower limit (33^0C) techniques such as turning on the radiant warmer are used until the desired temp is achieved.[26]

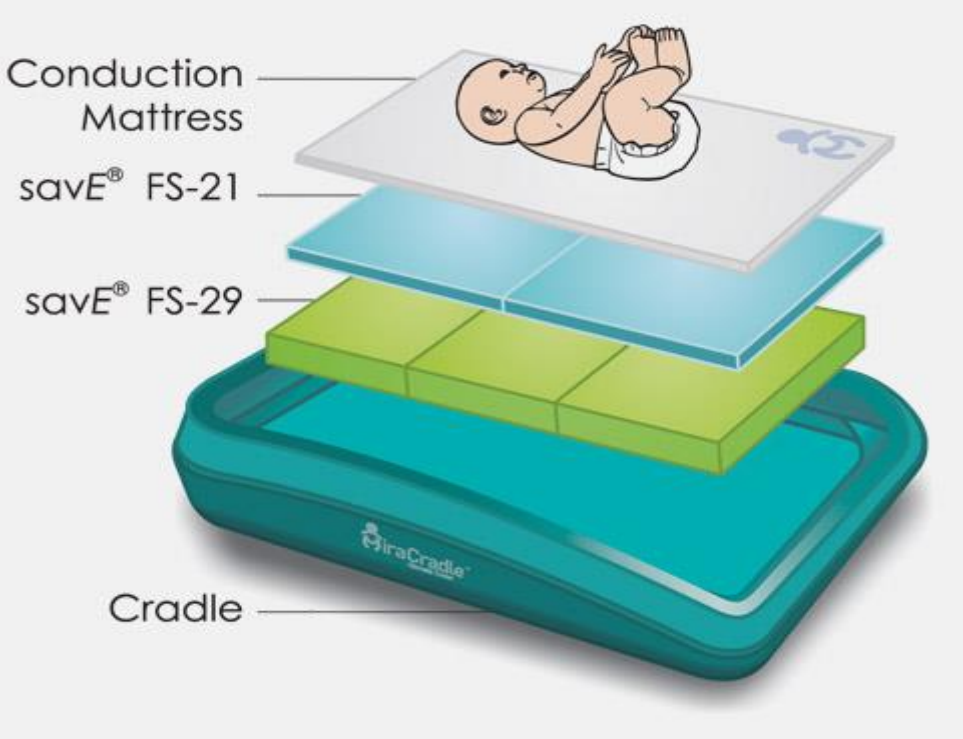


Figure 2: Components of the Mirror cradle neonatal cooler (Adapted from MiraCradle®)).[25]

2.6 Knowledge and impact of training

2.6.1 Knowledge

The Cambridge English dictionary defines knowledge as an understanding or information about a subject that is acquired through experience or study, either known by one person or by people generally.[27]

Knowledge can be categorized into three; personal, procedural and propositional knowledge. Personal knowledge is having an experience of something and remembering it while procedural knowledge is the ability to perform a certain skill. The two are related in that having knowledge should be justified by translating it into a skill aimed at solving a problem or making a decision.[28] Propositional knowledge comprises knowledge that can neither be classified into personal nor procedural and usually cannot be remembered or demonstrated.[28]

According to Hunt knowledge can either be correct, uninformed or misinformed. Correct knowledge is justifiable and can be demonstrated and applied to a skill. Uninformed knowledge is where a person is incorrect and there are doubts about the certainty of correctness. Misinformed knowledge is incorrect and unjustifiable and yet the person believes that the knowledge is correct.[29]

Miller illustrated the concept of knowledge in the clinical concept as shown in the figure below;30

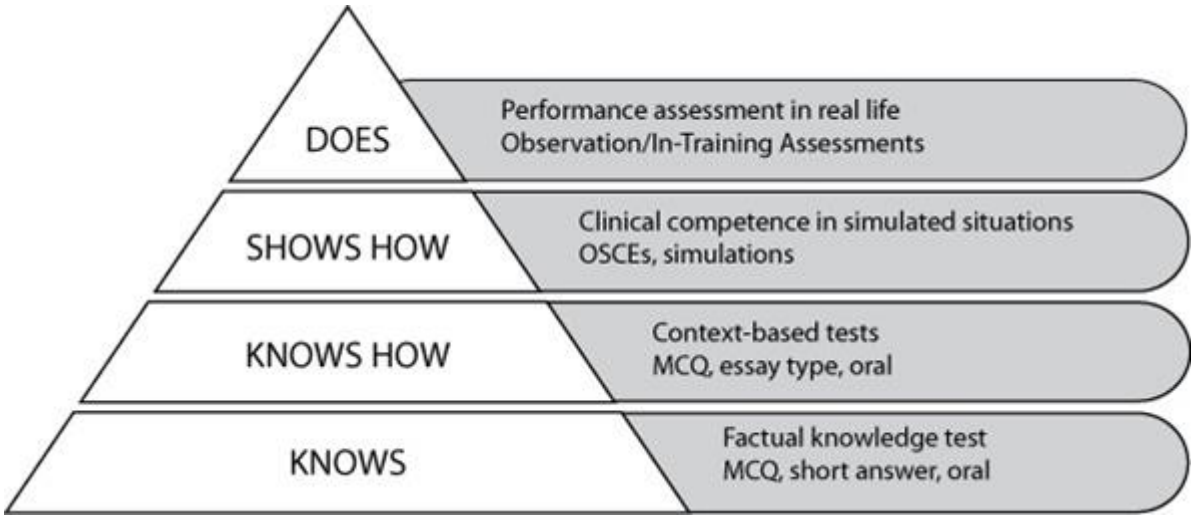


Figure 3: Miller's Pyramid for Assessing Clinical Competence (Adapted from Miller 1990).[30]

According to Miller a person can demonstrate knowledge by his or her ability to answer questions.[30]Competence assessment of higher levels that is '*shows how'* and '*does*' are evaluated through demonstration of skills in simulated or real-life situations. [30].

Many studies have been carried out to assess the competence of healthcare workers concerning knowledge and skills in newborn resuscitation as illustrated by Miller's pyramid. Assessment of knowledge in these studies ranged from semi-structured to multiple-choice standardized questions.

No local study has been done to evaluate the knowledge level of clinicians on neonatal encephalopathy. However, several knowledge assessment studies exist on neonatal resuscitation and birth asphyxia**.** For instance, a 2011 study by Dr. Murila et al., showed deficient knowledge in medics drawn from the labour and neonatal units of different Kenyan counties regarding neonatal resuscitation where only 35% scored above the 85% score.[31] In contrast, a study done in Nigeria's Federal medical centre in 2016 showed good knowledge level amongst nurses most likely attributable to training, with sub-specialisation in paediatrics being an added advantage.[32]

In our study knowledge was assessed based on a questionnaire derived from the Kenyan Newborn Guidelines of 2018. Each participant attaining a score of 60% to be considered knowledgeable.

2.6.2 Impact of training

The Helping Babies Breath (HBB) program was developed by the American Paediatric Academy to help reduce neonatal mortality during the first minute of life by applying simple steps in the resuscitation of newborns (skin-to-skin contact, stimulation when drying and ventilate if not breathing.[33] A before and after training study using the Help Babies Breathe training initiative in Tanzania showed a significant improvement in the knowledge and skills of health workers on neonatal resuscitation as well as a drastic reduction in neonatal mortality in the immediate post-training.[33]

A study in Pumwani hospital in 2018 showed that even a one-day training in neonatal resuscitation has a significant impact on the health workers' short-term practices.[34] A study by Rule et al., at Tenwek Hospital in Kenya demonstrated a 53% reduction in the incidence of suspected HIE (14.7/1000 to 7.1/1000 live births) within six months of inception of the neonatal resuscitation training amongst Health care workers.[35]

A interventional study in Ghana showed significant improvement in the post test scores health professionals (nurse anaesthetists nurses, physicians, and midwives) after a training module on neonatal resuscitation ($p<0.001$).[36] Another study in favour of training and it effect is by Taksande et al in India who showed significant improvement in the mean post knowledge scores ($p<0001$; 95% CI -10.92 to -0.37) after a neonatal resuscitation training conducted among undergraduate, post graduate and qualified nurses.[37]

Despite training, knowledge may remain unchanged as demonstrated by Hildegarde's study conducted among maternity staff in a tertiary hospital in Cameroon [38].

The impact of training healthcare workers in the assessment of neonatal HIE will be evaluated by comparing their knowledge and skills pre-intervention and post-intervention. The methods of evaluation have been outlined under data analysis.

2.7 Conceptual Framework

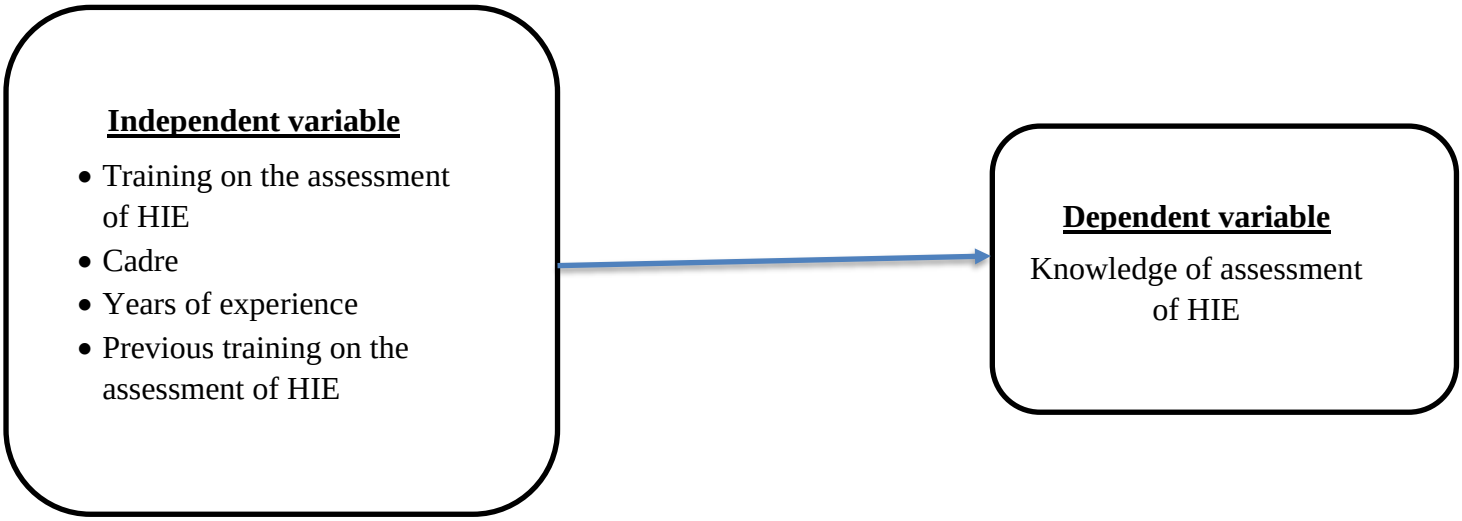


Figure 4: Conceptual framework

2.7.1 Variables

Independent variable

Training on assessment of Neonatal Hypoxic Ischemia- this study conceptualized that the training would increase the health workers' knowledge and skills in the assessment of Neonatal Hypoxic Ischemic Encephalopathy.

Health worker's cadre and years of experience – it was believed that the different cadres of the health workers would score differently depending on their level of

training. Years of experience is also likely to affect the score on assessment i.e., those with many years of experience may assess HIE better than those with fewer years of experience or vice versa since knowledge is known to decay after a while.

Dependent variables

Knowledge score was dependent on the training. It was believed that after the training, the scores on assessment knowledge among the health workers would increase.

2.8 Study justification and utility

Clinicians' knowledge of HIE and its assessment using neurological scores is important for correct diagnosis, and timely initiation of TH treatment to reduce morbidity and mortality. The Sarnat and Sarnat and Thompson score/grading systems are valuable tools used in the classification of encephalopathy, of which therapeutic hypothermia is recommended for moderate and severe HIE.

This is a novel study that sheds light on the knowledge level of HCWs in the post resuscitation care of neonates with suspected HIE unlike many previous studies that focus on the resuscitation, all in the spirited effort of reducing newborn mortality and morbidity.

Being an interventional study, it will help assess and improve knowledge which is one of the strategic mechanisms recommended for the reduction of neonatal mortality.

The study targets the KNH NBU staffing consisting of health workers who may or may not have received training in the assessment and management of hypoxic-ischemic encephalopathy. Furthermore, periodic rotations of staff occur in the NBU and many of the new staff may not be equipped with the necessary knowledge for the assessment of neonatal encephalopathy. Knowledge gaps identified will thereafter be assessed and filled through

training to enable better outcomes with the eventual goal of improving the management of HIE and timely use of Therapeutic hypothermia in the KNH.

2.9 Research Question

What is the effect of training HCWs on the knowledge of assessment of neonatal hypoxic-ischemic encephalopathy at the Kenya National Hospital?

2.10 Objectives

Primary Objective

To determine the effect of training on the knowledge of assessment of neonatal hypoxic-ischemic encephalopathy by HCWs at the Kenya National Hospital.

Secondary objectives

i. To determine the knowledge level of healthcare workers on the assessment of neonatal hypoxic-ischemic encephalopathy before and after training.
ii. To assess factors associated with knowledge level of the assessment of HIE among health care workers.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1.Study Design

This is was quasi-experimental prospective study design which is essential in determining the effect of an intervention. The intervention applied in this study was training of health care worker in the assessment of neonatal hypoxic ischemic encephalopathy. Thus, the baseline knowledge level was obtained and compared with the post-intervention level.

3.2.Study Location

The study was conducted at the Kenyatta National Hospital's newborn unit. Kenyatta National Hospital is the oldest and largest hospital in Kenya. It is a public, tertiary referral hospital that also serves as the teaching centre for the University of Nairobi's College of Health Sciences. Other institutions also send their students for rotation in Kenyatta National Hospital. The hospital also acts as an attachment centre where interns come for experience. The hospital is located in the area to the immediate west of Upper Hill in Nairobi, the capital and largest city of Kenya.[36]. The neonatal unit admits newborns from within KNH and those referred from the peripheral facilities. The unit has a total of 109 medical personnel who include consultants, registrars, medical officers and nurses.

3.3.Study Population

Healthcare workers of different cadres working in the Kenyatta National Hospital Newborn Unit. The Newborn unit is run by 109 medical personnel whereby; 7 are consultant neonatologists, 9 are paediatric registrars and 93 nurses according to a recent in hospital study by Dr. Kanguha in 2021.[41]

3.3.1. Inclusion Criteria

Healthcare workers working in the Newborn Unit. This refers to the health workers who are involved in assessment of patients not necessarily for diagnosis but for the day-to-day care. The health workers include neonatologist consultants, paediatric registrars, medical officers and nurses.

3.3.2. Exclusion Criteria

Health workers who meet the inclusion criteria above but are either on or declines participation.

3.4.Sample Size

A minimum sample size was calculated using Fisher' formula where as shown below.

$$\mathbf{n} = Z^2_{\frac{\alpha}{2}} * p(1-p)/d^2$$

where;

$Z_{\frac{\alpha}{2}} = the\ critical\ value\ at\ 95\%\ confidence\ level$

P = proportion of event, 0.5 for the population proportion

$d^2 = level\ of\ precision, 0.05$

$n = 1.96^2 * 0.5 * 0.5/0.05^2$

$n = 385$

Sample adjustment

$n = (N * n)/(N + n)$

$$n = \frac{118 * 385}{118 + 385}$$

n = 91

This study did not achieve 100% response but had a response rate of 93%. This is considered satisfactory in most studies. [37]

3.5.Census method for recruitment

Census method was used to achieve the desired number of participants. In the preintervention phase, respondents were given questionnaires based on their availability. Those who were engaged and not ready to respond were approached later for responses when they were free. The questionnaires were given a unique number based on the questionnaire they had filled. During the postintervention period, the respondents were again recruited based on availability and willingness to participate. The questionnaires were issued based on the unique numbers given in the preintervention period.

3.6.Study Period

The study was carried out in the 3rd quarter of the year 2022. During this period the investigator was having her three-month neonatal rotation at the NBU and was able to carry out her study as well as support her research assistants.

3.7.Recruitment procedure

The study was carried out by the principal investigator, a part two paediatric resident at the University of Nairobi. The head of the department of the newborn unit was approached to seek permission to interview the staff during their shifts. Consent was sought from each study participant. The principal investigator was assisted by two research assistants who were trained in the knowledge and assessment of neonatal hypoxic-ischemic encephalopathy, consent seeking and recruitment of the participants.

3.8. Study Procedure

The study was conducted in three phases;

Phase 1. Interviews

Interviews were conducted (over one week) during working hours (10 am – 8 pm) to cover morning, afternoon and night shifts in the newborn unit. These questionnaires collected demographic data and knowledge on the assessment of neonatal hypoxic-ischemic encephalopathy in terms of definition, diagnosis, grading and management. The knowledge assessment questions were derived from the HIE management protocol outlined in the Kenyan newborn guideline of 2018. Questionnaires were filled individually and electronically by the study participants while on the job over 5-10 minutes after obtaining consent. A study number was assigned to each of the interviewees to enable tracing for re-evaluation after training.

Phase 2 Training

On-the-job training lasted 10-15 minutes. The training was conducted in the admission rooms and the nurses' stations thrice a day (morning, afternoon and night shift) for one week targeting small groups of 2-3 participants. The training did not interfere with routine care of babies and the researcher helped out in the event of emergency or resuscitation. A chart of the modified Sarnat and Sarnat and Thompson score chart was displayed at the newborn unit to guide the participants in the assessment of HIE 5oft copy versions of these score charts, and the 2018 newborn guidelines were also shared with the study participants.

Phase 3 Re-evaluation after training

The same study participants were retested two weeks post-training using the same questionnaire used in the pre-intervention phase. A participant was considered to have passed if they scored 60% and above. The grading of scores was done using Modified Bloom Cut-off points.

3.9 Data collection

Data collection was carried out by the principal investigator and her research assistants. The research assistants were nursing officers working in the KNH newborn unit and paediatric critical care unit. The research assistants were trained on data collection standard procedures and rules as well as further requirements specific to the design of this study to achieve the best results possible. This study aimed to assess the health care workers' knowledge in the assessment of neonatal encephalopathy, provide appropriate training to fill in the identified gaps then re-evaluate the effect of this training.

Data on the assessment of the healthcare workers' knowledge on the assessment of NE was collected from the identified participants using a standardised questionnaire in the form of a google form before and after the training intervention.

Data entry was done using excel forms which were then imported into R version 4.0.2 for cleaning and analysis. Before data entry, the filled questionnaires were reviewed for validity and completeness by the statistician; this ensured that there was no chance of double entry and that the data had undergone verification.

3.9. Data collection tools

3.9.1. Questionnaires-

A questionnaire (appendix 11.4) consisting of 25 structured questions was formulated with the help of senior supervisors to assess the knowledge of the health workers. The questionnaire collected both qualitative and quantitative data. Qualitative data would help analyze emerging themes from the study. The questionnaire was divided into two sections; section one comprised 4 demographic questions, and section 2 had 21 knowledge-based questions on the definition, diagnosis, grading and treatment of neonatal HIE. The

questionnaire was piloted and tested for validity among health workers who not part of the study. The questions were derived from the chapter on Birth Asphyxia and HIE in the current Kenyan newborn guidelines of 2018 that are used in the KNH.

3.10. Data management and analysis

Data management

Quantitative data was coded and entry was done using excel forms. Quantitative data was parsed (classified under standard themes), coded and entered into excel using excel forms. The data was then stored in a password-protected computer for safety and confidentiality purposes. The data was then imported into R version 4.0.2 for cleaning and analysis.

Data analysis

Data analysis involved creating summaries of the various variables. Continuous variables e.g., participants' age and per cent knowledge score were summarised using medians and interquartile ranges. Categorical variables e.g., years of experience in categories and training status on assessment of HIE were summarised using frequencies and percentage proportions. Exploratory analysis for continuous variables was done using bar and pie charts.

To test whether there was a change pre- and post-training, we used Wilcoxon signed rank test. The test was interpreted using p-values. We also assessed the factors associated with knowledge on the assessment of HIE using odds ratios and confidence intervals for odds ratios. Tests were interpreted at 5% significance level. P-values less than 0.05 were considered statistically significant. Factors with odds

ratios whose confidence intervals traversed 1 were considered statistically insignificant.

3.11. Control of errors and biases

3.11.1. Completeness:

1. Avoiding missing data: questionnaires were checked for completeness immediately after filling in to probe respondents further if there were gaps.

2. The research assistants were trained and provided with standard definitions of terminologies used in the questionnaire to ensure uniform interpretation of the terms.

3. Weekly meetings with the research team were conducted to identify and solve any problems with the study.

3.11.2 Accuracy/Correctness

1. Double-entry of data was done to increase accuracy and a third-party review of all data sets was done.

3.12. Data Verification

A randomly selected sample with 10% of the observations from the entered data was used to verify the correctness of data entry. The filled questionnaires that were used to verify the entered data were selected using serial numbers corresponding to those of the randomly selected sample. The hard copy questionnaires were preserved in case a need for further verification arose.

3.13. Validity

The questionnaire was pretested on a sample population to ensure the validity of the questionnaire before the commencement of the study to reduce insensitive measure bias. This ensured that the questions were sensitive enough to detect important differences in the variables of interest.

3.14. Repeated recruitment

To avoid repeated recruitment unique algorithms were used to identify study subjects by use of serial numbers.

3.15. Study limitations

- The study may have suffered information bias and this was remedied by the researcher collecting data by way of interviews using the questionnaire.
  Further probing may encourage respondents to give accurate responses.
- A two-week post-training evaluation test for knowledge and skills may not be enough time for the retention of skills.
- The study was conducted only in one site and hence can only be generalised to the study population.

3.16. Ethical Considerations

Approval to conduct this study was sought from Kenyatta Hospital- University of Nairobi Ethics and Research Committee (KNH-UON ERC). We then sought authorization to collect data from the Kenyatta National Hospital where the study was conducted**.** Informed consent was sought from all study participants. Strict confidentiality was observed throughout the entire study period. The study participants were given study identification numbers and no

personal identification data was recorded. No pictures or recordings were taken during the study without the prior signing of consent forms to signal agreement and consent.

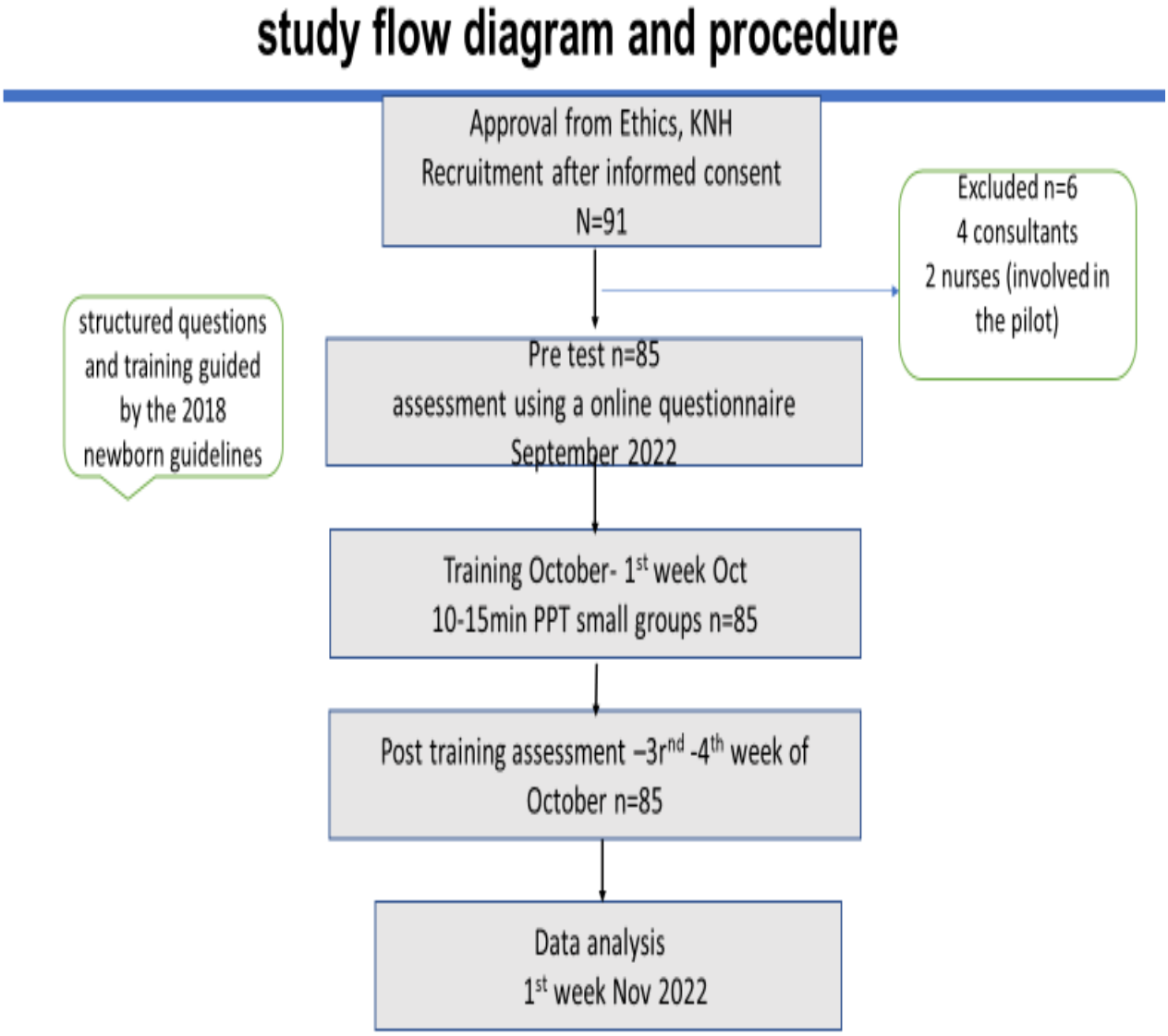
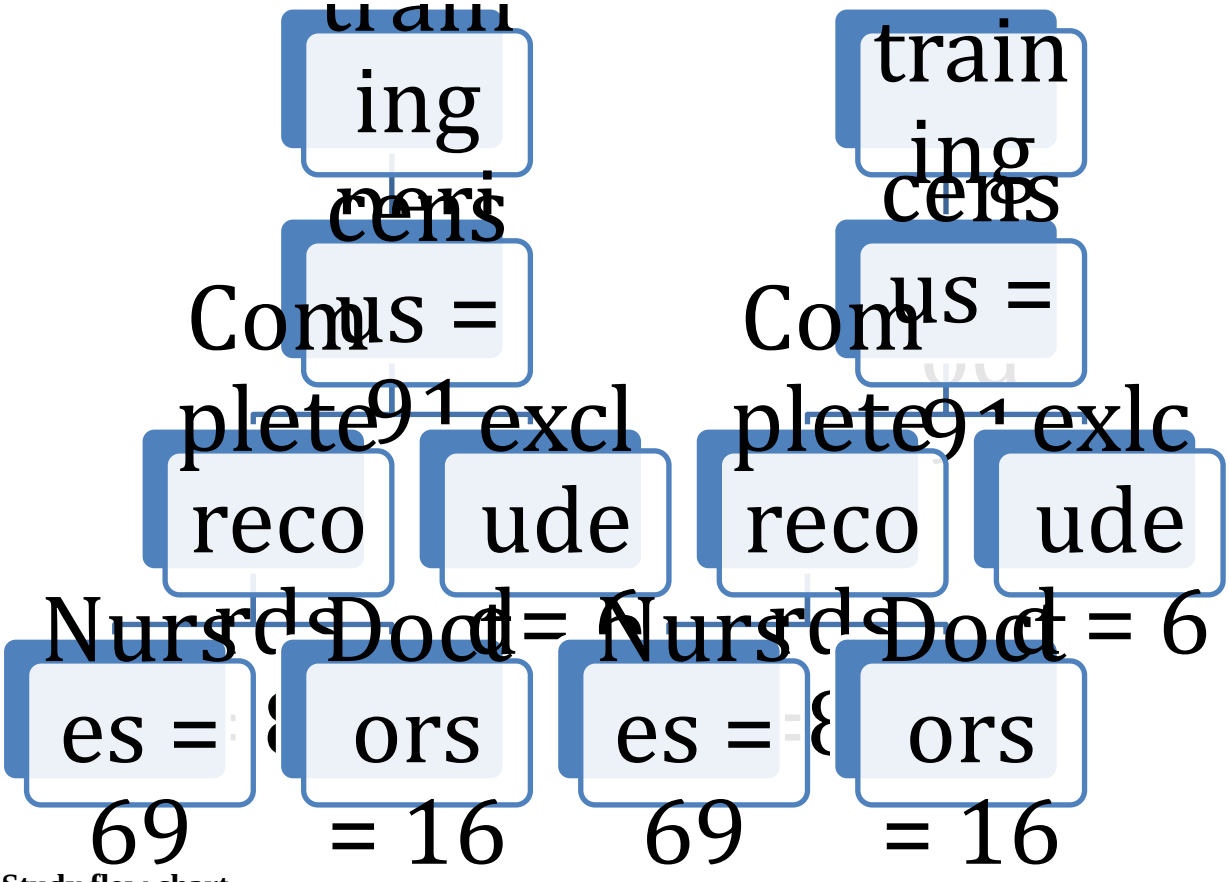


Figure 5: Study flowchart

2 consultants declined

2 directly involved in the study as supervisors

CHAPTER 4: RESULTS



Study flow chart

This study had a sample size of 91 participants, we managed to get 85 observations during the pre-training period and 85 during the post-training period. 6 health care workers were excluded of whom 4 were directly involved in the study(2 nurses and 2 consultants)while 2 declined participation (2 consultants).Out of the total observations, 81.2% (n = 69) were nurses, 11.7% (n = 10) were residents, 4.7% (n = 4) medical officers and the rest were consultants.

Female participants were the majority with 75.3% (n = 64) in the pre and post training period, the rest were male. The median age of the participants was 32.0 years both in the pre and post training period with an interquartile range of 28.0 to 41.0 years and 29.0 to 37.0 years respectively.

The majority of the participants, 41.2% (n = 35) had 2-5 years of NBU experience followed by those with over 5 years at 35.3% (n = 30). The rest had less than 2 years of NBU experience. Those who had undergone training in neurological assessment of HIE by the time of this study were 36.5% (n = 31) table 3.

Table 3: Demographic characteristics

		Pre-training		Post-training	
Variable	Subcategory	Frequency N = 85	Percent (%)/ IQR	Frequency N = 85	Percent (%)/ IQR
Cadre	Consultants	2	2.4	2	2.4
	Medical officer	4	4.7	4	4.7
	Nurses	69	81.2	69	81.2
	Residents	10	11.7	10	11.7
Sex	Male	21	24.7	21	24.7
	Female	64	75.3	64	75.3
Age in years	Median (IQR)	32.0	28.0, 41.0	32.0	29.0, 37.0
Years in NBU	Under 2 years	20	23.5	20	23.5
	2-5 years	35	41.2	35	41.2
	Over 5 years	30	35.3	30	35.3

Level of knowledge among healthcare workers on the assessment and management of neonatal hypoxic-ischemic encephalopathy before and after training

To answer the above objective, respondents were asked a set of questions to test their knowledge of hypoxic-ischemic encephalopathy. The proportion of those who correctly defined neonatal encephalopathy was 37.6% (32 out of 85) in the pre-training period and 62.4% (53 out of 85) in the post-training period. When respondents were asked to select statements that help define birth asphyxia, 43.5% (43 out of 85) were able to pick the components correctly in the pre-training period and 57.6% (49 out of 85) in the post-training period. On the appropriate definitive

management of a baby who suffered birth asphyxia but was successfully resuscitated after 15 minutes, the majority of the respondents 57.6% (49 out of 85) in the pre-training period and 86.0% post training (73 out of 85) chose the correct response of neurological assessment and then decide on therapeutic hypothermia.

When the respondents were asked whether they were aware of any neuroprotective treatment offered for babies who suffered birth asphyxia, 90.6% (n = 77) said they were aware in the pre-training period and 88.2% (75 out of 85) in the post-training period (table 4).

Respondents were also tested on whether they knew the time beyond which therapeutic hypothermia could not be offered, 83.5% (73 out of 85) chose 6 hours which was the correct response in the pre-training period and 93.0% (79 out of 56) in the post-training period.

When asked which grades of HIE qualified for hypothermic cooling, the majority of the respondents chose the correct grades i.e., 38.9% (33 out of 85), 40% (34 out 85) and 12.9% (11 out 85) chose moderate, severe and moderate/severe respectively in the pre-training period and 17.6% (15 out of 85) 17.6% (15 out of 85) and 60% (51 out of 85) in the post-training period.

On supportive management for babies during therapeutic cooling, the majority 55.4% (46 out of 85) chose the correct answer which was trophic feeds on day 2 of life in the pre-training period and 62.4% (53 out of 85) in the post-training period (table 4).

		Pre-training		**Post-training**		**P-value**
Variable	Subcategory	Frequency N = 85	Per cent	Frequency N = 85	Per cent (%)	
Definition of neonatal encephalopathy	Defined correctly	32	37.6	53	62.4	<0.001
	Not defined correctly	53	62.4	32	37.6	
Components that help define asphyxia	Correct components	37	43.5	49	57.6	0.06
	Incorrect components	48	56.5	46	42.4	
Appropriate management for a baby who suffered birth asphyxia but was resuscitated successfully within 15 minutes	Keep the baby warm	14	16.5	1	1.1	<0.001
	Monitor in nursey/postnatal unit	22	25.9	11	12.9	
	Neurological assessment and then decide on therapeutic hypothermia(correct)	49	57.6	73	86.0	
Aware of neuroprotective treatment offered for birth asphyxia	Yes	77	90.6	75	88.2	0.75
	No	8	9.4	10	11.8	
Time beyond which therapeutic cooling cannot be offered	1 hour	2	2.4			0.06
	6 hours (correct answer)	71	83.5	79	93.0	
	3 hours	5	5.9	3	3.5	
	15 hours	7	8.2	3	3.5	
Which grade of neonatal encephalopathy qualifies for cooling	Mild	7	8.2	4	4.8	0.49
	Moderate	33	38.9	15	17.6	
	Moderate/severe	11	12.9	51	60.0	
	Severe	34	40	15	17.6	
Grading score systems used in hypoxic-ischemic encephalopathy	Sanart and Sanart, Thompson score	60	70.6	78	91.8	<0.001
	Others: Silverman Anderson, Ballard's score	25	29.4	7	8.2	
HIE parameters used for therapeutic cooling	1-hour Arterial PH <7.0, Need for ventilation for >10min, APGAR of 3 at 5 min	5	5.9	13	15.3	0.05
Supportive management during therapeutic cooling	Trophic feeds from day 2 of life (correct)	46	55.4	53	62.4	0.39
	Feeding after cooling period (incorrect)	14	16.9	6	7.1	
	Restriction of fluids to 40MLS/kg for all affected HIE babies	13	15.7	21	24.6	

	Prophylactic phenobarbitone(incorrect)	9	10.8	5	5.9	
Diagnosis of HIE in clinical scenario	Correctly diagnosed HIE	73	86.2	79	92.9	0.19
	Incorrectly diagnosed HIE	12	13.8	6	7.1	
Grading of HIE in the clinical scenario	Correctly graded HIE	11	13.0	66	78	<0.001
	Incorrectly graded HIE	74	87	19	22	
Treatment of HIE in clinical scenario	Provided correct treatment for HIE	77	90.3	77	90.6	1.00
	Incorrect treatment for HIE	8	9.7	8	9.4	

Table 4: Knowledge of hypoxic-ischemic encephalopathy

The respondents were also presented with a clinical case scenario that tested their ability to make a diagnosis of HIE, to grade and choose the appropriate management.86.2% of the respondents gave the correct diagnosis as hypoxic-ischemic encephalopathy, 12.3% diagnosed as it as perinatal asphyxia. The rest gave the diagnosis of neonatal encephalopathy. After training, 92.9% of the respondents correctly diagnosed the case scenario as HIE and the rest diagnosed it as perinatal asphyxia (figure 6).

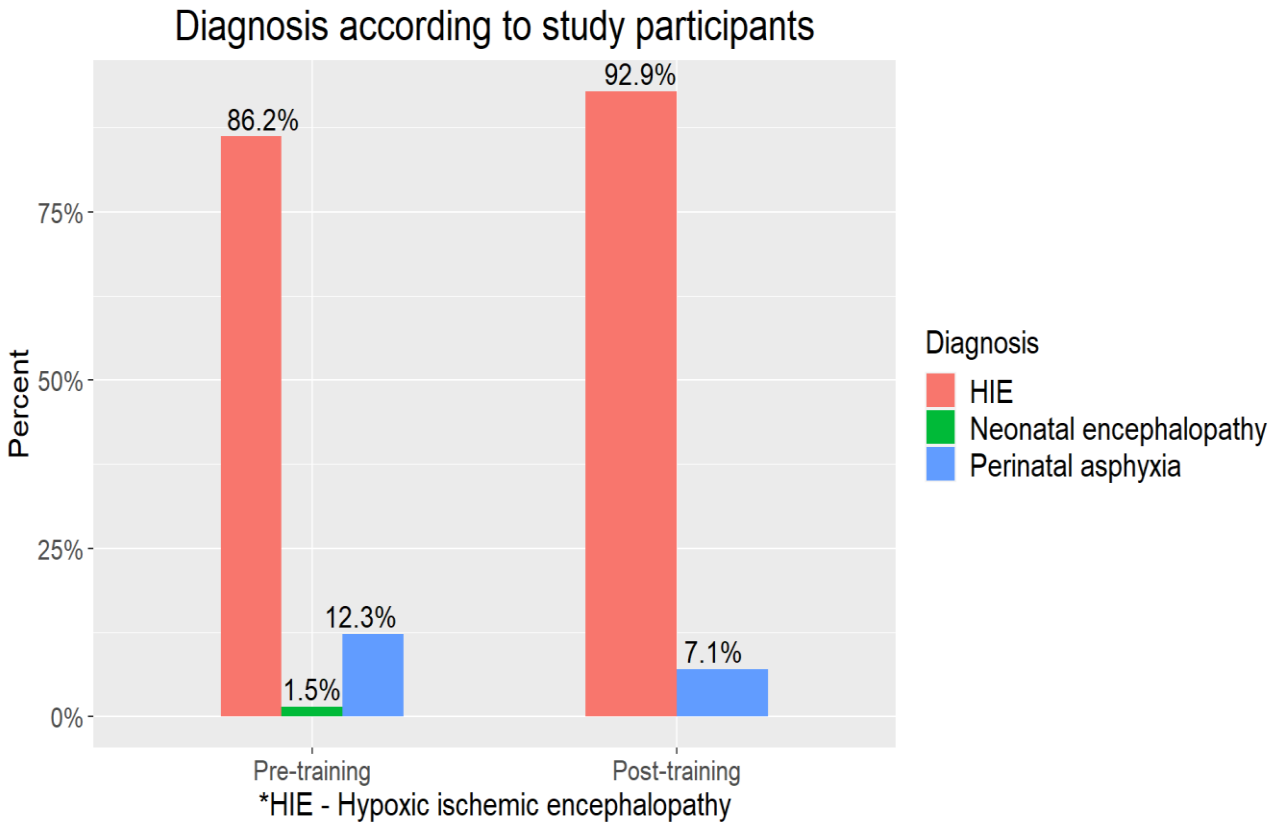


Figure 6: Diagnosis of HIE according to clinical scenario as provided by study participants after and before training

HIE clinical scenario grading before training

Under grading, the respondents were required to provide the score/grade of HIE as per their diagnosis. The score was mild, moderate or severe. The correct HIE grade in this question was moderate HIE. The majority of the respondents 66% were not sure of the HIE score, 21% gave a score of severe HIE and 13% said it was moderate HIE (figure 7).

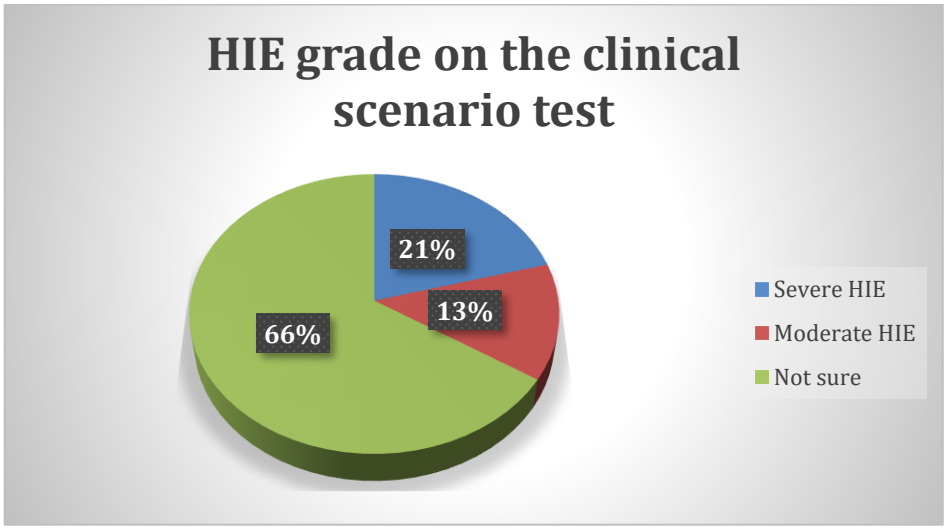


Figure 7: HIE grading on clinical scenario test by study participants before training

HIE clinical scenario grading after training

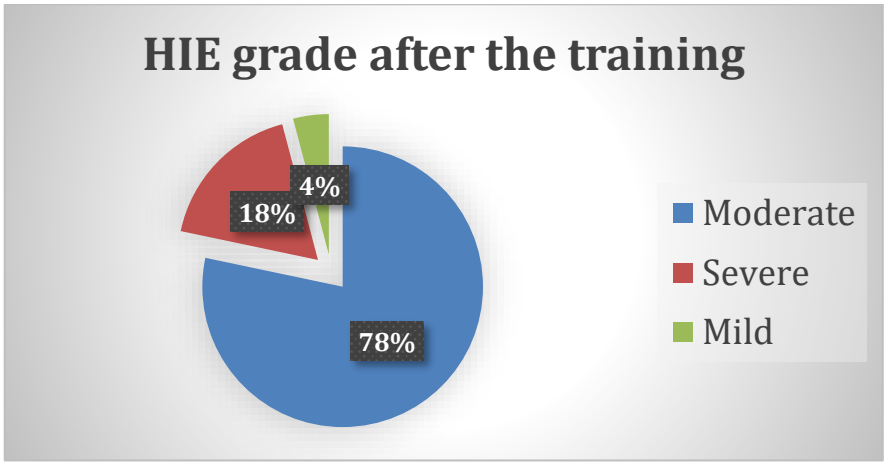


Figure 8: HIE grading of clinical scenario by participants after the training.

After the training, 78% of the respondents were able to correctly give the grade of HIE correctly as moderate. Those who said it was severe HIE were 18% and the rest said it was mild HIE (figure 8).

Treatment prescribed on the clinical scenario test before training

Finally, the respondents were supposed to offer a definitive treatment plan for the hypothetical patient. The majority of the respondents, 90.3% provided the correct treatment plan which was therapeutic cooling. Other respondents said they will give anticonvulsants, 4.8%, followed by 3.2% who prescribed 10% dextrose. The rest prescribed oxygen (figure 6).

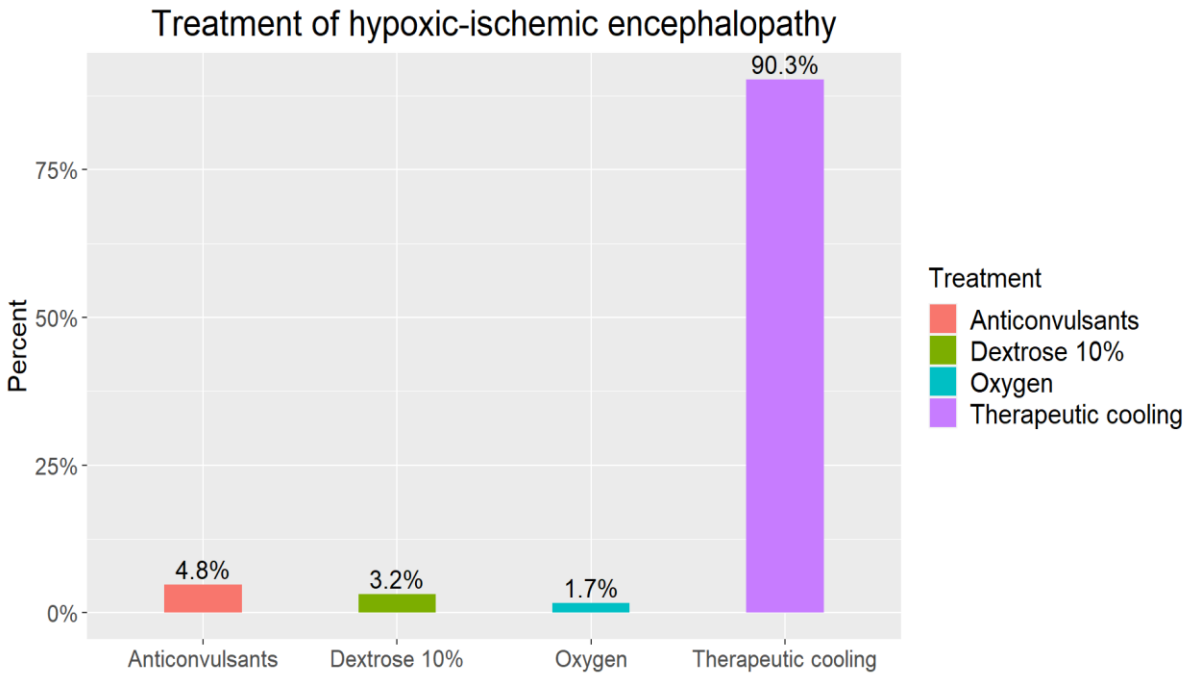


Figure 9: Treatment of HIE before training -clinical case scenario

Treatment of HIE based on the clinical scenario after training

After training, 90.6% of the respondents were able to provide the correct definitive treatment of HIE as per the case scenario up from 90.3% before training. Those who prescribed oxygen rose from 1.7% to 3.5%. Treatment with anticonvulsants decreased from 4.8% pre-training to 3.5% post-training (figures 6 & 7).

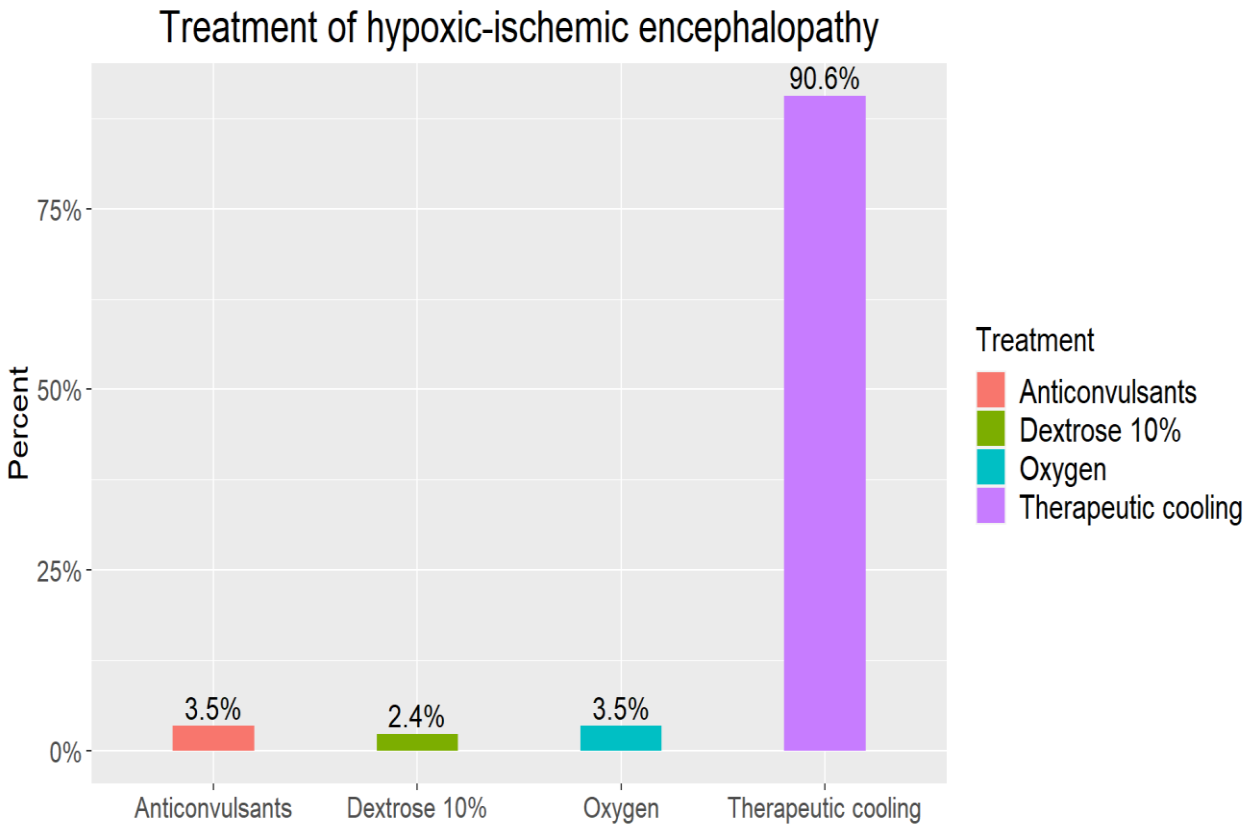


Figure 10: Treatment of HIE after training on a hypothetical patient

Use of newborn guidelines

When respondents were asked whether they were using the newborn guidelines of 2018, 86% said they used the guidelines while the rest did not use them (figure 8).

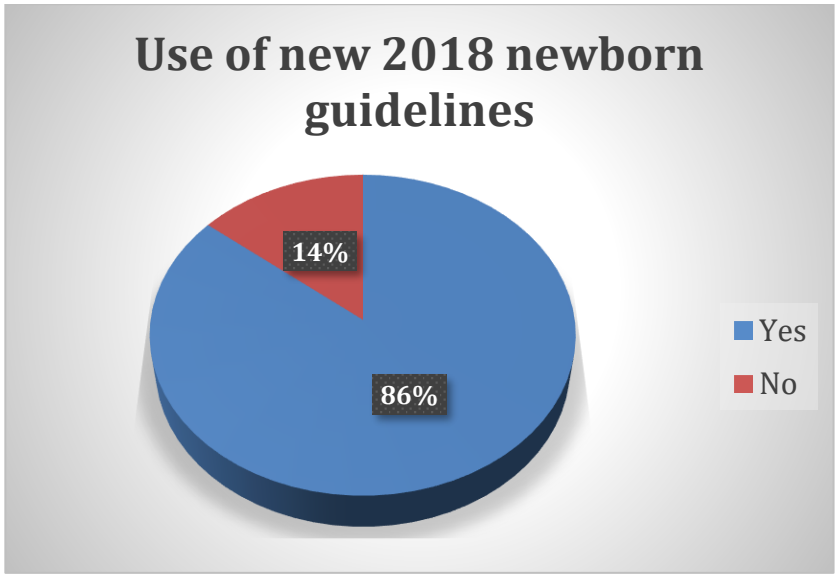


Figure 11: Use of Kenyan 2018 newborn guidelines

How often the respondents used the newborn guidelines

On how often the respondents were using the newborn guidelines, the majority of the respondents, 54% said they only used the guidelines sometimes. Those who used the guidelines very frequently and frequently were 19% and 13% respectively (figure 9).

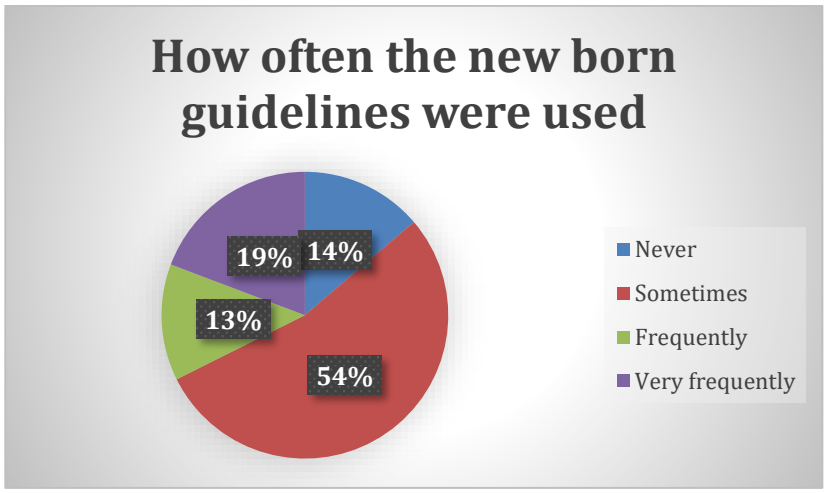


Figure 12: How often the newborn guidelines were used

Of all the questions provided in the questionnaire (table 2), only 4 had a statistically significant difference in their performance before and after training p-values <0.001 at 5% significance level. The performance for these questions significantly improved after the training. These questions were: definition of neonatal encephalopathy, appropriate management for a baby who suffered birth asphyxia but was resuscitated successfully within 15 minutes, grading score systems used in hypoxic-ischemic encephalopathy and scoring of hypoxic-ischemic encephalopathy in the hypothetical case scenario. The performance for the rest of the questions did not significantly improve after the training.

Overall knowledge score

For the overall knowledge score, each question scored correctly attracted 1 mark each. The marks were then added up to make the total marks scored. The total marks scored were converted into a percentage for each respondent. We then used Modified Bloom Cut-off to grade the respondents. Good and fair scores were combined to make a pass score and poor became a failure.

Table 5: Modified Bloom Cut-off point

Modified Bloom Cut-off	
Good	80-100%
Fair	60-79%
Poor	Less than 60%

Good and fair scores were combined to make a pass while poor constituted a fail.

Figure 10 below shows the overall score on knowledge pre and post-training. In the pre-training period, the majority of the respondents failed, 58% while the rest passed and this reduced to 52% post-training. The percentage of those who passed before training was 42% and rose to 48% post training.

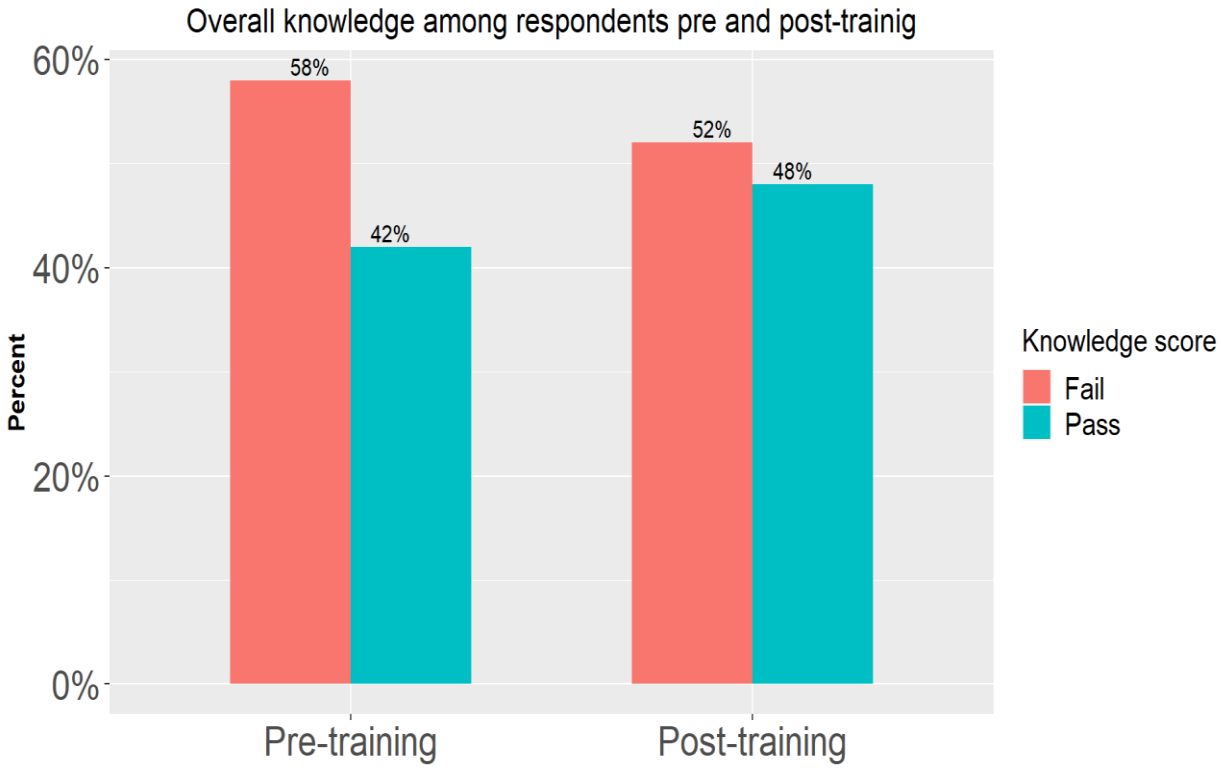


Figure 13: Overall knowledge score among respondents

Impact of training on knowledge of assessment of HIE among healthcare workers

To determine whether the training had an impact on the healthcare workers' knowledge of assessment and management of HIE, we used a Wilcoxon signed rank test to compare performance between the pre-and post-training period.

Wilcoxon signed-rank test

There was a significant difference between the pre-training and post-training medians on knowledge score at 5% significance level, p-value <0.001

Table 6: Wilcoxon signed-rank test

Period	Median knowledge score	V-statistic	p-value
Pre-training	53.3	2582	<0.001
Post-training	58.3		

Factors associated with knowledge level among healthcare workers

Bivariate analysis

Bivariate analysis was conducted using crude odds ratios and p-values at 5% significance level. Training on assessment of HIE was significantly associated with knowledge, p-value 0.02. The healthcare workers who had not been trained were 77% less likely to get a pass score compared to those who had been trained, crude OR 0.23 (95% CI, 0.09, 0.59). The confidence interval does not include 1 hence previous training was significantly associated with knowledge score on assessment, diagnosis and management of HIE.

Table 7: Factors associated with knowledge score

Predictor	**Detail**	**Pre-intervention Performance N = 85**			
Level of experience		Fail (**ref**) N = 49	Passed N = 36	Crude OR (95% CI)	P-value
	Under 2 years	10 (50%)	10 (50%)	**Reference**	
	2-5 years	18 (51.4%)	17 (48.6%)	0.94 (0.31, 2.83)	0.92
	Over 5 years	21 (70%)	9 (30%)	0.43 (0.13, 1.39)	0.15
Cadre	Consultant	1 (50%)	1 (50%)	**Reference**	
	Medical officer	0 (0%)	4 (100%)	NA	

	Nurses	45 (65.2%)	24 (34.8%)	0.53 (0.32, 8.91)	1.00
	Registrar	3 (30%)	7 (70%)	2.33 (0.11, 51.0)	1.00
Past training on assessment of HIE	Yes	11 (52.4%)	20 (47.6%)	**Reference**	
	No	38 (70.3%)	16 (29.7)	0.23 (0.09, 0.59)	0.02

The years of experience were not associated with knowledge. Our analysis shows that knowledge on assessment and management of HIE reduced with years of experience. Healthcare workers who had 2-5 years of experience were 6% less likely to pass compared to those who had less than 2 years of experience, crude OR 0.94 (0.31, 2.83). Those who had above 5 years of experience were 57% less likely to pass compared to those who had under 2 years of experience, crude OR 0.43 (0.13, 1.39).

CHAPTER 5: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 DISCUSSION

Quasi-experimental studies similar to this study (effect of training heath care workers on their knowledge of assessment of HIE) that delve into the post resuscitation care of newly born babies were scarcely found. However, closely related studies that focused on neonatal resuscitation largely demonstrated that training interventions are very effective for targeted outcomes.

This study showed an overall improvement in median knowledge scores after training in the assessment and management of HIE; Wilcoxon signed rank test, p-value <0.001. This finding is comparative to an interventional study in Ghana that showed significant improvement in the post test scores health professionals (nurse anaesthetists nurses, physicians, and midwives) after a training module on neonatal resuscitation ($p<0.001$).[39] Another study in favour of training and it effect is by Taksande et al in India who showed significant improvement in the mean post knowledge scores ($p<0001$; 95% CI -10.92 to -0.37) after a neonatal resuscitation training conducted among undergraduate, post graduate and qualified nurses.[40]

Despite training, knowledge may remain unchanged as demonstrated by Hildegarde's study conducted among maternity staff in a tertiary hospital in Cameroon .[41] One factor that may have contributed to the differences in findings was the level of training. Our study, the Ghanaian study and Taksande's had health cadres of higher training compared to Hildegarde's which only involved nurses and paramedical staff with minimal training.[39,40,41]

The effect of training often goes beyond knowledge improvement as demonstrated by a study in Tanzania that showed significant improvement in the skills (alongside

knowledge) of health workers on neonatal resuscitation as well as a drastic reduction in neonatal mortality in the immediate post-training.[33] Other studies in agreement with this study are; Rule et al. who by implementing a neonatal resuscitation training at Tenwek hospital in rural Kenya was able to significantly reduce the incidence of HIE by half, six months after the training.[35] The other study conducted at Pumwani Maternity Hospital concluded that even a one-day training on resuscitation had a significant impact on healthcare workers' short-term practices.[34]

Despite a significant improvement in the overall score post training, further analysis of individual questions in our study showed that only four areas were statistically significant. These areas were; definition of neonatal encephalopathy, appropriate management for a baby who suffered birth asphyxia but was resuscitated successfully within 15 minutes, awareness of grading systems used in hypoxic-ischemic encephalopathy and performance in the clinical scenario that tested the appropriate grade , p-values <0.001.The performance in the rest of the questions was not significantly improved after the training. . Outstanding areas that did not have significant effect post training included clinical and laboratory components of asphyxia, parameters considered for TH in HIE and supportive measures for HIE during TH, awareness of neuroprotective strategies and timing beyond which cooling is not indicated. Possible reasons include; the training time (15 minutes) may have not been enough for all the participants (who were of different cadres) to fully grasp the context of the training, majority of the participants were nurses and may not be too familiar with other aspects of management which largely done by the doctors and prior good knowledge in some questions.

We also assessed factors associated with the knowledge of healthcare workers on the assessment and management of HIE. Prior training of participants on assessment and management of HIE

was significantly associated with their knowledge scores, crude OR 0.23 (0.09, 0.59), p-value 0.02. This data supports the studies cited above.[33, ,34,35]

The level/years of experience in the unit was not associated with the knowledge level of assessment and management of HIE; experience of 2-5 years OR 0.94 (0.31, 2.83), p-value 0.92, more than 5 years OR 0.43 (0.13, 1.39), p-value 0.15 compared to those with experience of fewer than 2 years. A search of the literature found comparable results in a study (albeit slightly different study) by P. Ezedunka which showed that years of experience had no significant relationship with level of knowledge of nurses in the management of birth asphyxia.[32]

The health workers' cadre was also not associated with knowledge of the assessment and management of HIE. Nurses OR 0.53 (0.32, 8.91), paediatric registrars OR 2.33 (0.11, 51.0) compared to consultants. This is in contrast to P. Ezedunka's study which revealed that cadre did have a significance in the knowledge score. Possible reasons for this difference could be the lack of further stratification in our study of the different cadres (medical officers, registrars, nurses, and consultants) to identify those with additional/advanced neonatal certificates or diplomas. Furthermore, some of the HCWs in our study may have been new in the department due to the periodic rotations that occur in the hospital and therefore still be unfamiliar with the assessment and management of HIE despite their different cadre.

5.2 Conclusion

In conclusion, there was a statistically significant improvement in the knowledge of assessment and management of HIE overall. However, on the individual questions, some improved significantly while some did not. Previous training was statistically associated with knowledge of assessment and management of HIE. The level of experience and employee cadre were not associated with knowledge of assessment and management of HIE.

5.3 Recommendations

From the findings of this study, we recommend continuous training of healthcare workers to improve their knowledge and performance especially in the areas found deficient such as the diagnosis of neonatal asphyxia and supportive therapy during therapeutic hypothermia.

.

5.4 Study strengths and weaknesses

Study strengths

This study was able to maintain the same characteristics of the participants before and after training which is necessary for a before and after study.

The quasi-experiment method used by this study is powerful in showing the effect of an intervention at a low cost.

Study Weaknesses

The non-probabilistic sampling method used in this study does not allow generalization to the entire population.

REFERENCES

1. Executive summary: Neonatal encephalopathy and neurologic outcome, second edition. Report of the American College of Obstetricians and Gynecologists' Task Force on Neonatal Encephalopathy. *Obstet Gynecol*. 2014;123(4):896-901. doi:10.1097/01.AOG.0000445580.65983.D2

2. Aslam S, Strickland T, Molloy EJ. Neonatal Encephalopathy: Need for Recognition of Multiple Etiologies for Optimal Management. *Front Pediatr*. 2019;7(MAR). doi:10.3389/FPED.2019.00142

3. Mrelashvili A, Russ JB, Ferriero DM, Wusthoff CJ. The Sarnat Score for Neonatal Encephalopathy: Looking Back and Moving Forward. *Pediatr Res*. 2020;88(6):824. doi:10.1038/S41390-020-01143-5

4. Thompson CM, Puterman AS, Linley LL, et al. The value of a scoring system for hypoxic ischaemic encephalopathy in predicting neurodevelopmental outcome. *Acta Paediatr*. 1997;86(7):757-761. doi:10.1111/J.1651-2227.1997.TB08581.X

5. Jacobs SE, Berg M, Hunt R, Tarnow-Mordi WO, Inder TE, Davis PG. Cooling for newborns with hypoxic ischaemic encephalopathy. *Cochrane database Syst Rev*. 2013;2013(1). doi:10.1002/14651858.CD003311.PUB3

6. Wassink G, Davidson JO, Lear CA, et al. A working model for hypothermic neuroprotection. *J Physiol*. 2018;596(23):5641. doi:10.1113/JP274928

7. Flanagan E, Walsh C, Tubridy N. 'Neurophobia'--attitudes of medical students and doctors in Ireland to neurological teaching. *Eur J Neurol*. 2007;14(10):1109-1112. doi:10.1111/J.1468-1331.2007.01911.X

8. Padayachee N, Ballot DE. Outcomes of neonates with perinatal asphyxia at a tertiary academic hospital in Johannesburg, South Africa. *SAJCH South African J Child Heal*. 2013;7(3):89-94. doi:10.7196/SAJCH.574

9. Grading of perinatal asphyxia by clinical parameters and agreement between this grading and Sarnat & Sarnat stages without measures - PubMed. Accessed May 28, 2022. https://pubmed.ncbi.nlm.nih.gov/24292315/

10. Arnaez J, García-Alix A, Arca G, et al. Population-Based Study of the National Implementation of Therapeutic Hypothermia in Infants with Hypoxic-Ischemic Encephalopathy. *Ther Hypothermia Temp Manag*. 2018;8(1):24-29. doi:10.1089/THER.2017.0024

11. Joolay Y, Harrison MC, Horn AR. Therapeutic hypothermia and hypoxic ischemic encephalopathy: opinion and practice of pediatricians in South Africa. *J Perinat Med*. 2012;40(4):447-453. doi:10.1515/JPM-2011-0292

12. Patel A, Khatib MN, Kurhe K, Bhargava S, Bang A. Impact of neonatal resuscitation trainings on neonatal and perinatal mortality: a systematic review and meta-analysis. *BMJ Paediatr Open*. 2017;1(1):e000183. doi:10.1136/BMJPO-2017-000183

13. Msemo G, Massawe A, Mmbando D, et al. Newborn mortality and fresh stillbirth rates in Tanzania after helping babies breathe training. *Pediatrics*. 2013;131(2). doi:10.1542/PEDS.2012-1795

14. Coetzee M. Hypoxic-ischaemic encephalopathy: Identifying newborns who will benefit from therapeutic hypothermia in developing countries. *SAJCH South African J Child Heal*. 2018;12(4):175-180.

doi:10.7196/SAJCH.2018.V12I4.1539

15. Syed W, Liaqat N, Qazi Q, Yasmeen S. Relationship between immediate postpartum umbilical cord pH, fetal distress and neonatal outcome. *Pakistan J Med Sci*. 2020;36(7):1529-1532. doi:10.12669/PJMS.36.7.2536

16. Allen KA, Brandon DH. Hypoxic Ischemic Encephalopathy: Pathophysiology and Experimental Treatments. *Newborn Infant Nurs Rev*. 2011;11(3):125. doi:10.1053/J.NAINR.2011.07.004

17. Health MOF. National Newborn Guidelines For Hospitals July 2018. 2018;(July).

18. Newborn Assessment - APGAR Score Assessment of newborn ... | GrepMed. Accessed May 28, 2022. https://www.grepmed.com/images/3423/apgar-diagnosis-assessment-peds-score

19. Magai DN, Koot HM, Mwangi P, Chongwo E, Newton CR, Abubakar A. Long-term neurocognitive and educational outcomes of neonatal insults in Kilifi, Kenya. *BMC Psychiatry*. 2020;20(1):1-12. doi:10.1186/S12888-020-02939-9/TABLES/5

20. Dalili H, Nili F, Sheikh M, Hardani AK, Shariat M, Nayeri F. Comparison of the Four Proposed Apgar Scoring Systems in the Assessment of Birth Asphyxia and Adverse Early Neurologic Outcomes. *PLoS One*. 2015;10(3). doi:10.1371/JOURNAL.PONE.0122116

21. Mendler MR, Mendler I, Hassan MA, Mayer B, Bode H, Hummler HD. Predictive Value of Thompson-Score for Long-Term Neurological and Cognitive Outcome in Term Newborns with Perinatal Asphyxia and Hypoxic-

Ischemic Encephalopathy Undergoing Controlled Hypothermia Treatment. *Neonatology*. 2018;114(4):341-347. doi:10.1159/000490721

22. Thompson Score for Hypoxic Ischaemic Encephalopathy (HIE) Calculator. Accessed May 28, 2022. https://www.mdapp.co/thompson-score-for-hypoxic-ischaemic-encephalopathy-hie-calculator-410/

23. Saraswat DD, Aradhya G, R. C, Guruprasad G. Therapeutic hypothermia in asphyxiated neonates, using phase change material (Mira Cradle): experience from neonatal intensive care unit of tertiary care centre South India. *Pediatr Rev Int J Pediatr Res*. 2019;6(12):606-612. doi:10.17511/IJPR.2019.I12.04

24. Saw CL, Rakshasbhuvankar A, Rao S, Bulsara M, Patole S. Current Practice of Therapeutic Hypothermia for Mild Hypoxic Ischemic Encephalopathy. *J Child Neurol*. 2019;34(7):402-409. doi:10.1177/0883073819828625

25. MiraCradle® - Neonate Cooler. Accessed May 28, 2022. https://www.miracradle.com/product.html

26. MiraCradle | Engineering For Change. Accessed May 28, 2022. https://www.engineeringforchange.org/solutions/product/miracradle/

27. knowledge | meaning in the Cambridge Learner's Dictionary. Accessed May 28, 2022. https://dictionary.cambridge.org/dictionary/learner-english/knowledge

28. Types of Knowledge - Library & Information Science Network. Accessed May 28, 2022. https://www.lisedunetwork.com/types-of-knowledge/

29. Hunt DP. The concept of knowledge and how to measure it. doi:10.1108/14691930310455414

30. Ramani S, Leinster S. AMEE Guide no. 34: Teaching in the clinical environment. doi:10.1080/01421590802061613

31. Assessment of knowledge on neonatal resuscitation amongst health care providers in Kenya - PubMed. Accessed May 28, 2022. https://pubmed.ncbi.nlm.nih.gov/22655112/

32. P.O. E, E.C. N, E.T. O. Assessment of knowledge, attitude, and practice of nursing management of birth asphyxia in federal medical centre Asaba, Delta State-Nigeria. *Clin Nurs Stud*. 2016;4(2). doi:10.5430/CNS.V4N2P21

33. Perlman J, Msemo G, Ersdal H, Ringia P. Designing and Implementing the Helping Babies Breathe Program in Tanzania. *J Pediatr intensive care*. 2017;6(1):028-038. doi:10.1055/S-0036-1584674

34. Opiyo N, Were F, Govedi F, Fegan G, Wasunna A, English M. Effect of Newborn Resuscitation Training on Health Worker Practices in Pumwani Hospital, Kenya. *PLoS One*. 2008;3(2). doi:10.1371/JOURNAL.PONE.0001599

35. Rule ARL, Maina E, Cheruiyot D, Mueri P, Simmons JM, Kamath-Rayne BD. Using quality improvement to decrease birth asphyxia rates after "Helping Babies Breathe" training in Kenya. *Acta Paediatr*. 2017;106(10):1666-1673. doi:10.1111/APA.13940

36. History - KENYATTA NATIONAL HOSPITAL. Accessed May 28, 2022. https://knh.or.ke/index.php/history/

37. Fincham JE. Response Rates and Responsiveness for Surveys, Standards, and the Journal. *Am J Pharm Educ*. 2008;72(2):43. doi:10.5688/AJ720243

39. History - KENYATTA NATIONAL HOSPITAL. Accessed May 28, 2022. https://knh.or.ke/index.php/history/

40. Kenyatta National Hospital Map - Kenya - Mapcarta. Accessed May 28, 2022. https://mapcarta.com/29301244

41. Coagulopathy and Thrombocytopenia in Asphyxiated Neonates Undergoing Therapeutic Hypothermia in Kenyatta National Hospital New Born Unit | Enhanced Reader.

Appendix I: Consent form

Study title: The Impact of Training Health Care Workers on the Assessment of Neonatal Hypoxic-Ischemic Encephalopathy at The Kenyatta National Hospital

Principal investigator

Dr. Esther Tabalya

Paediatric registrar

The University of Nairobi, Department of Paediatrics and Child Health.

Mobile Phone no: 0723362774

Introduction

Hypoxic-ischemic encephalopathy (HIE) is one of the leading causes of neonatal encephalopathy and has many complications such as cerebral palsy, learning disabilities, epilepsy, and hearing impairment among others. A proper and timely assessment using tools such as the modified Sanart and Sarnat score or the Thompson score by the healthcare team is therefore important for quicker intervention (Therapeutic cooling and supportive management) to reduce complications associated with hypoxic injury to the brain.

Purpose of the study

The main objective of this study is to assess the effect of training of health workers on the assessment of hypoxic-ischemic encephalopathy. This study aims to improve the assessment of hypoxic-ischemic encephalopathy for quicker interventions.

Study procedure

Once you agree to participate in my study, I will ask you some questions using a pre-developed questionnaire. The study will be conducted in three phases; the pre-training phase which will entail data collection before training.

Training phase: the health care team will be trained on the assessment of hypoxic-ischemic encephalopathy.

Post-training phase: data collection after the training.

Role of the participant

Your role in participating in this study is mainly to provide information and participate in the training.

Benefits

The study will provide knowledge and skills to HCWs in the assessment of the newborn with neonatal encephalopathy hence improving the diagnosis of HIE and early appropriate treatment for reduction in morbidity and mortality in the study facility. There will be no financial benefits.

Risks

No experimental drugs will be employed in this study. The training methods provided for newborn assessment for neonatal encephalopathy will be non-invasive.

Confidentiality

Your name will not feature anywhere in this study. The data will be used solely for this study and will not be shared with any party.

Voluntary Participation/Participants' rights and roles

Your participation in the study is voluntary and you are free to withdraw from the study even after recruitment without any consequences

In case of any questions:

If you have any questions regarding the study, feel free to contact me Dr. Esther Tabalya on my Mobile Phone no: 0723362774.

KNH-UoNERC Secretary

Contact telephone numbers: 2726300 ext 44102,

Email: uonknh_erc@uonbi.ac.ke

PART II: Certificate of Consent

I have read the information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate in this research.

Signature: _____Date:__Day/month/year

Statement by the person taking consent:

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands the purpose of the study.

I confirm that the participant was allowed to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Name of person taking the consent:_____

Signature of person taking the consent:_____

Date:_

Dr. Esther Tabalya

Signature……. Date…….

Appendix II: Questionnaire

Serial No……

Section A. Demographic Data

Encircle one answer and specify where indicated.

1. Age in years……
2. Gender

Sex a) Male b) Female

3. Years of Service in the Unit
    a. Less than 6 months
    b. Under 2 years
    c. 2-5 years
    d. Over 5 years
4. What is your formal training?

    a. Nurse **b**. Paediatric Registrar **c**. Consultant

Section B: **Health care worker knowledge**

5. Have you been trained in the neurological assessment of HIE?

    a) Yes b) No

6. How much time has passed since you were trained in question 6 above?

    a.) less than 1-year **b.)** 1 year and above **c.)** NA

7. How many times have you performed neurological assessment in babies with birth asphyxia in the past 3 months?

    a. Less than 5 times
    b. 5-10 times

c. more than 10 times

d. Never

8. Define Neonatal encephalopathy?

    a. An infant born at 34 weeks with altered consciousness poor breathing, convulsions and altered tone.

    b. an infant born at 32 weeks with altered consciousness poor breathing, convulsions and altered tone.

    c. an infant born at 35 weeks with an altered level of consciousness poor breathing and convulsions

    d. An infant born at 33 weeks with an altered level of consciousness and difficulty breathing and altered muscle tone

9. Select **all** the clinical components that help define birth asphyxia

    a. Inability to breathe within 1 min of birth

    b. Arterial PH of less than 7.35

    c. Arterial PH of less than 7

    d. need for resuscitation beyond 10 min from birth

    e. APGAR score of 3 at 5 min

    f. APGAR score of 3 at 10 min

10. What would be the **most** appropriate management for a baby who suffered birth asphyxia but was resuscitated successfully within 15 minutes?

    a. Keep warm.

    b. Monitor in Nursery/postnatal Unit.

    c. Neurological assessment

11. Are you aware of any neuroprotective treatment offered for birth asphyxia at KNH?

    a. Yes

b. No

12. Mention any neuroprotective strategy you know……..

13. What is the most appropriate time beyond which treatment cannot be offered?

a. 1 hr

b. 6 hrs.

c. 3 hrs.

d. 15 hrs.

14. Are you aware of the Newborn guidelines of 2018?

a. Yes

b. No

15. If yes, how often do you use it?

a. Very frequently

b. Sometimes

c. Infrequently

d. Never

16. Which grade of neonatal encephalopathy qualifies for cooling according to the Kenyan neonatal guidelines? Select the most appropriate

a. Mild encephalopathy

b. Moderate encephalopathy

c. Severe encephalopathy

17. Indicate whether true or false for the common grading scores systems used in Hypoxic ischemic encephalopathy

a. Thompson score

b. Sarnat and Sarnat score

c. Silverman Anderson score

d. Ballard's score

18. Mention any neurological scoring tool you know and list its components…….

……

……

19. **Select true or false for HIE parameters used to qualifying for cooling.**

a. 34weeks
b. 1-hour Arterial PH <7.0
c. Convulsions
d. Severe malformations
e. Inborn errors of metabolism
f. Need for ventilation for >10min
g. APGAR of 5 at 10 min**.**

20.Supportive management during cooling includes:

a. Trophic feeds on Day 2.
b. Trophic feeds from after the duration of Therapeutic cooling
c. Restrict fluids to 40ml/kg for all babies.
d. Prophylactic phenobarbital

21.How confident are you using the Sanart and Sanart scoring system?

a. Very confident
b. Fairly confident
c. Confident

d. Not confident

22.How confident are you using the Thompson scoring system?

a. Very confident
b. Fairly confident
c. Confident
d. Not confident

You are working in the admission room and receive a term baby born via emergency CS 45 min ago due to foetal distress and cord around the neck. His APGAR score was 3 at 1 min,4 at 5 minutes and 5 at 10 minutes and was resuscitated for 15minute. He has been referred for further management.

On examination- Baby is lethargic, hypotonic, has tense fontanelle and has cycling movements with a weak suck reflex. He respiratory rate of 30 and a heart rate of 80 per mi. You do a BGA and PH is 7 BE -16. Evaluate the baby.

23.What is the diagnosis?

24.Score/grade-

25.Treatment prescribed-

Appendix IV: Time Frame

Activity	Dec. 2021-Jan. 2022		Feb-July 2022	August 2022	September 2022	October 2022	November 2022
Proposal Development							
Ethical review							
Data collection							
Data analysis							
Final write-up of results							
Presentation of results							

Appendix V: Study Budget

Category	Remarks	Units	Unit cost Ksh	Total
Proposal development				
	Proposal draft	1000	10	10000
	Proposal copies	10	600	6000
	KNH/UON ERC	1	2000	2000
	Security cabinet	1	5000	5000
	Airtime			2000
Data collection	Training research assistants	1 day	300	3000
	Research assistants	4 weeks	2500	10,000
Data analysis	Research statistician	1		30000
Thesis write up	Printing Drafts	1000	10 copies	10000
	Printing thesis	10 copies	600	6000
Contingency				30000
Total				194000

Appendix VI: Training content

Modified Sarnat and Sarnat Scoring System (adapted from National Newborn Guidelines 2018[17])

Category	**Moderate encephalopathy (Stage 2)**	**Severe encephalopathy (Stage 3)**
Level of consciousness	Lethargic	Stupor or coma
Spontaneous activity	Decreased	Absent
Posture	Distal flexion/complete extension	Decerebrate
Tone	Hypotonia focal or general	Flaccid
Neonatal reflexes		
Suck	Weak	Absent
Moro	Incomplete	Complete
Autonomic system Pupils Heart Respiration	 Constricted but reactive Bradycardia Periodic breathing	 Dilated or non-reactive Variable Apnoea requires IPPV

Thompson score (Adapted from *Thompson Score for Hypoxic Ischaemic Encephalopathy*).[22]

Sign	0	1	2	3
Tone	Normal	Hypertonia	Hyportonia	Flaccid
Consciousness	Normal	Hyperalert , stare	Lethargic	Comatosed
Fits	Normal	infrequent < 3day	frequent > 2/day	
Posture	Normal	Fisting / cycling	Strong, distal flexion	Decerebrate
Moro	Normal	Partial	Absent	
Grasp	Normal	Poor	Absent	
Suck	Normal	Poor	Absent± bites	
Respiration	Normal	Hyperventilation	Brief apnea	(Apnoea)
Fontanelle	Normal	Full not tense	Tense	

Appendix VII: Study approval

UNIVERSITY OF NAIROBI
FACULTY OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/266

8th July, 2022

APPROVED
08 JUL 2022

Dr. Esther Tabalya
Reg. No. H58/34200/2019
Dept. of Paediatrics and Child Health
Faculty of Health Sciences
University of Nairobi

Dear Dr. Tabalya,

RESEARCH PROPOSAL: THE IMPACT OF TRAINING HEALTH CARE WORKERS ON THE KNOWLEDGE OF ASSESSMENT OF NEONATAL HYPOXIC-ISCHEMIC ENCEPHALOPATHY AT THE KENYATTA NATIONAL HOSPITAL (P119/02/2022)

This is to inform you that KNH-UoN ERC has reviewed and approved your above research proposal. Your application approval number is **P119/02/2022.** The approval period is 8th July 2022 – 7th July 2023.

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by KNH-UoN ERC.
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to KNH-UoN ERC 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH-UoN ERC within 72 hours.
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to KNH-UoN ERC.

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

Yours sincerely,

PROF. M.L CHINDIA
SECRETARY, KNH- UoN ERC

c.c. The Dean-Faculty of Health Sciences, UoN
The Senior Director, CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information, KNH
The Chair, Dept. of Obstetrics and Gynaecology, UoN
Supervisors: Dr. Alfred Osoti, Dept.of Obstetrics and Gynaecology, UoN
Dr. Francis Odawa, Dept.of Obstetrics and Gynaecology, UoN