"IMPACT OF HYPOTHERMIA ALERT DEVICE(BEMPU) AND WRAP (KANGA SLING) ON PARENT COMPLIANCE TO KANGAROO CARE IN LOW BIRTH WEIGHT BABIES BETWEEN 1.5-2.5KG COMPARED TO THE CONVENTIONAL KANGAROO MOTHER CARE.A ONE YEAR HOSPITAL BASED THREE ARM RANDOMISED CONTROL TRIAL"

BY

REGISTER NUMBER: BM0121004

Dissertation

Submitted to

KAHER, Belagavi, Karnataka

In partial fulfilment

of the requirements for the degree of

M.D.

IN

PAEDIATRICS

J. N. MEDICAL COLLEGE,
BELAGAVI - 590010. KARNATAKA

DEC – 2024/JAN – 2025

ENDORSEMENT

KLE Academy of Higher Education and Research
Belagavi, Karnataka

Endorsement

This is to certify that the dissertation entitled **"Impact of hypothermia alert device (BEMPU) and wrap (KANGA sling) on parent compliance to Kangaroo care in low birth weight babies between 1.5-2.5kg compared to conventional Kangaroo mother care. A one year hospital based three arm randomized control trial"** is a bonafide research work done by **Reg No. Bm0121004.**

DR DNYANESH D K M.D., L.L.B
Professor & Head
Department of Pediatrics
J N Medical College
KAHER
Belagavi, Karnataka

Professor & Head
Department of Pediatrics
KLE University's
J.N. Medical College, Belagavi

Date: 01/07/2024
Place: JNM, Belagavi

DR N S MAHANTASHETTI M.D.
Principal
J N Medical College
KAHER
Belagavi, Karnataka

PRINCIPAL
JAWAHARLAL NEHRU MEDICAL COLLEGE
BELAGAVI

Date: 01/07/2024
Place: JNMC, Belagavi

UNDERTAKING

I, **REG NO.: BM0121004**, hereby declare that the information and data mentioned in my dissertation entitled "**Impact of hypothermia alert device (BEMPU) and wrap (KANGA sling) on parent compliance to Kangaroo care in low birth weight babies between 1.5-2.5kg compared to conventional Kangaroo mother care.A one year hospital based three arm randomized control trial"** belongs to me and is original. I am aware of the definition of plagiarism as detailed below:

- An act or instance of using or closely imitating the language and thoughts of another author without authorization and the representation of that author's work as one's own, as by not crediting the original author.
- A piece of writing or other work reflecting such unauthorized use or imitation.
- The deliberate or reckless representation of another's words, thoughts or ideas as one's own without attribution in connection with submission of academic work whether graded or otherwise.

I hereby declare that the dissertation prepared by me is original one and does not involve plagiarism anywhere. In case at a later stage, it is found that I have indulged in plagiarism, then I am solely responsible for the same and the institution is at liberty to take any disciplinary action against me including cancellation of dissertation or any other penalties imposed by the University.

Date: 01/07/2024 

Place: JNMC, Belagavi **REG NO.: BM0121004**

ANTI-PLAGIRISM CHECK ACCEPTANCE LETTER

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

JAWAHARLAL NEHRU MEDICAL COLLEGE

(A constituent unit of KLE Academy of Higher Education & Research Deemed-to-be-University)

(Recognized by National Medical Commission, New Delhi)

Accredited 'A+' Grade by NAAC (3rd Cycle) **Placed in Category 'A' by MoE (GoI)**

Nehru Nagar, Belagavi- 590 010, Karnataka, INDIA

0831 – 2471350 0831 – 2470759 www.jnmc.edu principal@jnmc.edu

Ref No: MDC/PG/ Date: 01-07-2024

"ACCEPTANCE LETTER"

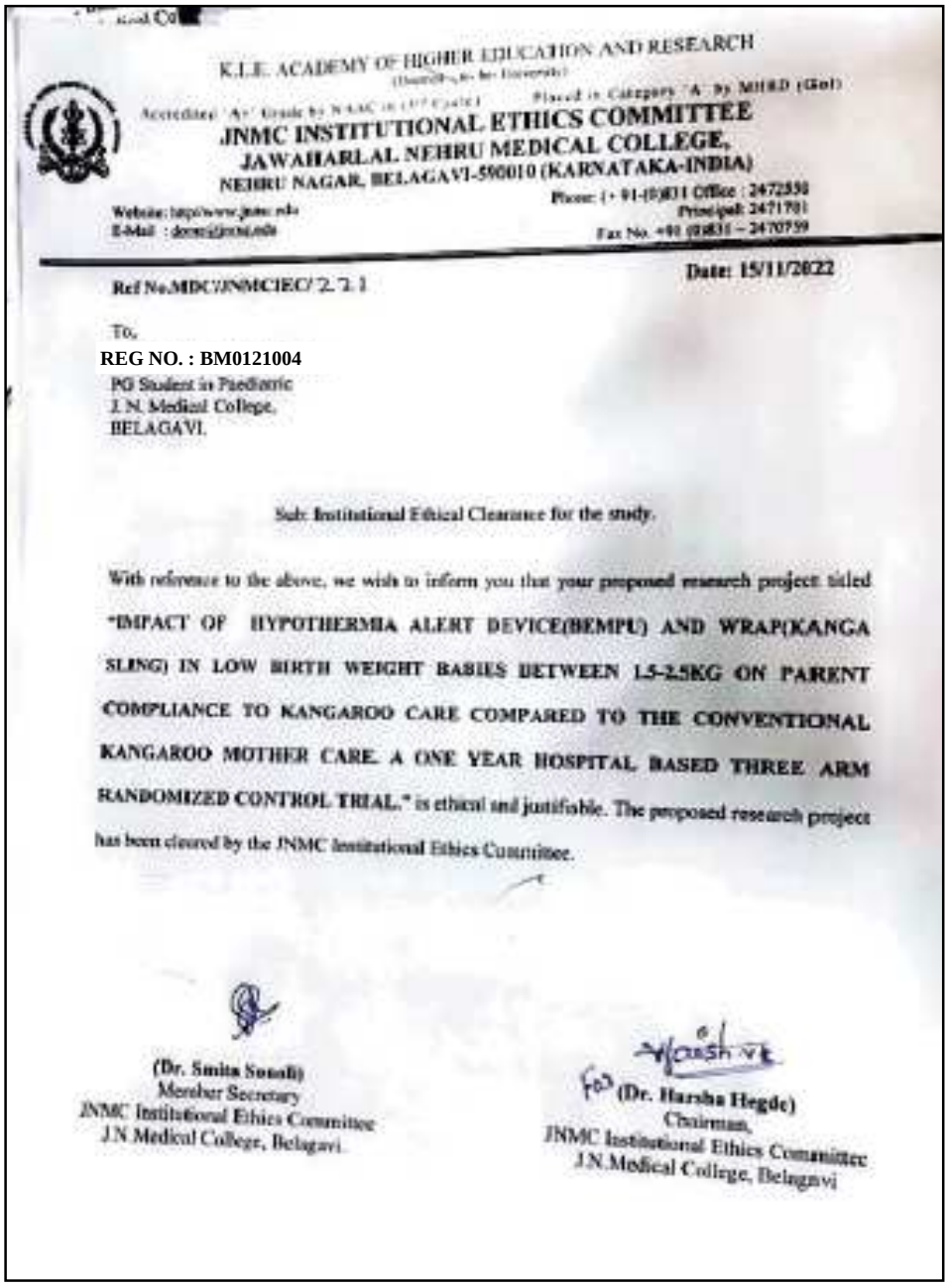
The softcopy of thesis entitled: **"IMPACT OF HYPOTHERMIA ALERT DEVICE(BEMPU) AND WRAP (KANGA SLING) ON PARENT COMPLIANCE TO KANGAROO CARE IN LOW BIRTH WEIGHT BABIES BETWEEN 1.5-2.5KG COMPARED TO THE CONVENTIONAL KANGAROO MOTHER CARE.A ONE YEAR HOSPITAL BASED THREE ARM RANDOMISED CONTROL TRIAL"** has been submitted for anti-plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of **08%** which is within the acceptable limits of **10%** as per the guidelines given by UGC.

Guide.

Dr. (Mrs.) N.S. Mahantashetti.
Chairperson-Antiplagiarism Committee &
Principal,
J. N. Medical College, Belagavi.

To,
Reg. No. BM0121004
Postgraduate Student,
2021-22 Batch,
Department of Paediatrics
J. N. Medical College, Belagavi.

ETHICAL CLEARANCE



K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH

Placed in Category 'A' by MHRD (GoI)

JNMC INSTITUTIONAL ETHICS COMMITTEE
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)

Phone: (+91-0831) Office : 2472550
Principal: 2471701
Fax No. +91 (0831) – 2470759

Ref No.MDC/JNMCIEC/ 2.2.1

Date: 15/11/2022

To,

REG NO. : BM0121004

PG Student in Paediatric
J.N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"IMPACT OF HYPOTHERMIA ALERT DEVICE(BEMPU) AND WRAP(KANGA SLING) IN LOW BIRTH WEIGHT BABIES BETWEEN 1.5-2.5KG ON PARENT COMPLIANCE TO KANGAROO CARE COMPARED TO THE CONVENTIONAL KANGAROO MOTHER CARE. A ONE YEAR HOSPITAL BASED THREE ARM RANDOMIZED CONTROL TRIAL."** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

(Dr. Smita Sonali)
Member Secretary
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi.

(Dr. Harsha Hegde)
Chairman,
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi

LIST OF ABBREVIATIONS

KMC	-	Kangaroo Mother care
RDS	-	Respiratory distress syndrome
ROP	-	Retinipathy of prematurity
BPD	-	Bronchopulmonary dysplasia
WHO	-	World Health Organization
LBW	-	Low Birth Weight
VLBW	-	Very Low Birth Weight
ELBW	-	Extremely Low birth weight
SGA	-	Small for Gestational Age
LSCS	-	Lower segment caesarian section
NVD	-	Normal Vaginal Delivery

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background and objectives:

WHO strongly recommends KMC as a part of routine care of newborn in order to improve preterm birth outcomes. Ideally KMC should be practiced for 24 hours but due to lack of compliance it is practiced for 2-10 hours a day. The utilization of traditional cloth wrap has certain disadvantages that impede the appropriate adherence to KMC. The KANGA SLING is sturdy, hand free, comfortable sling that can help better compliance to kangaroo care. BEMPU is a device that can pick up hypothermia early and can alert the mother to provide KMC hence can improve the compliance. This study assesses the parent compliance to kangaroo mother care(KMC) with KANGA sling and BEMPU device in low birth weight babies between 1.5-2.5kg compared to the conventional kangaroo mother care.

Materials and methods

This is a three arm randomised control trial conducted in the neonatal intensive care unit and KMC ward under the KLEH DR. Prabhakar Kore Charitable Hospital We included 90 newborns in our study between 1.5-2.5kg birth weight who fulfilled the inclusion criteria. 90 newborns in the study were divided into three groups: Group A, which used both the KANGA sling and BEMPU device; Group B, which used only the BEMPU device with conventional cloth wrap; and Group C, which used only conventional cloth wrap. Data regarding gender, gestational age, birth weight, mode of delivery, maternal problems and neonatal problems at birth and during the hospital stay was recorded into a structured proforma. Number of hours of KMC per day was assessed along with anthropometry parameters and compliance to breastfeeding until discharge and on follow up until 40weeks gestation or 2.5kg

weight whichever happened later.

Results

Neonatal factors such as gender, gestational age, birth weight, mode of delivery along with newborn problems at birth and maternal factors such as maternal age, socioeconomic status, parity and maternal problems were comparable across the study arms and did not play a role in the results of the study. Mothers in the group A practiced KMC for statistically significant longer duration when compared to the mothers in group B and group C both during the hospital stay and at home($p<0.001$) Duration of KMC practiced per day was reduced at home when compared to the hospital stay. Newborns in group A had statistically significant($p<0.001$) better weight gain and increase in length compared to newborns belonging to group B and group C. Time taken to reach to full breastfeeds was shorter among newborns belonging to group A compared to group B and was longest among newborns in group C though not statistically significant. BEMPU alarms were found to be significantly lesser in group A that practiced KMC for longer duration compared to newborns in group B($p<0.001$)

Conclusion

Our study showed that the use of KANGA sling along with BEMPU device promoted better compliance to KMC, better growth and better breastfeeding of the newborn when compared to use of conventional wrap with or without BEMPU device.

Keywords: LOW BIRTH WEIGHT, KANGAROO MOTHER CARE, KANGA SLING, BEMPU DEVICE

INTRODUCTION

The World Health Organization (WHO) defines low birth weight (LBW) as a birth weight of less than 2,500 grams, which can result from being born prematurely or being smaller than expected for the gestational age, or both[1]. Preterm refers to being born prior to completing 37 weeks of gestation, whereas SGA refers to having a weight for gestation that falls below the 10th percentile of the gestation norm.[2]

Out of the total of 20 million infants born with low birth weight worldwide annually, around 8 million of them are born in India. According to the Lawn Every Newborn Lancet Series 2014, more than 80% of deaths among newborns happen to small infants.[3] Out of these deaths, 65% are caused by preterm infants and 19% are caused by infants who are SGA. India has the highest prevalence of premature births and also has the largest number of newborn fatalities caused by prematurity. The prevalence of low birth weight in India is approximately 27% of the total number of live births.[3]

Preterm birth, which refers to births that occur before 37 weeks of gestation, is a significant contributor to the mortality of children under the age of five globally. It is responsible for around 18% of all global deaths.[4] The World Health Organization highly advises the use of Kangaroo mother care (KMC) as a standard practice in health-care facilities for newborns who are clinically stable, in order to enhance preterm birth outcomes.[5] KMC, as defined by the WHO, refers to the practice of providing care to preterm children by having them in direct contact with their mother's skin. The primary components of this approach involve initiating and maintaining direct and uninterrupted contact between the mother and the infant, known as skin-to-skin contact, as well as exclusively breastfeeding or providing breastmilk as the preferred method of feeding[5]. This innate kind of human care helps

regulate body temperature, facilitates breastfeeding, and avoids infection and other illnesses. Additionally, this results in early discharge, enhanced neurodevelopment, and fosters a strong connection between the mother and the newborn.

The utilization of traditional cloth wrap presents numerous disadvantages that impede the right adherence to Kangaroo Mother Care (KMC). The KANGASLING is a reliable and protected wrap that allows for convenient hands-free kangaroo care. It permits empowers parents to independently place the baby in kangaroo care position and carry out daily duties effortlessly, while also encouraging early breastfeeding.[6]

Hypothermia is acknowledged by the World Health Organization as a significant risk factor for morbidity and mortality in newborns, regardless of their birth weights and gestational ages. Neonates have an immature temperature regulating mechanism, which makes them more susceptible to hypothermia. Preterm and low birthweight neonates are particularly vulnerable to hypothermia, which can have severe consequences such as apnea, hypothermia, and poor weight gain.[7] It is common for mothers to be unaware of the risks of hypothermia in low birth weight and preterm babies, and the conventional touch method for detecting hypothermia is not reliable for early detection.[8] The BEMPU gadget has the capability to detect hypothermia at an early stage and can notify the mother to administer Kangaroo Mother Care (KMC), hence enhancing adherence.[9]

NEED FOR STUDY:

Ideally, Kangaroo Mother Care (KMC) should be implemented for a continuous period of 24 hours. However, due to non-adherence, it is typically done for a duration ranging from 2 to 10 hours per day. The utilization of traditional cloth wrap has certain disadvantages that impede the appropriate adherence to KMC[6].The KANGA SLING is durable and allows for hands-free movement, yet there is a scarcity of research to substantiate improved adherence to kangaroo care.

The conventional touch method for detecting hypothermia is not dependable for early identification of hypothermia.[7]A significant amount of study has been carried out to ascertain the optimal approach for temperature readings in newborns. The device should be accurate, simple, quick, non-intrusive, replicable and cost-efficient. It is found that the BEMPU Bracelet is an accurate device that can be used in limited resource settings[8]. The BEMPU device can pick up hypothermia early and can alert the mother to provide KMC hence can improve the compliance.[9]

This study is based on the premise that the KANGA SLING together when used with BEMPU device can improve the parent compliance to KMC but there very limited studies currently to prove the same.

AIMS & OBJECTIVES

AIM:

To study the parent compliance to kangaroo mother care with Kanga sling and BEMPU device in low birth weight babies compared to the conventional kangaroo mother care and to assess the correlation between compliance to KMC and growth parameters of babies and breastfeeding.

PRIMARY OBJECTIVE:

Assess parent compliance to kangaroo mother care(KMC) with KANGA sling and BEMPU device in low birth weight babies between 1.5-2.5kg compared to the conventional kangaroo mother care.

SECONDARY OBJECTIVES:

- To assess the correlation between compliance to kangaroo mother care and growth parameters of the babies.
- To assess the correlation between compliance to kangaroo mother care and early breastfeeding.
- To assess compliance to kangaroo mother care at home.

REVIEW OF LITERATURE

Review of literature of this study on compliance to Kangaroo mother care-conventional method, with Kanga sling and BEMPU device in neonates admitted in KMC ward is discussed under the following headings:

1) Preterm and Low birth weight-definition, etiology, complications.

2) Hypothermia

3) Kangaroo mother care: Definition and benefits

PRETERM AND LOW BIRTH WEIGHT-

Definition and classification:

Low birth weight is characterized by a birth weight below 2500 g, according to the World Health Organization (WHO).[1] Low birth weight is classified into two subcategories: very low birth weight (VLBW), which refers to infants weighing less than 1500 grams, and extremely low birth weight (ELBW), which refers to infants weighing less than 1000 grams[1].Low birth weight is caused by either preterm birth (PTB), intrauterine growth restriction (IUGR), or a combination of both.[11]

Low birth weight is defined as a weight of less than 2500 g, regardless of the length of the pregnancy. Small for gestational age (SGA) is a term used to describe neonates whose birth weight falls below the 10th percentile for their gestational age.[11]

Table no 1:Case definition of low birth weight

Newborn infant weighed within 24 h of birth	AND
Use electronic scale which is graduated to 10 g	AND
Scale is calibrated at least once a year	AND
Scale placed on level, hard surface	AND
Scale tared to zero grams	AND
Weight recorded as <2500 g	OR
Birth weight recorded as <2500 g	AND

PRETERM:

Preterm refers to infants who are born alive before the completion of 37 weeks of pregnancy. Preterm birth can be categorized into sub-categories according on gestational age[13]

Very preterm (less than 28 weeks)

Extreme preterm (28 to less than 32 weeks)

Moderate preterm(32 to 34weeks)

Late preterm(34 to 37weeks)

EPIDEMIOLOGY:

On a global scale, it is approximated that 15-20% of all births, which amounts to around 20 million babies each year, are infants with low birth weight. Low- and middle-income nations bear a higher share of the burden of low birth weight (LBW).[12] More than 95% of LBW newborns worldwide are born in these countries. LBW rates exhibit significant disparities both globally and regionally. In East Asia and Pacific,

approximately 6% of newborns are born with low birth weight (LBW), while in Sub-Saharan Africa, the percentage is 13%, and in South Asia, it can reach up to 28% . (12)Approximately 50% of all infants with low birth weight (LBW) are born in the region of south Asia[13]

ETIOLOGY:

In a significant number of cases, the precise reason for preterm delivery remains unknown. However, there are several factors related to the mother, fetus, and placenta that may play a role in contributing to premature birth.[14]

1) Significant maternal factors include extra-uterine infection, chorioamnionitis, and illnesses such as pre-eclampsia.

2)Significant fetal factors include intrauterine growth restriction, infection and, fetal abnormalities.

3) Placental pathologic disorders include abruptio placenta and placenta praevia.[14]

Typically, the reasons of IUGR can be attributed to factors related to the mother, fetus, and placenta. While the causes may vary, they frequently share the common pathway of inadequate blood flow to the uterus and placenta, resulting in insufficient nourishment for the fetus.[15]

IUGR can manifest as asymmetrical IUGR, symmetrical IUGR, or mixed IUGR. Asymmetrical intrauterine growth restriction (IUGR) is the predominant form of IUGR, accounting for 70-80% of cases. It occurs when a problem, frequently related to insufficient blood flow between the uterus and placenta, arises later in pregnancy. As a result, fetus affected by this condition have normal length and head circumference (indicating preservation of brain development), but their weight is lowered.[15]

Symmetrical intrauterine growth restriction (IUGR) occurs when there is an insult, such as a genetic, structural, or viral factor, that happens earlier in pregnancy. This results in decrease in all anthropometric parameters in the fetus.[15]

IUGR is caused by inadequate blood flow due to faulty placentation, improper development of blood vessels in the placenta, maternal hypertensive diseases, and tobacco use. Having multiple gestation, such as twins or triplets, is linked to a higher risk of both IUGR and preterm birth (PTB) [16]. Infectious illnesses, such as intrauterine infections, HIV, and malaria, cause low birth weight (LBW) by both limiting growth and causing premature birth.

Materernal factors that are associated with intrauterine growth restriction and preterm birth include:

- maternal short stature,
- malnutrition during pregnancy,
- low BMI,
- poverty, short interval between childbirths, inadequate maternal education
- Inadequate prenatal healthcare, substance abuse, and psychological and physiological stress [17]

Preterm delivery can occur either spontaneously or as a result of medical intervention, such as induction or cesarean section, which may be necessary due to maternal problems including pre-eclampsia.[18]

Preterm birth is more likely to occur in cases of infectious and inflammatory conditions, such a chorioamnionitis, bacterial vaginosis, bacteriuria, sepsis, and periodontal disease.[19]

PREVENTION:

Antenatal care guidelines encompass essential measures aimed at mitigating the risk of preterm birth, such as

1.Providing guidance on maintaining a nutritious diet, achieving optimal nutrition, and addressing tobacco and substance abuse.

2.Fetal measures, including the utilization of early ultrasonography, are employed to accurately establish the gestational age and identify the presence of multiple pregnancies.

3.At least 8 antenatal visits during pregnancy, beginning before 12 weeks, to detect and address potential risks such as infections.

4.Administration of antenatal steroids and tocolytic therapy to postpone labor, as well as the use of antibiotics for preterm premature rupture of membranes (PPROM).[20]

COMPLICATIONS:

Neonates with low birth weight have a >20 times greater risk of dying than neonates with birth weight of >2500 g [21]

Low birth weight is associated with:

- long-term neurologic disability,
- impaired language development
- impaired academic achievement
- increased risk of chronic diseases including cardiovascular disease and diabetes.

Preterm infants carry additional risk due to:

- immaturity of multiple organ systems
- intracranial hemorrhage
- respiratory distress
- sepsis
- blindness
- gastrointestinal disorders.[22]

Preterm birth is the leading cause of all under-5 child mortality worldwide

COMPLICATIONS OF PRETERM BIRTH

- RESPIRATORY SYSTEM:

RDS: RDS, or respiratory distress syndrome, is linked to a lack of surfactant. The frequency of RDS rises as gestational age decreases. RDS is a acute illness that is managed with breathing assistance (such as oxygen, positive airway pressure, ventilator, or surfactant) as necessary. It typically improves within 2 to 4 days and disappears within 7 to 14 days.[23]

BRONCHOPULMONARY DYSPLASIA AND CHRONIC LUNG DISEASE: Bronchopulmonary dysplasia (BPD) is the term used to describe the chronic lung disease (CLD) that can develop in premature newborns after they have experienced respiratory distress syndrome (RDS). BPD/CLD is a persistent condition that occurs due to inflammation, damage, and formation of scar tissue in the airways and alveoli. It is linked to the processes of growth, well-being, and the occurrence of neurodevelopmental issues in childhood.[24]

APNEA: Apnea is a condition that can occur in premature newborns, when they may temporarily stop breathing for a duration of 20 seconds or longer. This may be followed by a decrease in heart rate, known as bradycardia. The primary factor contributing to apnea and bradycardia in preterm newborns is the underdevelopment of respiratory control. However, there are instances where these infants have obstructive apnea, which occurs when there is a blockage in their airways that hinders the flow of air.[25]

- GASTROINTESTINAL SYSTEM:

Feeding intolerance frequently occurs as a consequence of premature delivery. The underdeveloped gastrointestinal system has challenges in breaking down essential nutrients required for continuous growth and maturation.[26]

Necrotizing enterocolitis (NEC) is a sudden damage to the small or large intestines that leads to inflammation and harm to the lining of the bowel. This condition mainly impacts premature infants. Necrotizing enterocolitis (NEC) affects 3% of infants born prior to 33 weeks of gestation and 7% of infants with birth weights below 1,500 grams.It usually happens within 14 days after delivery and manifests as problems with feeding, swelling of the abdomen, low blood pressure, and other indications of sepsis.[27]

Gastroesophageal reflux (GER) is a frequent occurrence in both premature and full-term newborns. It often manifests as regurgitation and can have negative consequences on the infant's growth and overall well-being. Additionally, it can be observed by the occurrence of aspiration pneumonia, wheezing, or deterioration of BPD/CLD due to the failure to protect the airway during reflux.[27]

- SKIN:

The skin fulfills crucial functions in maintaining fluid equilibrium, regulating body temperature, and safeguarding against infections. The dermis of neonates born at the lower threshold of viability (i.e., 22 to 25 weeks of gestation) typically exhibits a gelatinous texture, rendering it more susceptible to injury upon contact. Additionally, it exhibits a significant permeability to fluids, leading to substantial fluid loss. Furthermore, it fails to offer a sufficient defense against infections..[27]

- INFECTIONS AND IMMUNE SYSTEM:

Preterm newborns has underdeveloped immune systems that exhibit inefficiency in combating bacteria, viruses, and other microorganisms that have the potential to induce illnesses. Preterm newborns typically experience severe symptoms of infections caused by these agents, such as pneumonia, sepsis, meningitis, and urinary tract infections.[27]

- HEMATOLOGICAL SYSTEM:

Congenital anemia can be caused by fetal blood loss, fetomaternal hemorrhage, and hemolysis. However, the most frequent hematologic problem in premature neonates is anemia of prematurity. Anemia of prematurity is a condition where there is an excessive decrease in red blood cell production in premature infants, lasting for 6 to 12 weeks after birth. This condition occurs earlier and shows symptoms earlier compared to the normal decrease in red blood cell production that occurs in all infants..[27]

- OPHTHALMIC SYSTEM AND VISION:

Retinopathy of prematurity (ROP) is the prevailing ocular anomaly observed in premature babies. This is a retinal condition characterized by the growth of new blood vessels, which becomes more common as gestational age and birth weight decrease. The condition has multiple causes, but the main problem is the immaturity of the retina, which lacks blood vessels. Retinopathy of prematurity (ROP) affects a range of babies, with a prevalence of 16 to 84 percent among those born with gestational ages below 28 weeks. It is observed in 90 percent of children with birth weights below 500 or 750 grams, and in 42 to 47 percent of infants with birth weights below 1,000 or 1,500 kilos.[28]

- CNS:

Preterm newborns are particularly susceptible to damage in the white matter around the ventricles and the highly vascular germinal matrix eminence. The occurrence of CNS injury in preterm infants is influenced by ischemia, hypoxia, and inflammation. However, there is ongoing debate on the relative significance of each of these factors. The predominant indications of central nervous system (CNS) damage in premature newborns are intraventricular hemorrhage (bleeding inside the brain's ventricles), intraparenchymal hemorrhage and white matter injury (including periventricular leukomalacia).[29]

- CVS:

Preterm newborns may encounter a range of cardiovascular problems, including significant structural abnormalities and impaired regulation of blood vessel activity (hypotension).

Around 5 percent of newborns weighing less than 1,500 grams receive treatment for patent ductus arteriosus. Clinical signs of this condition include a heart

murmur, an active precordium, and bounding pulses. An echocardiography performed at the bedside can confirm the presence of a patent ductus arteriosus and a normal anatomy otherwise. A patent ductus arteriosus (PDA) can be without symptoms and may shut naturally during the first week after birth, or it might complicate the medical progress of a premature newborn and raise the chances of intraventricular hemorrhage (IVH), necrotizing enterocolitis (NEC), and bronchopulmonary dysplasia/chronic lung disease (BPD/CLD).[30]

Apnea and bradycardia frequently occur in premature newborns and are indications of underdeveloped cardiorespiratory regulation. Nevertheless, both premature infants and, in fact, certain full-term infants may experience bradycardia when feeding, even in the absence of other cardiorespiratory symptoms and without clinical reflux. [31]

HYPOTHERMIA

A newborn is biologically capable of maintaining a stable body temperature and has a high metabolic rate . Newborns have a body temperature between 36.5°C-37.4°C, irrespective of their weight and gestation period. Infants have a high ratio of body surface area to body mass. Thus, heat loss in a child is four times more per unit of body mass than in an adult [33]. WHO emphasizes the importance of maintaining a consistent and optimal temperature for infants during the neonatal period, which is referred to as the 'warm chain'.

Hypothermia in babies is characterized by a body temperature below 36.5°C. Hypothermia is observed in preterm and low-birth weight newborns as a result of variables such as reduced brown fat, diminished subcutaneous fat, and underdeveloped temperature regulation mechanisms. Additionally, it is recognized

that hypothermia in neonates contributes to the exacerbation of difficulties associated with preterm and illnesses [34]

Neonatal hypothermia is widespread worldwide, even in hot tropical regions. The incidence of newborn hypothermia ranges from 11% to 95% . Nevertheless, it is typically not seen as a significant concern in infants who are born full-term and have a normal weight of over 2500 grams [35]. These newborns are expected to receive care from their mothers and relatives in the postnatal wards after delivery to ensure they are kept warm, clean, and appropriately breastfed.

Developing nations face a significant challenge in ensuring newborn survival due to a lack of thermal protection.[36] In India, the occurrence of hypothermia varies greatly, with recent estimates indicating a prevalence of around 31% in normal newborns in community settings and approximately 32% in hospital settings. [37]However, these estimates primarily include normal weight newborns, and the prevalence is likely to be even higher for low birth weight newborns. India has an annual birth rate of around 27 million, with approximately 8 million of those kids being born with low birth weight.[38]

Babies who experience hypothermia shortly after birth are prone to encountering problems such as inadequate weight gain, insufficient oxygen supply to tissues, low blood sugar levels, infection, and mortality. In low- and middle-income nations, the primary concern is mortality. Research has demonstrated that hypothermia significantly amplifies the likelihood of neonatal mortality, increasing it by up to 23 times.[39]

The World Health Organization (WHO) acknowledges that preventing hypothermia is a crucial aspect of neonatal care. Consistently monitoring the temperature can facilitate prompt action and is among the most efficacious methods to

guarantee optimal growth in infants. Implementing measures to avoid hypothermia can lead to a reduction of up to 42% in newborn mortality.[40]

Extensive study has been carried out to ascertain the optimal approach for temperature readings in newborns. The consensus on the optimal approach is the device should be uncomplicated, quick, non-intrusive, replicable , cost-efficient, and precisely indicate the newborn's core body temperature.[41]

Various thermometry methods employ distinct ways to measure temperature and are influenced by diverse circumstances. The following table shows the different approaches that are available[42]

TABLE 2 | Summary of current methods of temperature monitoring and their advantages and disadvantages.

Temperature monitoring device	Advantages	Disadvantages
Human touch	• Simple and quick • Inexpensive • Easy to implement	• Only accurate when performed by someone trained
Mercury-in-glass thermometer	• Traditionally considered gold standard	• Contains mercury • Long time required to reach stable temperature • Variable accuracy due to suboptimal use
Electronic thermometer	• Poses minimal risk • Provides rapid temperature readings • Probes allow for continuous monitoring and dual monitoring	• Variable accuracy depending on site • Skin measurements affected by environmental factors
Infrared tympanic thermometer	• Rapid and painless	• Variable accuracy depending on model used • Temperatures differ between protected & unprotected ears • Expensive
Temporal artery and mid-forehead infrared thermometers	• Rapid and painless • Causes minimal disturbance to the neonate	• Variable accuracy depending on site • Measurements affected by environmental factors • Expensive
Liquid crystal thermometry	• Simple and inexpensive • Able to be understood by non-literate and non-numerate carers • Accurate in detecting hypothermia <35.5°C	• Does not provide a specific temperature reading • Falls off occasionally
BEMPU TempWatch	• Continuous monitoring • Able to be understood by non-literate and non-numerate carers • Promotes skin-to-skin contact and weight gain	• Does not provide a specific temperature reading • Limited studies regarding its accuracy

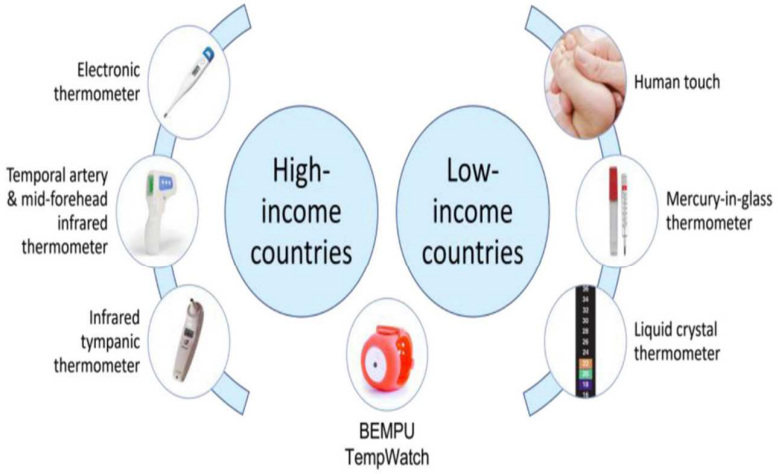


FIGURE 1 | Temperature monitoring devices currently available for use in neonates.

Human Touch:

In resource-limited areas, the WHO suggests using human touch to identify hypothermia. This technique entails the simultaneous examination of the baby's Abdomen and the soles of their feet using the back of the examiner's hand. If the feet and the abdomen of the infant are warm it indicates a warm infant with a body temperature of 36.5-37.5◦C. On the other hand, a warm abdomen and cold feet suggest mild hypothermia with a body temperature of 36-36.4◦C. Lastly,if the baby's feet and abdomen are cold it indicates serious hypothermia.[43]

The accuracy of human touch in detecting hypothermia is significantly lower when performed by untrained mothers, health personnel, and field workers, in comparison to mercury-in-glass axillary thermometry. One study indicated that the sensitivity of accurately identifying hypothermic neonates ranged from 11% to 42%, while the specificity ranged from 93% to 100%, depending on the observer[44]. Another study reported that only 24.6% to 34.4% of the newborns who were hypothermic were successfully identified [45]. Nevertheless, the precision of human tactile perception

increases when employed for detecting moderate hypothermia in comparison to mild hypothermia.

The precision of manual touch is enhanced when performed by skilled personnel [45] and pediatricians, as evidenced by a study where all pediatricians demonstrated the ability to accurately identify all hypothermic infants.

BEMPU Temp Watch:

- This device, developed by BEMPU Health in Bangalore, Karnataka, India, is an innovative bracelet gadget that enables uninterrupted temperature monitoring for a period of 30 days . The device comprises a thermistor metal cup enclosed in a plastic case, along with a silicone band designed to be worn around the wrist of the newborn weighing between 800 and 3,300 g[46.] The device emits a beeping sound accompanied by an orange light until the baby's body temperature reaches a stable state, at which point the orange light changes back to blue. This gadget is user-friendly, cost-effective, suitable for infants due to its lightweight and compact size, and readily accessible in India.
- Tanigasalam V et al. conducted a study from January to June 2016 in the step-down nursery of the Level III NICU (Neonatal Intensive Care Unit) at Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER) in Pondicherry, India. The purpose of the study was to evaluate the diagnostic accuracy of a new hypothermia monitoring and alert bracelet device (BEMPU Bracelet) in neonates with low birth weight (LBW), specifically those weighing less than 2000 grams. The study determined that the BEMPU device had a diagnostic accuracy rate of 95.8% in detecting hypothermia. The BEMPU Bracelet is a precise screening device that

detects and alerts for newborn hypothermia, enabling quick intervention to prevent complications..[47]

- Sreekumar K et al. carried out a study in the postnatal ward of a high-level hospital in southwest India, from July 2018 to October 2018, with the aim of investigating if excessive weight loss in the newborn postnatally can be prevented by continuous temperature monitoring while they are in the hospital. The study determined that Hypothermia is a contributing factor to excessive weight loss after birth, and consistent temperature monitoring effectively prevents this in healthy infants.[48]
- Jagadish AS et al conducted a Randomized Control Trial was in Bangalore, Karnataka, India from April 2016 to December 2016 to assess the impact of the hypothermia alarm device on compliance with KMC at home and the weight increase of babies during the 4th week follow-up. The clinical trial results indicated that parents of infants in the BEMPU group had higher levels of adherence to KMC. Within the BEMPU group, the average amount of time spent practicing Kangaroo Mother Care (KMC) per day was notably greater during the first week (3.02 hours vs. 1.96 hours, p=0.016) and fourth week (3.04 hours vs. 2.38 hours, p=0.094) after discharge. The BEMPU group experienced a significant increase in weight gain after the first (25.7 v 20.7 g, p=0.1.85) and fourth (28.3 v 22.9 g, p=0.057) week following discharge. [9]
- Sharma M et al. This non-randomized study was conducted in the Udaipur and Dungarpur districts of Rajasthan, India from 29 September, 2016 to 10 January, 2017. It was the study conducted to know the effectiveness of a hypothermia monitoring device in reducing neonatal mortality and increasing Kangaroo Mother Care compliance. It was found in areas where the risk of neonatal hypothermia is high due

to the prevalence of preterm birth and low birth weight, use of the BEMPU Bracelet and that of promoting KMC had positive effect on neonatal health outcomes.[50]

KANGAROO MOTHER CARE:

Kangaroo mother care (KMC) is a validated practice that has demonstrated clear effectiveness and safety in both the short and long term. It is ideal for implementation in any setup.. It has 3 components:

(1) kangaroo position (that is continuous skin-to-skin contact between mother and newborn) which provide adequate thermal care

(2) exclusive breastfeeding of the newborn

(3)early discharge with regular follow-up.

Kangaroo Mother Care (KMC) was initially started in Colombia as a substitute for a newborn minimum care unit where neonates are kept in an incubator as they gradually gain weight , allowing children to be cared for on an outpatient basis.[3]

INAP targets of KMC[51]-

Newborn with low birth weight/Prematurity managed with KMC at facility:

2017-35%

2020-50%

2025-75%

2030-90%

Duration of KMC[3] as per NHM guidelines-

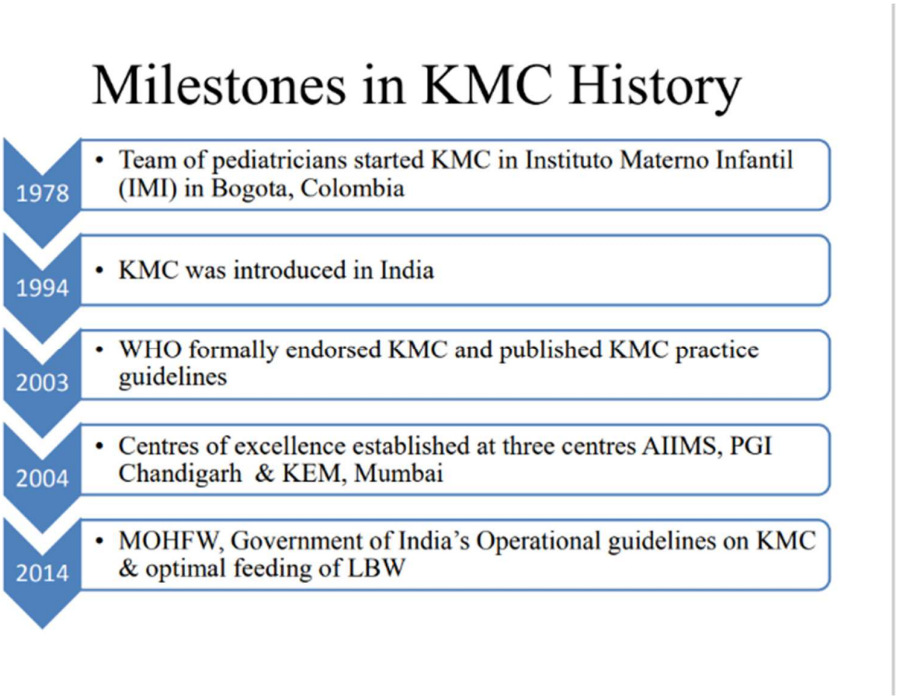
Short: 4 hours per day

Extended: 5-8 hours per day

long: 9-12 hours per day

Continuous: More than12 hours per day

Figure no 2:Milestones in KMC History



Counseling:

Prior counseling is necessary to address socio-cultural barriers and alleviate anxiety among both mothers and healthcare providers when it comes to initiating Kangaroo Mother Care (KMC) for low birth weight infants.

Clothing:

Mother: It is recommended to wear a front-open, lightweight dress that aligns with the local culture. However, there is no requirement to wear any specific attire. An infant should be dressed in a cap, socks, disposable diapers, and a front-open sleeve(less shirt or 'Jhabala' made of a soft natural fabric such as cotton.[3]

- Thapa K et al. conducted a feasibility study employing a mixed technique approach was conducted in Nepal from May to October 2015. This research project aims to investigate the consumer preference and acceptance of both the traditional and a novel ergonomic wrap for the continuation of KMC in both

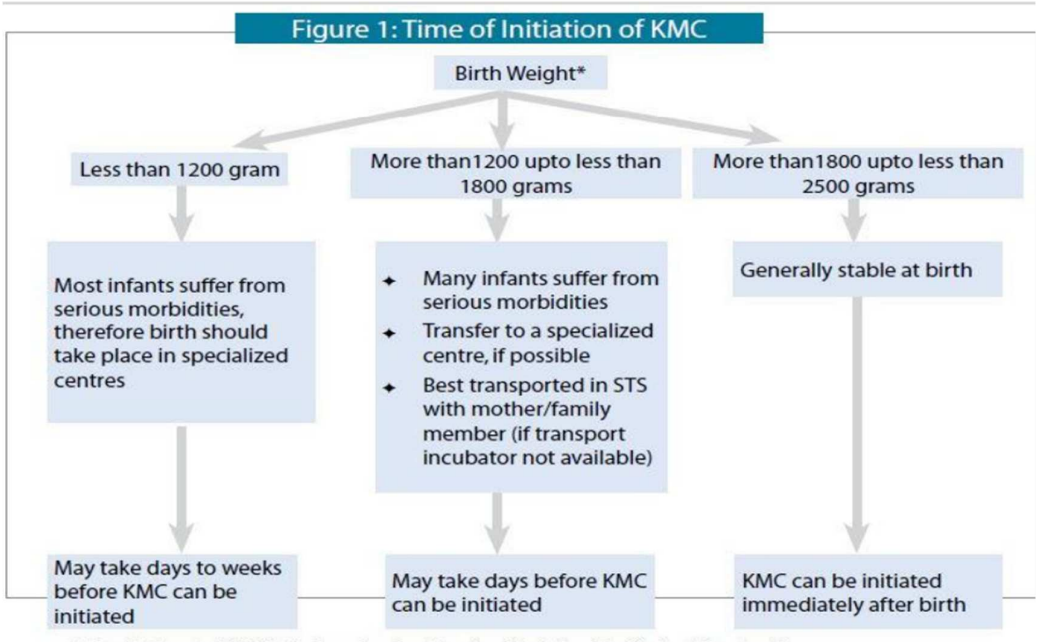
healthcare facilities and the community after discharge. The study revealed that the participation of mothers and family in the use of ergonomic wraps resulted in enhanced implementation of KMC both during the hospital stay and at home..[49]

- In 2016, a study was done to assess the acceptability and efficacy of a personalized KMC wrap in enhancing compliance to KMC among mothers. A total of 301 participants in were randomly assigned to receive either a personalized Care Plus Wrap, produced by Laerdal Global Health, or a traditional 'chitenje'. The participants were evaluated in the Kangaroo Mother Care (KMC) unit within 2-3 days of admission, and subsequently at 7-15 days following discharge. The study discovered that women strongly approved of a personalized KMC wrap and that it enhanced compliance to KMC in the health care facility. Specifically, 44% of mothers who used a customized wrap reported engaging in 20 or more hours of skin-to-skin contact per day, but only 33% of moms who used the traditional 'chitenje' reported the same. The women who used the personalized wrap reported feeling more comfortable practicing KMC compared to the women who used the 'chitenje' fabric (96% vs. 71%). Additionally, a higher percentage of women using the customized wrap were able to tie it on themselves (86% vs. 10%). This study presents empirical evidence demonstrating that a customised KMC wrap is widely embraced by mothers, and it has the potential to enhance skin-to-skin practices.[6]
- Rehman MO et conducted a RCT at the Department of Neonatology, the Children Hospital and the Institute of Child Health, Lahore, Pakistan, from March to October, 2018. The study involved recruiting neonates who were admitted to the neonatal intensive care unit. The participants were randomly assigned to either the case or control groups. The case group received intermittent KMC for a duration

of seven days. The control group was given conventional care. Out of the 153 newborns, 140 (91.5%) were selected for inclusion, with 70 (50%) in each group.. In the case group, average weight gain was 10.22±1.65 grams/kg/day compared to 7.87±1.71 in the control group. This study showed that the average weight-gain was more and statistically significant in the KMC group compared to the conventional group.[52]

Figure no 3: Instructions for Careplus wrap use

Figure no 4: Time of initiation of KMC



KMC Position:

1. The newborn should be positioned vertically between the mother's breasts.
2. The head should be rotated to one side and in a slightly extended position.
3. The baby should be in a “frog” position where the hips are flexed and abducted and the arms are flexed.
4. The infant’s abdomen should be at the same level as the mother’s epigastrium.
5. Provide support to the infant from the bottom with a sling/binder.

A mother in the KMC position can ambulate, maintain an upright posture, assume a seated position, or participate in other activities. If the mother is at ease, she can sleep in the Kangaroo Mother Care (KMC) position with her newborn. Newborns undergoing Kangaroo Mother Care (KMC) should be closely observed to ensure their airway remains unobstructed, ,breathing pattern is regular, their skin color remains pink and they are not hypothermic.

Suman Rao el al conducted a prospective randomized controlled trial in a teaching institution with a tertiary level neonatal intensive care unit (NICU) in Western India over a 9month period. The study population included 206 consecutive singleton intramural neonates with birth weight. The participants were randomly assigned to two groups: mothers in the intervention group (KMC-103) practiced Kangaroo mother care. The control group, designated as CMC: 103, got routine care. The KMC babies had a higher average daily weight gain compared to the CMC babies (KMC: 23.99 g vs CMC: 15.58 g $P<0.0001$). A substantially greater proportion of infants in the CMC group experienced hypothermia, hypoglycemia, and sepsis. There was no impact on the duration of hospital stay. A higher proportion of KMC babies were exclusively breastfed at the end of the study (98% versus 76%).[53]

Kangaroo Mother Care was widely accepted by the majority of women and families in domestic settings, leading to enhanced growth and decreased health complications in infants with low birth weight. It is uncomplicated, agreeable to mothers and may be sustained at home.

Figure no 5: Benefits OF KMC to the newborn:

Benefits to the newborn

- ✓ Stabilizes body temperature
- ✓ Decrease morbidities; better neurodevelopment
- ✓ Early discharge
- ✓ Promotes breastfeeding; prevents infection
- ✓ Encourages bonding in mother & Child

Table no 3: Discharge and follow up criteria

Discharge & Follow-up

Discharge	Follow-up
The infant is • Stable and not on parenteral medication • Maintaining temperature in mother's bed for 3 consecutive days at room temperature • Gaining 15-20 grams per day for at least 3 consecutive days • Accepting feeds directly from breast (preferable) by spoon, paladai or cup	• Follow-up is a fundamental prerequisite of KMC, to make a regular assessment of growth, sensory functions, behaviour and neurodevelopment. • ASHA will continue to provide care to the infant under HBNC in the community, following discharge • First Follow-up should be at one week, followed by fortnightly follow-ups till next two visits. Additional follow-up visits may be done until s/he reaches 40 PMA/2500 grams.

MATERIALS AND METHODS

Source of Data:

- *The present study will be conducted at KLE DR. Prabhakar Kore charitable hospital, Belagavi.*
- Study Design: A three arm randomized controlled trial

Study Period: 1 year

Sample size:

The formula used for sample size calculation is,

$$n = \frac{2\left(Z_{\alpha/2} + Z_{\beta}\right)^2}{d^2}$$

$$where,\ d = \left(\frac{|\mu_1 - \mu_2|}{\sigma}\right)$$

where, μ_1 is mean of the first group, μ_2 is mean of the second group, σ^2 is the common error variance, $Z_{\alpha/2}$ value is 1.96 for 95% confidence level and Z_{β} value is 0.8416 for 80% power.

Average number of hours of KMC given per day over 1 week is 1.96 ± 1.28 and 3.02 ± 1.61 in control and BEMPU groups respectively(9). Considering similar result at 5% level of significance and 80% power, the minimum sample size is obtained to 27 subjects per group.

Considering 10% follow-up loss, the sample size will by 30 subjects for each group. Hence, total sample size required is 30 x 3= 90 subjects. As sample size increases, accuracy of result also increases.

SAMPLING TECHNIQUE: computer generated simple random sampling

This is a three arm study with 2 intervention and 1 control group.

Intervention group 1-KANGA SLING AND BEMPU DEVICE.

Intervention group 2-BEMPU DEVICE WITH THE CONVENTIONAL CLOTH WRAP.

C*ONTROL GROUP-CONVENTIONAL CLOTH WRAP FOR KMC.*

INCLUSION CRITERIA:

All new born infants whose birth weight is between 1.5-2.5kg and clinically stable irrespective of gestational age or mode of delivery

EXCLUSION CRITERIA:

- Infants not clinically stable or who had a major congenital malformation will be excluded
- Mothers with debilitating illness who would not be able to provide KMC Mothers already providing KMC using the kanga sling.
- Multiple gestation.
- **Study protocol:** After obtaining ethical clearance neonates who fulfil inclusion criteria were chosen. Informed consent was obtained from the parents after explaining the purpose of the study.
- Stable neonates between 1.5-2.5 kg weight were enrolled and divided into 3 groups. Number of hours of KMC per day provided by the parent in each group was assessed.

Data collection procedure*:*

A proforma with maternal and neonatal details including the birth weight, gestation, parity, mode of delivery was filled. The baby's weight was checked everyday using a standardized digital weighing machine until the baby will be discharged. Duration of kangaroo care taken by mother was recorded in a diary provided to all mothers.

- The primary endpoint was number of hours of KMC performed per day. Weight was measured on the same electronic scale for all 3 the groups. Follow-up was done till 40 weeks of age or 2.5kg weight whichever later. All the final KMC diaries were collected.

EXPECTED OUTCOMES: It was expected that this intervention will increase compliance to KMC resulting in positive neonatal outcomes like initiation of early breast feeding and weight gain in LBW babies. If the infant is hypothermic , the device sounds an alarm alerting the parent.

PROJECT IMPLEMENTATION PLAN:

ENROLLMENT OF PARTICIPANTS: All LBW babies born in the hospital were weighed and screened for eligibility. If the infant was eligible to study participation consent was obtained. Participants were randomly assigned in the ratio 1: 1:1 to two intervention and one control group. Study groups were isolated to avoid any contamination.

INTERVENTION GROUPS:

GROUP 1: LBW babies enrolled in this intervention group were given the BEMPU bracelet and KANGASLING. Mothers were taught to recognize alarms and take necessary action to manage hypothermia when the device alarmed. The device was used on the baby until 40 weeks of gestational age or 2.5kg weight whichever later.

The no. of times the device alarmed during the day and duration of kangaroo care was recorded.

GROUP 2: LBW babies enrolled in this group were given the BEMPU bracelet and the conventional cloth wrap for KMC.

CONTROL GROUP: Babies enrolled in the control group used the conventional cloth wrap for KMC.

For all 3 groups, routine neonatal care, monitoring and discharge instructions were provided. In routine care patients are counselled regarding how to practice KMC, including how to practice skin to skin contact ,how to care for the low birth weight babies including initiation of breast feeding, expressing breast milk, hygiene and importance of skin-to-skin position when the baby was initiated on KMC. Counselling was done regarding importance of temperature monitoring, hypothermia detection and the complications associated with hypothermia. Infants were monitored and information regarding temperature, blood glucose levels, heart rate ,respiratory rate and anthropometry along with the number of hours of KMC were recorded everyday until discharge.

- DISCHARGE INSTRUCTIONS: Families of both the groups received discharge instructions on KMC and swaddling techniques, hypothermia awareness and prevention . Follow-up schedule and data collection methods were identical between groups. They were provided with diaries to enter the number and duration of KMC performed each day.

DATA PROCESSING AND ANALYSIS/STATISTICAL ANALYSIS:

- Descriptive statistics
- Independent t and dependent t test or repeated measures of ANOVA
- Mann-Whitney U test and Wilcoxon matched pairs test (if necessary)
- A significance will be set at 5% level of significance

RESULTS

- **Results of the study** IMPACT OF HYPOTHERMIA ALERT DEVICE(BEMPU) AND WRAP (KANGA SLING) ON PARENT COMPLIANCE TO KANGAROO CARE IN LOW BIRTH WEIGHT BABIES BETWEEN 1.5-2.5KG COMPARED TO THE CONVENTIONAL KANGAROO MOTHER CARE. A ONE YEAR HOSPITAL BASED THREE ARM RANDOMIZED CONTROL TRIAL.
- A one year hospital based randomized control trial was conducted at KLES Dr. Prabhakar Kore hospital. All low birth weight babies fitting in the inclusion criteria were included in the study.
- A total of 2024 deliveries were conducted in the labour room from July 2023 to December 2023.Out of this 547 babies were admitted in the NICU.
- 190 babies out of this were admitted in KMC ward in view of low birth weight after stabilisation. 90 babies out of this were selected to be included in the study based on the inclusion criteria and those who gave consent to be a part of the study.
- Stable neonates between 1.5-2.5 kg weight were enrolled and divided into 3 groups. Number of hours of KMC per day provided by the parent in each group was assessed. Details regarding the birth weight, gestation, parity, mode of delivery was collected.

STATISTICAL METHODS:

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram.

The association between explanatory variables and categorical outcomes was assessed by cross tabulation and comparison of percentages. Chi square test was used to test statistical significance.

- The association between quantitative explanatory variables and categorical outcomes was assessed by ANOVA (>2 groups) will be used to assess statistical significance.
- P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

Randomisation Groups:

90 newborns were allocated into 3 groups with each group having 30 subjects each (33.33%).

Group A:Both the BEMPU device and KANGA sling was provided.

Group B:Only BEMPU device was used along with conventional cloth wrap.

Group C:Only Conventional cloth wrap used.

NEONATAL FACTORS:

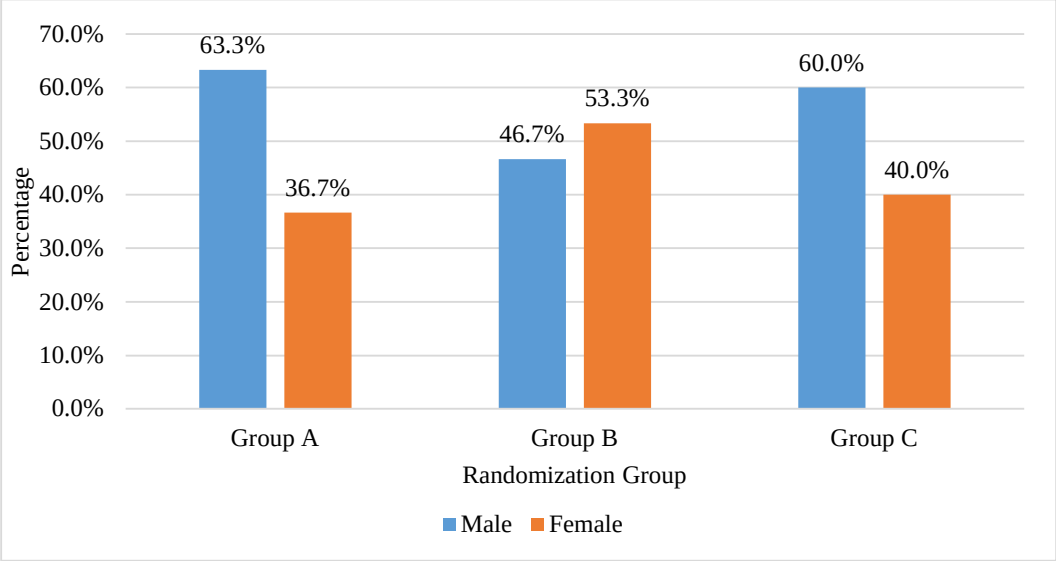
GENDER:

The gender distribution in our study population shows a higher proportion of male participants (56.67%) compared to female participants (43.33%). When further comparison of gender across the three randomization groups was done it was observed that group A consisted of 63.33% males and 36.67% females; group B had 46.67% males and 53.33% females; and group C included 60% males and 40% females. This difference was not statistically significant.

Table 4: Comparison of Gender across randomization group (N=90)

PARAMETER	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Gender						
Male	19 (63.33%)	14 (46.67%)	18 (60%)	51 (56.67%)	1.900	0.387
Female	11 (36.67%)	16 (53.33%)	12 (40%)	39 (43.33%)		

Figure 6: Cluster bar chart of comparison of gender across randomization groups (N=90)



GESTATIONAL AGE:

Majority of the newborns in our study(65.56%) were between 34 and 36 weeks 6 days period of gestation. A significant portion (33.33%) had a gestational age of more than 37 weeks, while a small minority (1.11%) had a gestational age between 32 and 33 weeks 6 days.

When compared across randomization groups, group A had the highest proportion of newborns between 34-36 weeks 6 days period of gestation(80%), while group B had the highest proportion of newborns beyond 37weeks gestation(40%).No statistically significant difference was observed between the three groups.

Table 5: Comparison of Gestational age across randomization groups (N=90)

PARAMETER	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Gestational Age						
32-33W6D	0 (0%)	1 (3.33%)	0 (0%)	1 (1.11%)	5.86	0.210
34-36W6D	24 (80%)	17 (56.67%)	18 (60%)	59 (65.56%)		
More Than 37 Weeks	6 (20%)	12 (40%)	12 (40%)	30 (33.33%)		

Figure 7 : Pie chart of gestational age in the study population (N=90)

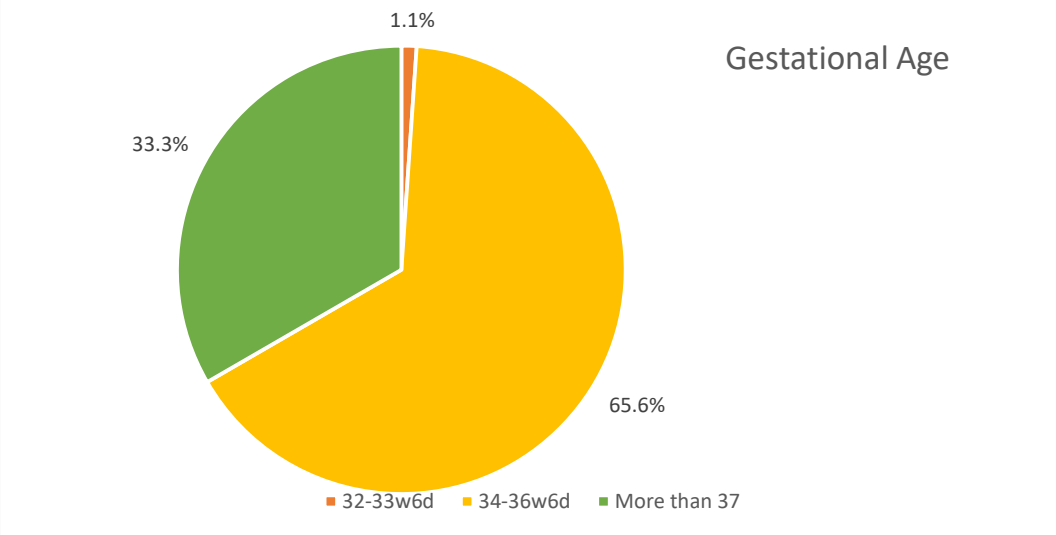
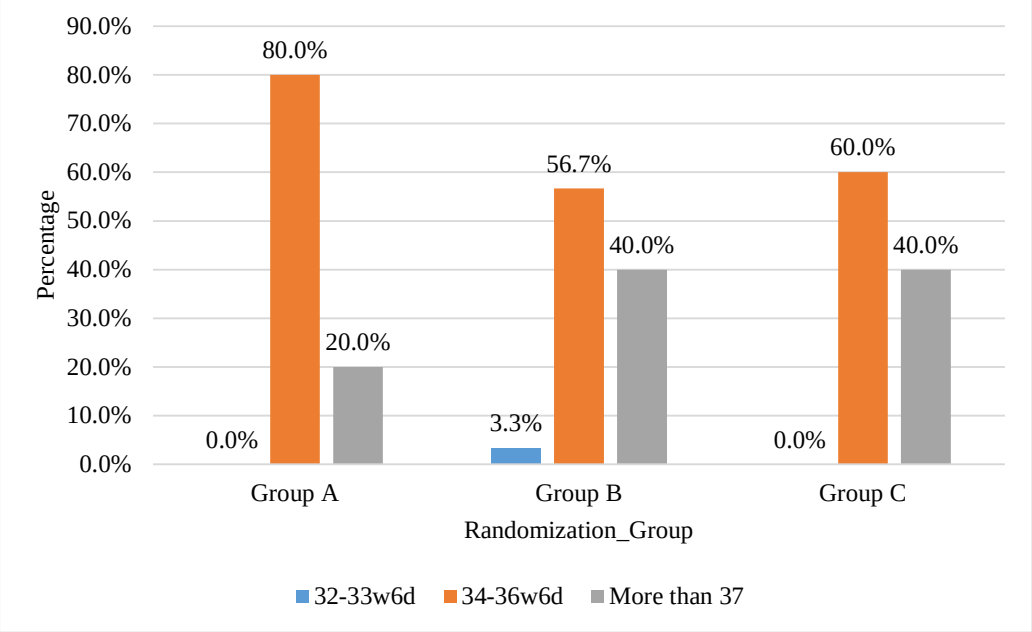


Figure 8: Cluster bar chart of comparison of gestational age across Randomization Groups (N=90)



BIRTH WEIGHT:

Majority of the newborns in our study weighed between 2 and 2.2kg(46.67%).17.7% of newborns were between 1.5-1.8kg while 18.8% and 16.6% of the newborns were between 1.8-2kg and 2.2-2.5kg respectively. Group C had the highest proportion of infants with a birth weight of 2-2.2kg(56.67%) , while group A had the highest proportion of infants in the 1.5-1.8kg(26.67%).There was no statistically significant difference between the groups.

Table 6: Comparison of birth weight across randomization groups (N=90)

PARAMETER	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Weight (Kg) At Birth						
1.5-1.8 kg	8 (26.67%)	5 (16.67%)	3 (10%)	16 (17.78%)	3.846	0.698
1.8-2 kg	5 (16.67%)	7 (23.33%)	5 (16.67%)	17 (18.89%)		
2-2.2 kg	12 (40%)	13 (43.33%)	17 (56.67%)	42 (46.67%)		
2.2-2.5kg	5 (16.67%)	5 (16.67%)	5 (16.67%)	15 (16.67%)		

Figure 9 : Pie chart of weight (kg) at birth in the study population (N=90)

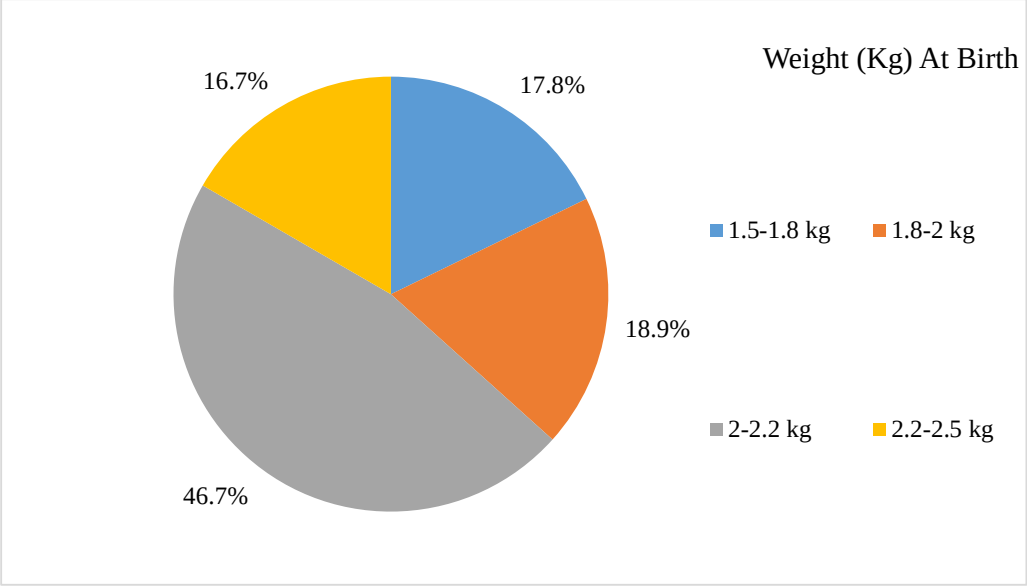
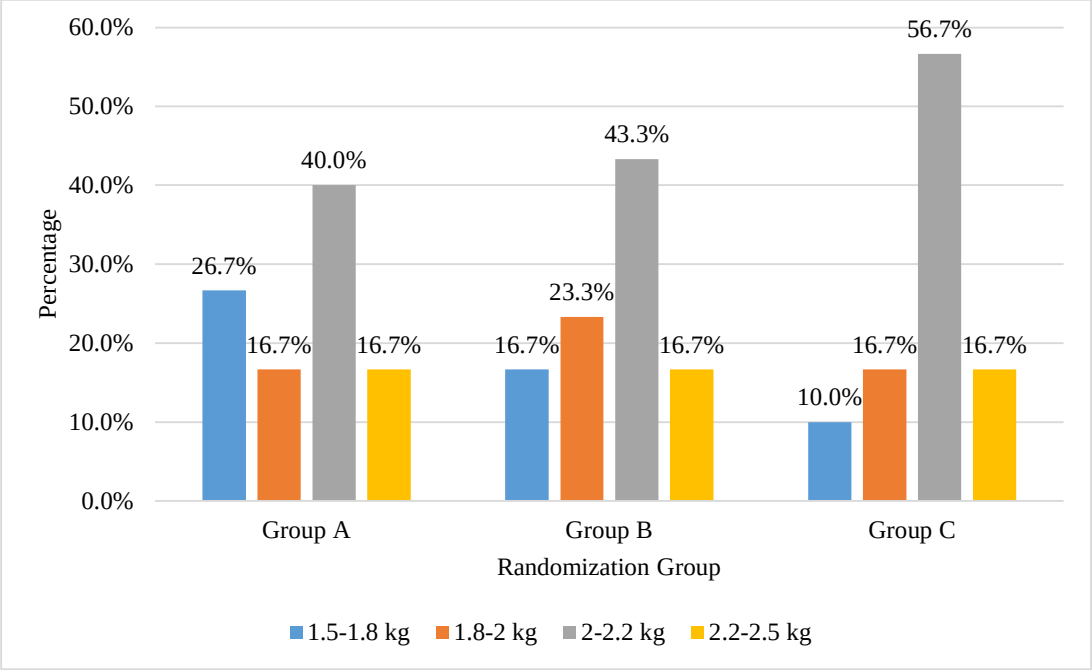


Figure 10: Cluster bar chart of comparison of Weight (Kg) At Birth across randomization groups (N=90)



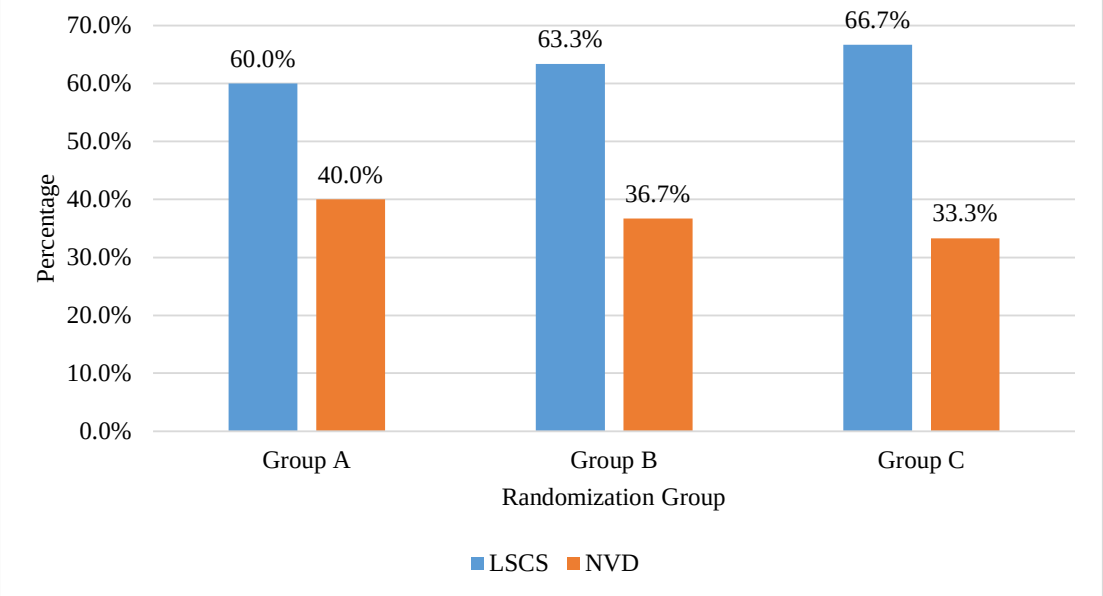
MODE OF DELIVERY:

In our study, majority of the newborns were delivered via lower segment caesarean section(LSCS)(63.33%), while 36.67% were normal vaginal deliveries(NVD). It was also observed that majority of deliveries in each group were via LSCS with group C having the highest number(66.67%).Their differences were not statistically significant.

Table 7: Comparison of Mode of delivery across randomization groups (N=90)

Parameter	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Mode of Delivery						
LSCS	18 (60%)	19 (63.33%)	20 (66.67%)	57 (63.33%)	0.287	0.866
NVD	12 (40%)	11 (36.67%)	10 (33.33%)	33 (36.67%)		

Figure 11: Cluster bar chart of comparison of mode of delivery across randomization groups (N=90)



NEONATAL PROBLEMS AT BIRTH:

Among the 90 newborns,15 newborns had problems at birth.

8 newborns(8.89%) were found to have respiratory distress syndrome(RDS) with majority of cases (4) being in group A followed by group B(3) and group C(1).

4.4% of newborns(4) had transient tachypnoea of newborn(TTNB) with 3 cases in group B and one in group C.

Small proportion of newborns(2.2%) had feed intolerance with 1 case each in group B and C.

1 newborn(1.11%) was found to have perinatal asphyxia belonging to group A.

All the above problems were observed before the initiation of KMC.

Table 8: Comparison of neonatal problems across randomization groups (N=90)

Neonatal Problems						
Feed Intolerance	0 (0%)	1 (3.33%)	1 (3.33%)	2 (2.22%)	6.592	0.360
RDS	4 (13.33%)	3 (10%)	1 (3.33%)	8 (8.89%)		
TTNB	0 (0%)	3 (10%)	1 (3.33%)	4 (4.44%)		
Perinatal asphyxia	1(3.33%)	0	0	1(1.11%)		
Nil	25 (83.37%)	23 (76.67%)	27 (90%)	75 (8334%)		

Figure 12: Pie chart of neonatal problems in the study population (N=90)

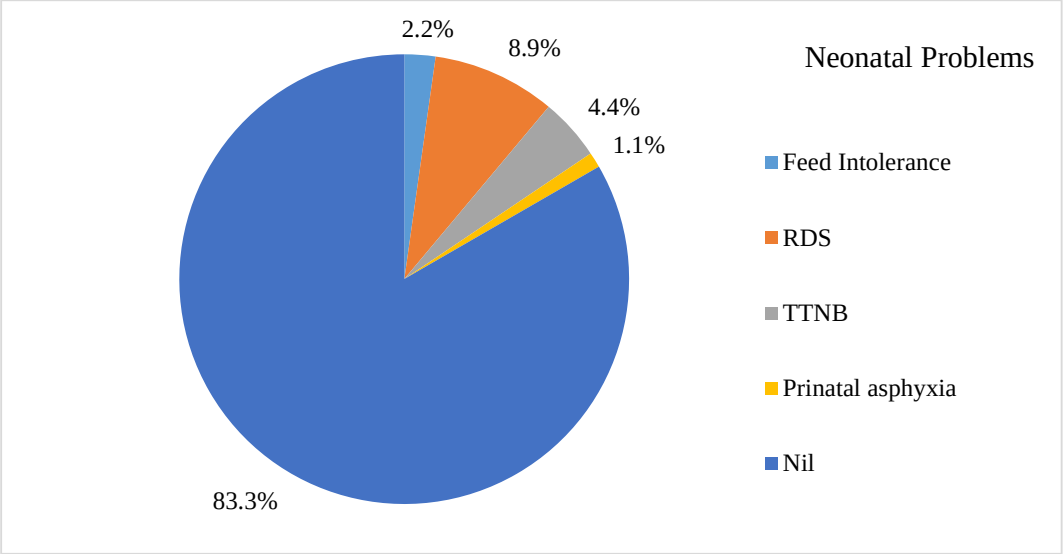
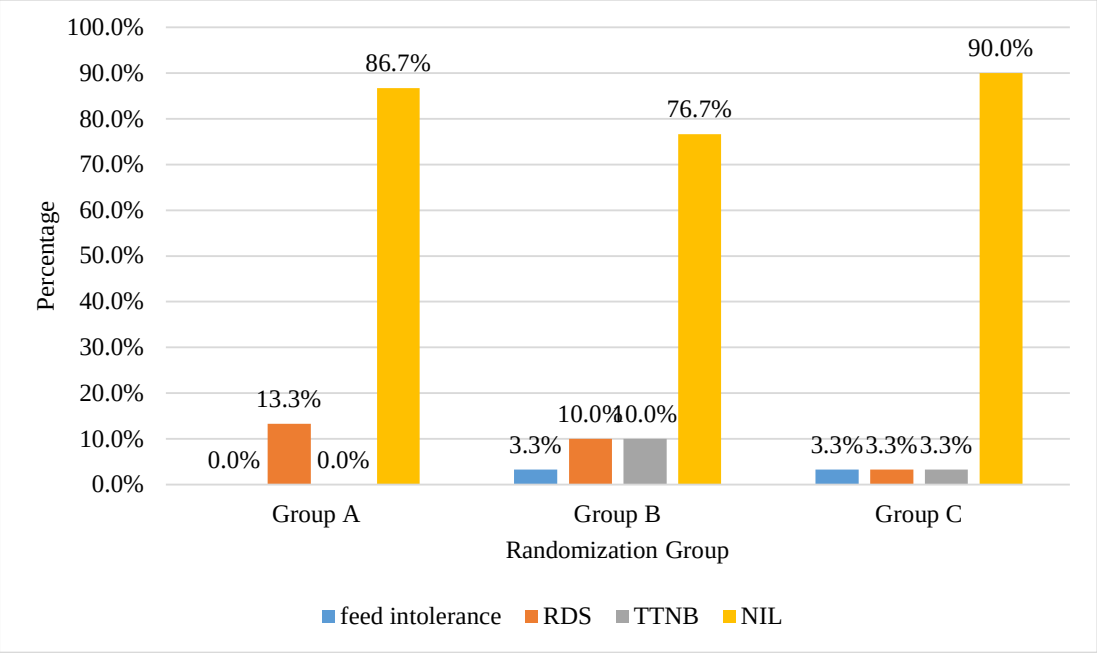


Figure 13: Cluster bar chart of comparison of neonatal problems across randomization groups (N=90)



Neonatal jaundice and hypoglycemia:

48.89% of the total newborns had neonatal hyperbilirubinemia. Majority of the cases (60%) were in group C followed by group B(46.67%) and group A(40%).Their differences were not statistically significant.

1 newborn had hypoglycemia and the newborn belonged to C group(1.11%).

Table 9: Comparison of neonatal jaundice and hypoglycaemia across randomization groups (N=90)

Parameter	Randomization Group			Overall (N=90	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Neonatal Jaundice						
Yes	12 (40%)	14 (46.67%)	18 (60%)	44 (48.89%)	2.490	0.288
No	18 (60%)	16 (53.33%)	12 (40%)	46 (51.11%)		
Hypoglycaemia						
Yes	0 (0%)	0 (0%)	1 (3.33%)	1 (1.11%)	2.020	0.364
No	30 (100%)	30 (100%)	29 (96.67%)	89 (98.89%)		

Figure 14: Cluster bar chart of comparison of neonatal jaundice across randomization groups (N=90)

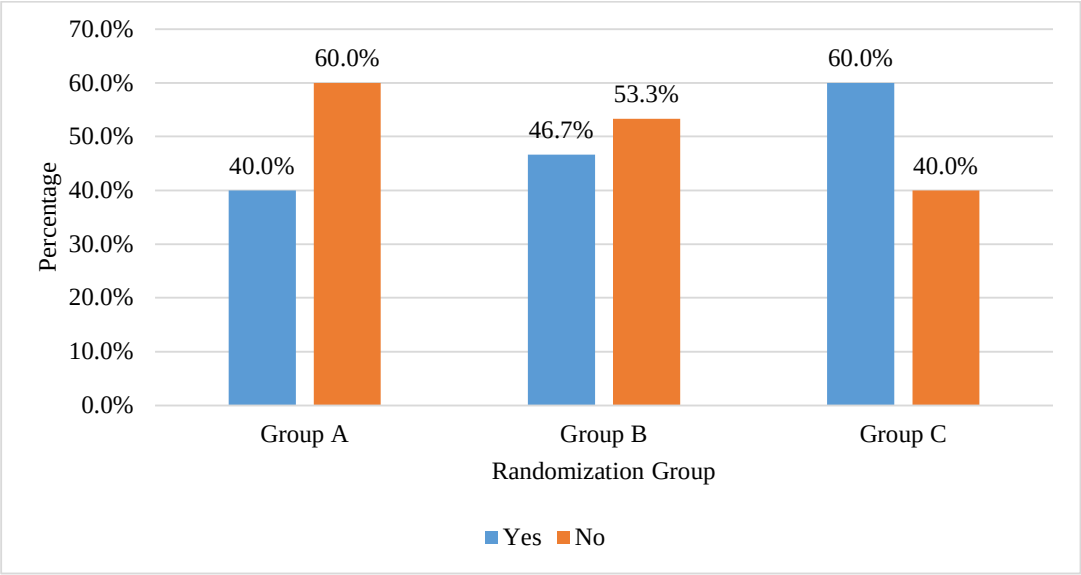
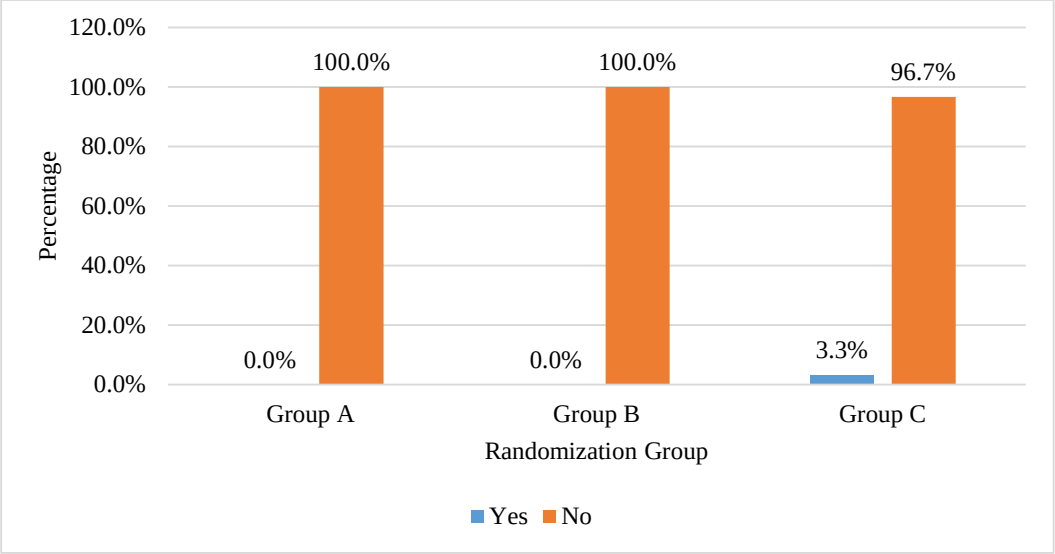


Figure 15: Cluster bar chart of comparison of hypoglycaemia across randomization group (N=90)



MATERNAL FACTORS:

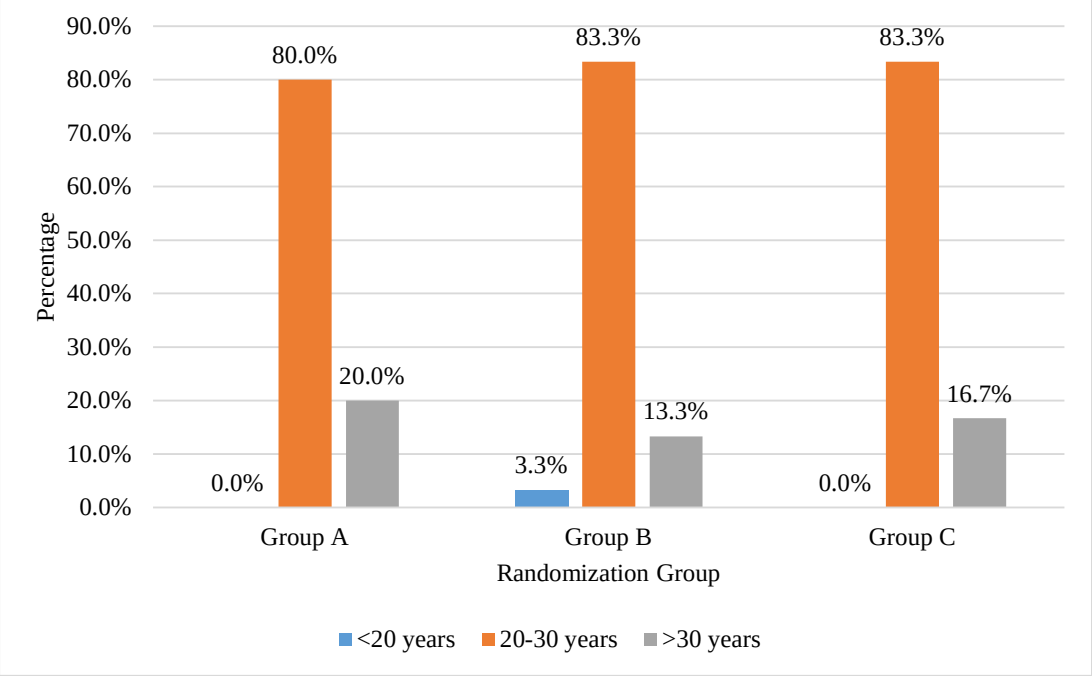
Maternal age:

The maternal age distribution shows that vast majority of mothers (82.22%) were between 20 to 30 years old. A smaller proportion (16.67%) were over 30 years and a very small number (1.11%) were under 20 years.When compared across the groups, majority of participants in each group were aged 20-30 years, with a slightly higher proportion in group B and group C(83.33%) compared to group A(80%).The difference was not statistically significant.

Table 10 :Comparison of maternal age across randomization groups(N=90)

Parameter	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Maternal Age (Years)						
<20 Years	0 (0%)	1 (3.33%)	0 (0%)	1 (1.11%)	2.427	0.658
20-30 Years	24 (80%)	25 (83.33%)	25 (83.33%)	74 (82.22%)		
>30 Years	6 (20%)	4 (13.33%)	5 (16.67%)	15 (16.67%)		

Figure 16: Cluster bar chart of comparison of maternal age (years) across randomization groups (N=90)



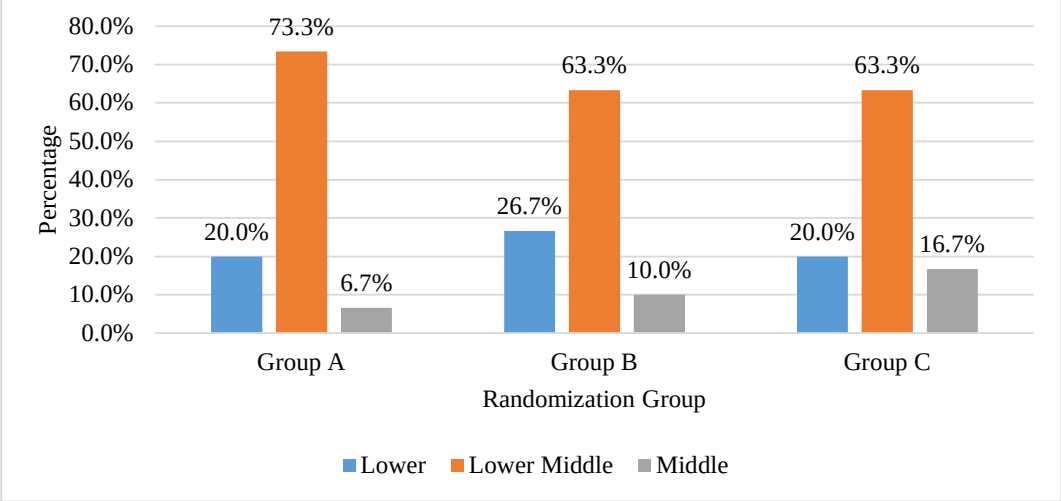
Socioeconomic status:

66.6% of the study population belonged to lower middle socioeconomic status according to the BG Prasad's classification with 73.3% belonging to group A and 63.3% belonging to group B and C. 22.2% of the participants belonged to lower SES and 11.1% in middle SES. No statistical significant difference was found across the groups.

Table 11: Comparison of socioeconomic status across randomization groups (N=90)

PARAMETER	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Socioeconomic status						
Lower	6 (20%)	8 (26.67%)	6 (20%)	20 (22.22%)	2.100	0.717
Lower Middle	22 (73.33%)	19 (63.33%)	19 (63.33%)	60 (66.67%)		
Middle	2 (6.67%)	3 (10%)	5 (16.67%)	10 (11.11%)		

Figure 17: Cluster bar chart of comparison of socioeconomic across randomization group (N=90)



Parity:

In this study, Majority of the mothers(61.1%) were primipara and this was observed across all groups with 66.6% in group C,60% in group B and 56.6% in group A. This was followed by gravida two (18.8%) and gravida three(10%).Small proportion of mothers were gravida four(3.33%).This was however statistically insignificant.

Table 12 :Comparison of maternal parity across randomization groups(N=90)

PARAMETER	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Parity						
G2A1	0 (0%)	0 (0%)	3 (10%)	3 (3.33%)	13.451	0. 337
G2P1L1	8 (26.67%)	5 (16.67%)	4 (13.33%)	17 (18.89%)		
G3P1L1A1	1 (3.33%)	1 (3.33%)	1 (3.33%)	3 (3.33%)		
G3P2L2	3 (10%)	5 (16.67%)	1 (3.33%)	9 (10%)		
G4P2L2A1	0 (0%)	1 (3.33%)	1 (3.33%)	2 (2.22%)		
G4P3L3	1 (3.33%)	0 (0%)	0 (0%)	1 (1.11%)		
Primi	17 (56.67%)	18 (60%)	20 (66.67%)	55 (61.11%)		

Figure 18: Pie chart of parity in the study population (N=90)

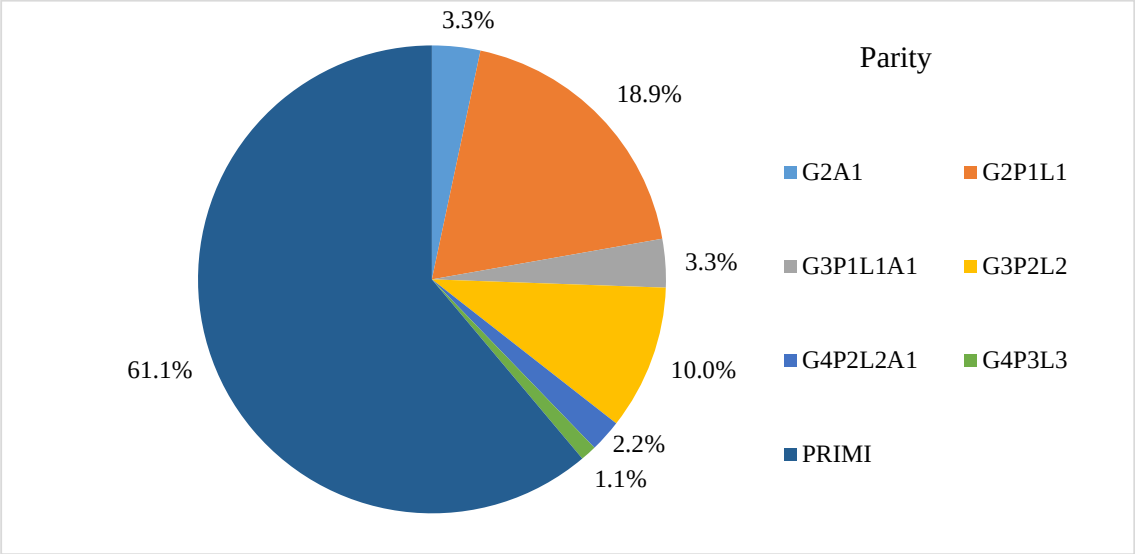
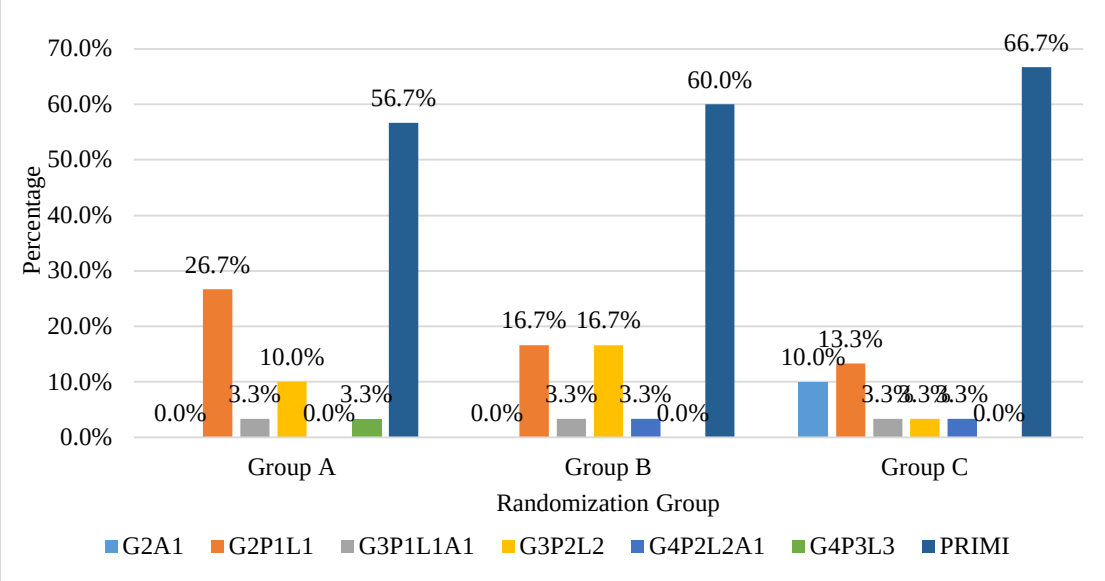


Figure 19: Cluster bar chart of comparison of parity across randomization groups (N=90)



Maternal problems:

10 mothers in the study had postpartum problems. The proportion of mothers having Surgical site infection(SSI) was slightly higher(4.44%) when compared to postpartum hemorrhage(PPH) and postpartum blues(3.33%).

2 mothers in group B and 1 each in group A and C had SSI while 2 in group A and 1 in group B had PPH and 2 in group C had postpartum blues. A surrogate was required to practice KMC was these newborns. There was no statistically significant difference of maternal problems across the groups.

Table 13: Comparison of Maternal problems across randomization groups(N=90)

PARAMETER	Randomization Group			Overall (N=90)	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Maternal problems						
Postpartum Blues	0 (0%)	1 (3.33%)	2 (6.67%)	3 (3.33%)	4.525	0.606
PPH	2 (6.67%)	1 (3.33%)	0 (0%)	3 (3.33%)		
SSI	1 (3.33%)	2 (6.67%)	1 (3.33%)	4 (4.44%)		
Nil	27 (90%)	26 (86.67%)	27 (90%)	80 (88.89%)		

Figure 20: Pie chart of maternal problems in the study population (N=90)

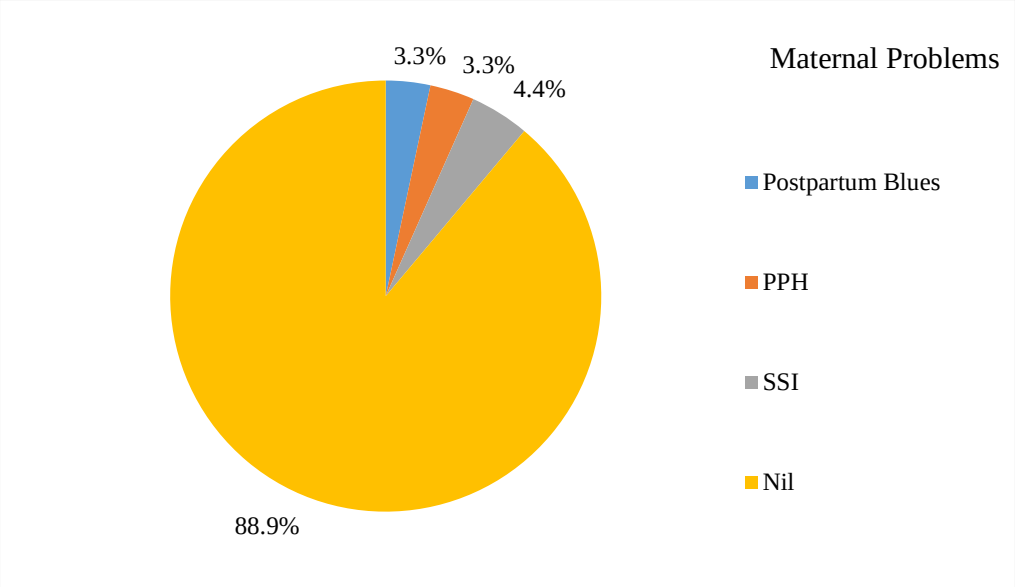


Figure 21: Cluster bar chart of comparison of maternal problems across randomization group (N=90)

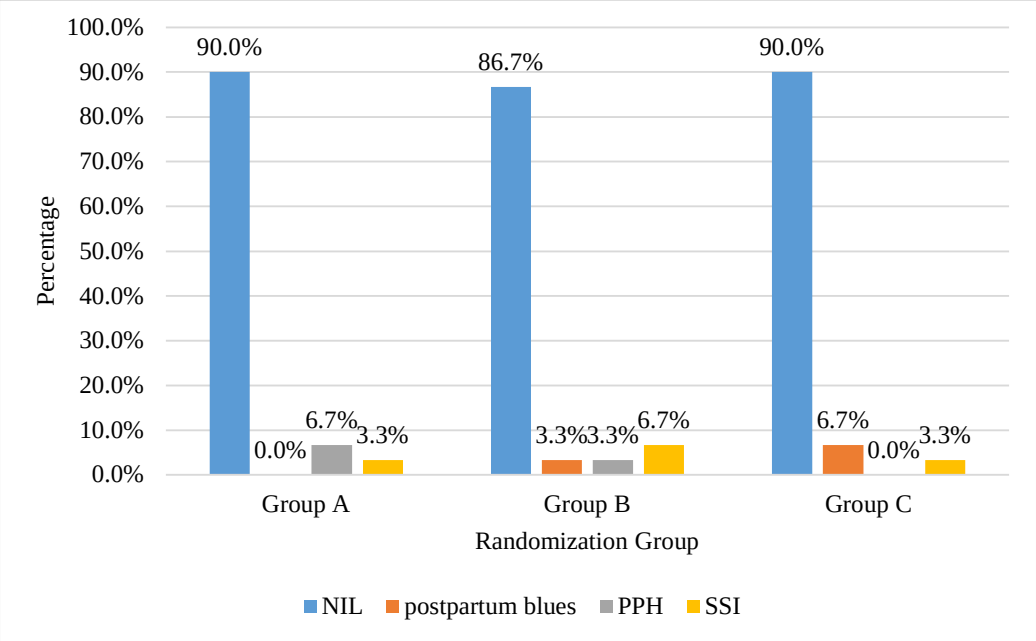


Table 14: Comparison of mean maternal and gestational age and across randomization group (N=90)

Parameter	Randomization Group			Overall (N=90	P-value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
Maternal Age (Years)	27.07 ± 3.32	26.03 ± 3.53	26 ± 3.38	36.46 ± 1.29	0.392
Gestational Age (Weeks)	35.96 ± 1.01	36.75 ± 1.39	36.66 ± 1.33	36.37 ± 3.41	0.034

Table 15: Pairwise Comparison for mean maternal and gestational age and across randomization group

Pairs	Mean Difference	P-value
Maternal age (years)		
Group A vs Group B	1.03	0.244
Group A vs Group C	1.07	0.229
Group B vs Group C	0.03	0.970
Gestational age (Weeks)		
Group A vs Group B	0.79	0.017
Group A vs Group C	0.70	0.034
Group B vs Group C	0.09	0.780

KANGAROO MOTHER CARE(KMC):

The overall mean age of KMC initiation was 2.58 days of life with mean age of initiation being more in group A(3.03) when compared to group B(2.3) and C(2.4) which was statistically significant($p<0.002$).

Table 16: Comparison of mean age KMC initiation (days) and across randomization groups (N=90)

Parameter	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
Age KMC Initiation (Days)	3.03 ± 1.16	2.3 ± 0.53	2.4 ± 0.67	2.58 ± 0.89	0.002

The mean daily hours of KMC practiced by mothers was found to be highest on day 8(9.76) and lowest on day 1 (6.33) across all groups. Further, group A had higher mean hours of KMC(11) compared to group B(10.9) and group C(7.6).The difference in the mean hours of KMC practiced by mothers was statistically significant(<0.001) between groups A and C and groups B and C. The hours of KMC practiced by mothers in group A was higher than group B across all days but statistically significant difference was seen only in days 6 and 7 being 11hrs versus 9.94hrs on day 6 and 11.56hrs vs 10.44hrs on day 7($p<0.01$).Mothers in group A and group B took 4 days to practice long KMC while mothers in group C practiced extended KMC during the hospital stay.

Table 17: Comparison of Mean Daily KMC Hours Over 8 Days Until Discharge Across Randomization Groups (N=90)

Parameter	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
Day 1	6 ± 0	8 ± 0	5 ± 0	6.33 ± 1.53	*
Day 2	7.4 ± 0.84	7.2 ± 1.04	5.46 ± 0.78	6.72 ± 1.24	<0.001
Day 3	8.15 ± 1.53	8.05 ± 1.3	5.8 ± 1.3	7.26 ± 1.75	<0.001
Day 4	9.92 ± 1.8	9.28 ± 1.72	6.81 ± 0.81	8.57 ± 2.01	<0.001
Day 5	10.2 ± 2.35	9.97 ± 1.77	7.35 ± 1.31	9.39 ± 2.25	<0.001
Day 6	11 ± 1.65	9.94 ± 1.26	7.31 ± 1.33	9.5 ± 2.06	<0.001
Day 7	11.56 ± 1.66	10.44 ± 1.45	7.33 ± 1.34	9.65 ± 2.33	<0.001
Day 8	11 ± 1.6	10.96 ± 1.44	7.62 ± 1.25	9.76 ± 2.15	<0.001

**: No statistical test was applied due to the small sample size, with only one sample in each group on day 1.*

The overall average hours of KMC per day before discharge was 8.8hrs across all groups with higher number of hours of KMC being practiced in mothers in group A(10.1) compared to mothers in group B(9.2) and group C(7.02).This difference was statistically significant($p<0.001$).

However, on follow up, the overall average duration of KMC per day had reduced to 7.2.It was still found to be higher in group A(8.3) when compared with group B(7.4) and group C(6).

Table 18: Comparison of mean KMC parameters and across randomization groups (N=90)

Parameter	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
Average Hours of KMC Per Day Before Discharge	10.1 ± 1.3	9.28 ± 1.28	7.02 ± 1.15	8.8 ± 1.8	<0.001
Average Duration of KMC Per Day on Follow Up (Hours)	8.37 ± 1.43	7.48 ± 1.21	6 ± 1.03	7.28 ± 1.57	<0.001

Table 19: pairwise comparison of mean KMC parameters and across randomization groups (N=90)

Pairs	Mean Difference	P-value
Average hours of KMC per day before discharge		
Group A vs Group B	0.82	0.013
Group A vs Group C	3.08	<0.001
Group B vs Group C	2.27	<0.001
Average Duration of KMC per day on follow up (Hours)		
Group A vs Group B	0.88	0.007
Group A vs Group C	2.37	<0.001
Group B vs Group C	1.48	<0.001

According to the NHM classification, before discharge,33 mothers(36.6%) practiced extended KMC(5-8hours) with majority being in group C(86.6%) followed by mothers in group B(20%) and group A(3.3%).48 mothers(53.3%) had practiced long KMC(9-12 hours) before discharge with majority of participants in group A(80%)

followed by group B(70%) and lowest being in group C(10%).10% of the overall participants practiced continuous KMC(>12hours) with 16.6%,10% and 3% being in group A,B and C respectively.

Higher proportion of mothers in group A and B practiced long and continuous KMC compared to group C.

On follow up,majority of the mothers(73.3%) practiced extended KMC and 23.3% of them practiced long KMC and none of them were found to be practicing continuous KMC. 3.3% of mothers practiced short KMC(<5hours) all of them belonging to C group.

Group A had equal proportion of participants(50%) practicing extended and long KMC while group B had majority of subjects(80%) practicing extended KMC and the rest 20% practicing long KMC.Most of the participants in group C(90%) practiced extended KMC while none of them practiced long KMC.

There was statistically significant difference across the groups with respect to the hours of KMC before discharge and on follow up($p<0.001$).

The overall mean duration of hospital stay was found to be 9.07days with slightly longer duration of stay for group A(9.2) and B(9.2) compared to group C(8.8).There was no statistical significance across groups for the duration of stay.

Table 20: Comparison of Average hours of KMC per day before discharge and on follow up as per NHM guidelines across randomization groups (N=90)

Parameter	Randomization Group			Overall (N=90	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Average Hours of KMC Per Day Before Discharge						
Short(<5hrs)	0(0%)	0 (0%)	0 (0%)	0 (0%)		
Extended(5-8hrs)	1 (3.33%)	6 (20%)	26 (86.67%)	33 (36.67%)	50.610	<0.001
Long(9-12hrs)	24 (80%)	21 (70%)	3 (10%)	48 (53.33%)		
Continuous(>12hrs)	5 (16.67%)	3 (10%)	1 (3.33%)	9 (10%)		
Average Duration of KMC Per Day on Follow Up						
Short(<5hrs)	0 (0%)	0 (0%)	3 (10%)	3 (3.33%)	25.83	<0.001
Extended	15 (50%)	24 (80%)	27 (90%)	66 (73.33%)		
Long	15 (50%)	6 (20%)	0 (0%)	21 (23.33%)		
Continuous	0(0%)	0 (0%)	0 (0%)	0 (0%)		

Figure 22: Cluster bar chart of comparison of Average Hours of KMC Per Day Before Discharge across randomization group (N=90)

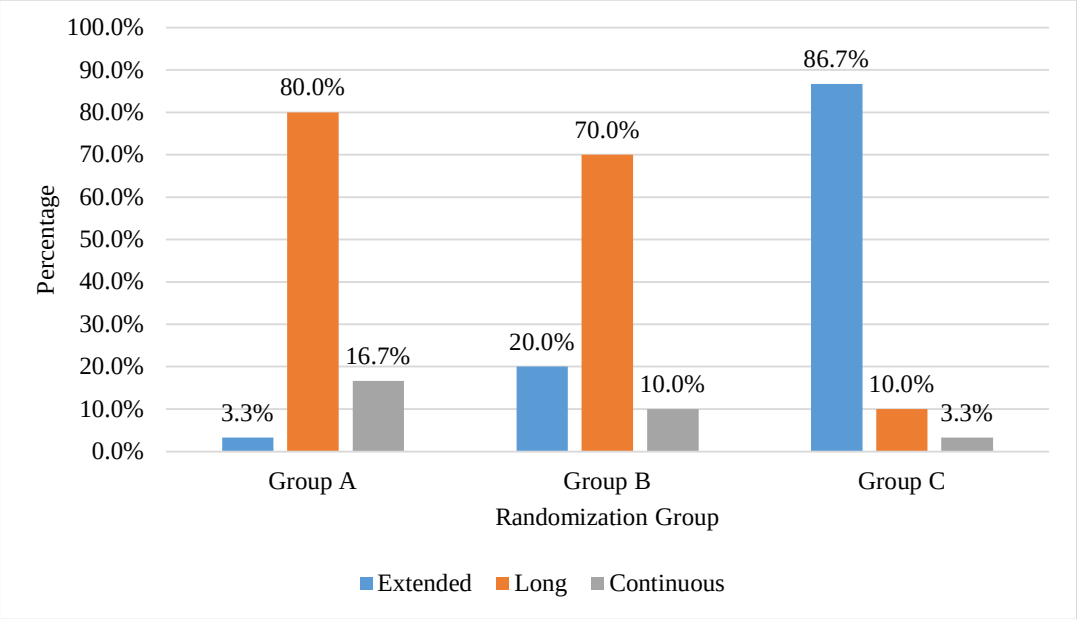


Figure 23: Cluster bar chart of comparison of average hours of KMC per day on follow up across randomization group (N=90)

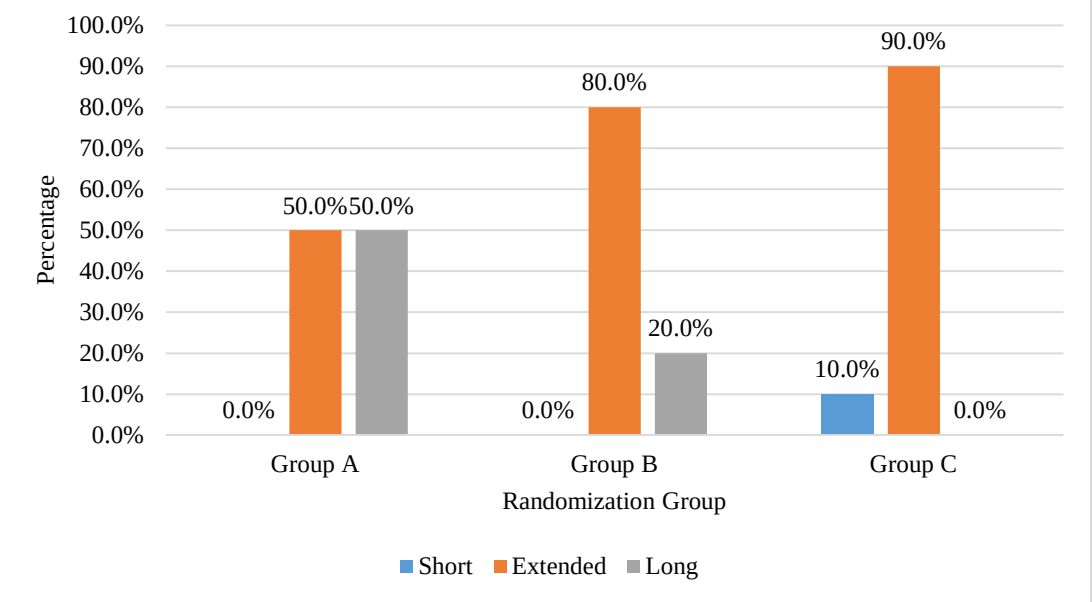


Table 21: Comparison of mean duration of hospital stay (days) and across randomization group (N=90)

Parameter	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
Duration Of Hospital Stay (Days)	9.2 ± 3.31	9.2 ± 2.09	8.8 ± 1.63	9.07 ± 2.43	0.766

Table 22: Pairwise Comparison of mean duration of hospital stay (days) and across randomization group (N=90)

Pairs	Mean Difference	P-value
Group A vs Group B	0.0	1.00
Group A vs Group C	0.4	0.528
Group B vs Group C	0.0	1.00

BREASTFEEDING:

The overall time taken to reach full breastfeed was 9.2days.Particants belonging to group A took shorter time to reach full feeds(8.8) followed by group B(9) and then group C(9.9).There was no statistical significant difference between the groups. Higher proportion of particiants in group A and B were compliant to breastfeeding(93.3%) compared to group C(76.6%) with overall compliance across the groups being 87.7%.The difference was not found to be statistically significant.

Table 23: Comparison of mean parameters and across randomization groups (N=90)

Parameter	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
Time Taken to Reach Full Breastfeeding (Day)	8.87 ± 2.79	9 ± 2.33	9.9 ± 1.58	9.26 ± 2.31	0.170

Table 24: Pairwise comparison of mean parameters and across randomization groups (N=90)

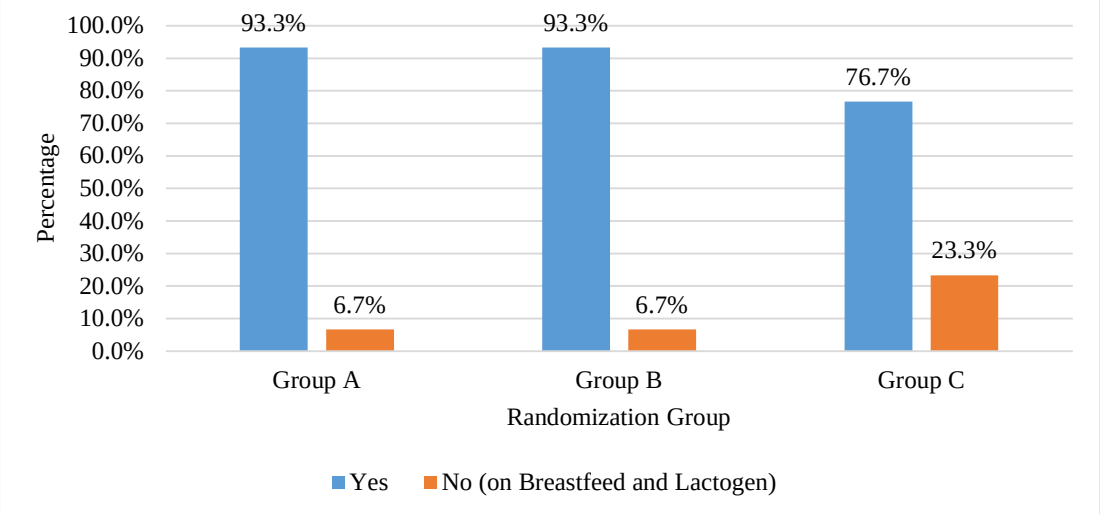
Pairs	Mean Difference	P-value
Group A vs Group B	0.13	0.822
Group A vs Group C	1.03	0.084
Group B vs Group C	0.90	0.132

Table 25: Comparison of compliance to breastfeed on follow up across randomization group (N=90)

Compliance To Breastfeed	Randomization Group			Overall (N=90	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Yes	28 (93.33%)	28 (93.33%)	23 (76.67%)	79 (87.78%)	5.178	0.075
No*	2 (6.67%)	2 (6.67%)	7 (23.33%)	11 (12.22%)		

**Subjects on Breastfeed and formula feed*

Figure 24: Cluster bar chart of comparison of compliance to breastfeed across randomization group (N=90)



ANTHROPOMETRY:

WEIGHT:

The mean birth weight across groups was 2050.44gms with group C having higher mean birth weight(2077gm) compared to group B(2055gm) and group A(2018gm).This was however not statistically significant.

The overall mean day of weight gain was 8.3days.Newborns in group A(7.5days) and B(7.9days) had earlier weight gain being 7.5days and 7.9days respectively when compared to group C(9.5days).The difference was found to be statistically significant.($p<0.001$)

For all 90 newborns, the average weight gain per day on follow up was 16.9gms with newborns in group A having higher average weight gain (20.1gm) compared to group B(17.4gm) and group C(13.2gm).Their difference was statistically significant($p<0.001$).

In the overall analysis, the average duration of Kangaroo Mother Care (KMC) per day showed a significant positive effect on weight gain, with a beta coefficient of 1.89. The 95% confidence interval (CI) ranges from 1.60 to 2.17 grams, indicating a high level of precision in this estimate. The p-value was less than 0.001, demonstrating strong statistical evidence for the positive association between KMC duration and weight gain.

Further, it was observed that the overall time taken to reach 2.5kg weight was 37.4days with group A (32.3) and group B(35.9) newborns taking shorter time compared to newborns in group C(44.1).This difference was statistically significant($p<0.001$).

LENGTH:

The mean length at birth across all groups was 45.6cm.Participants belonging to Group B had higher length at birth(46.1cm) followed by group C(45.7cm) and group A(45.07cm).The difference was however not statistically significant.

The overall average gain in lengh per day on follow up was 0.11cm/day with better gain in length per day in group A(0.12) compared to group B and C(0.1) newborns. The difference was found to be statistically significant($p<0.001$).

HEAD CIRCUMFERENCE:

The mean head circumference at birth across all groups was 32.2cm.Participants belonging to Group A and C(32.3cm) had higher head circumference at birth compared to group B(32cm).This difference was however not statistically significant.

The average gain in head circumference per day on follow up across all groups was 0.04cm/day with better gain per day in group A(0.05) compared to group B and C(0.04).This difference was not statistically significant.

Table 26: Comparison of mean weight parameters and across randomization groups (N=90)

Weight (grams)	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
At Birth	2018.33 ± 223.42	2055.33 ± 200.96	2077.67 ± 176.49	2050.44 ± 200.45	0.517
At Discharge	2034.6 ± 213.71	2065.33 ± 188.51	2054.33 ± 169.19	2051.42 ± 189.61	0.820
At Follow-up	2528.33 ± 14.4	2544 ± 23.43	2548.67 ± 27.38	2540.33 ± 23.82	0.002
Day of Weight Gain	7.5 ± 2.1	7.97 ± 1.52	9.5 ± 1.43	8.32 ± 1.9	<0.001
Average Weight Gain Per Day on Follow Up (gm)	20.17 ± 2.82	17.47 ± 2.1	13.27 ± 1.66	16.97 ± 3.61	<0.001

Table 27: Pairwise comparison of mean weight parameters and across randomization group (N=90)

Pairs	Mean Difference	P-value
Day of weight gain		
Group A vs Group B	0.47	0.293
Group A vs Group C	2.00	<0.001
Group B vs Group C	1.53	0.001
Average weight gain per day on follow up (gm)		
Group A vs Group B	2.70	<0.001
Group A vs Group C	6.90	<0.001
Group B vs Group C	4.20	<0.001

Table 28: Comparison of mean Time Taken to Reach 2.5Kg Weight (Days) and across randomization group in different birth weight population (N=90)

Parameter	Randomization Group			Overall	P Value
	Group A	Group B	Group C		
Overall (N=90)					
Time Taken to Reach 2.5Kg Weight (Days)	32.3 ± 9.57	35.93 ± 10.74	44.17 ± 12.94	37.47 ± 12.12	<0.001
Birthweight 1.5-1.8 kg (N=16)					
Time Taken to Reach 2.5Kg Weight (Days)	44.75 ± 5.73	53.8 ± 4.6	65.67 ± 8.74	51.5 ± 9.87	<0.001
Birthweight 1.8-2 kg (N=17)					
Time Taken to Reach 2.5Kg Weight (Days)	34.2 ± 5.26	37.86 ± 3.72	54.8 ± 9.58	41.76 ± 10.62	<0.001
Birthweight 2-2.2 kg (N=42)					
Time Taken to Reach 2.5Kg Weight (Days)	27.17 ± 5.06	33.77 ± 5.18	40.71 ± 9.29	34.69 ± 8.96	<0.001
Birthweight 2.2-2.5 kg (N=15)					
Time Taken to Reach 2.5Kg Weight (Days)	22.8 ± 1.48	21 ± 3.74	32.4 ± 5.13	25.4 ± 6.24	0.001

Table 29: Comparison of mean growth parameters and across randomization group (N=90)

Parameter	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group A (N=30)	Group A (N=30)		
Length (cm)					
At Birth	45.07 ± 2.86	46.17 ± 1.84	45.7 ± 2.48	45.64 ± 2.45	0.219
At Discharge	45.4 ± 2.8	46.53 ± 1.8	45.8 ± 2.5	45.91 ± 2.42	0.185
At Follow-up	48.77 ± 2.42	49.83 ± 1.62	50 ± 1.95	49.53 ± 2.07	0.042
Average Length Gain Per Day on Follow Up (cm)	0.12 ± 0.02	0.1 ± 0.02	0.1 ± 0.02	0.11 ± 0.02	<0.001
Head Circumference (cm)					
At Birth	32.37 ± 1.22	32 ± 1.08	32.37 ± 0.81	32.24 ± 1.05	0.300
At Discharge	32.5 ± 1.11	32.07 ± 1.01	32.37 ± 0.81	32.31 ± 0.99	0.223
At Follow-up	34.7 ± 1.06	34.13 ± 0.82	34.6 ± 0.56	34.48 ± 0.86	0.024
Average Head Circumference Gain Per Day on Follow Up (cm)	0.05 ± 0.02	0.04 ± 0.02	0.04 ± 0.02	0.04 ± 0.02	0.607

BEMPU alarms:

Group B had higher number of alarms(10) in the first 3 days compared to group A(5). The number of alarms were significantly higher iin group B between days 3 to 6 compared to group A.

The number of alarms reduced significantly as the days progressed with only 1 alarm in group A beyond 7 days of hospital stay.

The average number of alarms per week on follow up was 3.5 overall which was similar and statistically insignificant between groups A and B.

50% of the total mothers were comfortable while practicing KMC with higher proportion of mothers in group A being comfortable(63.3%) compared to group B(46.6%) and group C(40%) mothers.This difference was however not statistically significant.

Table 30: Comparison of number of BEMPU alarms per day before discharge between randomization group (N=60)

Number Of BEMPU Alarms Per Day Before Discharge	Randomization Group		Overall	Chi square	P value
0-3 Days (N=15)					
	Group A (N=5)	**Group B (N=10)**	**Overall (N=15)**		
Once	4 (80%)	7 (70%)	11 (73.33%)	3.545	0.177
Twice	1 (20%)	0 (0%)	1 (6.67%)		
Thrice	0 (0%)	3 (30%)	3 (20%)		
3-6 Days (N=24)					
	Group A (N=5)	**Group B (N=10)**	**Overall (N=24)**		
Once	5 (50%)	14 (100%)	19 (79.17%)	8.84	0.003
Thrice	5 (50%)	0 (0%)	5 (20.83%)		
>7 Days (N=1)					
	Group A (N=1)	**Group B (N=0)**	**Overall (N=1)**		
Once	1 (100%)	-	1 (100%)	-	-

No alarms for 20 subjects

Figure 25: Cluster bar chart of comparison of number of BEMPU alarms per day before discharge between randomization group (N=15)

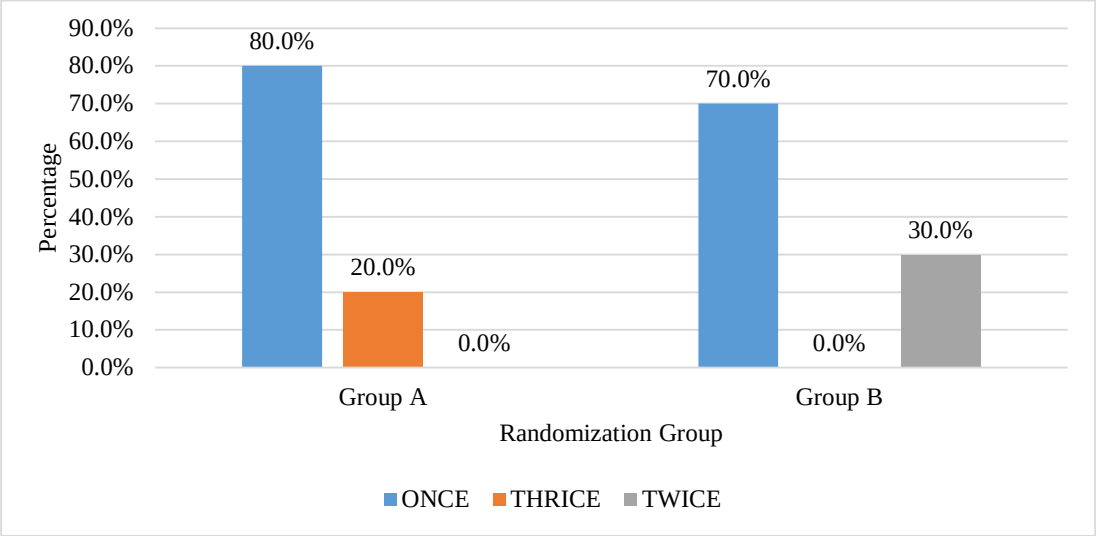


Figure 26: Cluster bar chart of comparison of number of BEMPU alarms per day before discharge between randomization group (N=24)

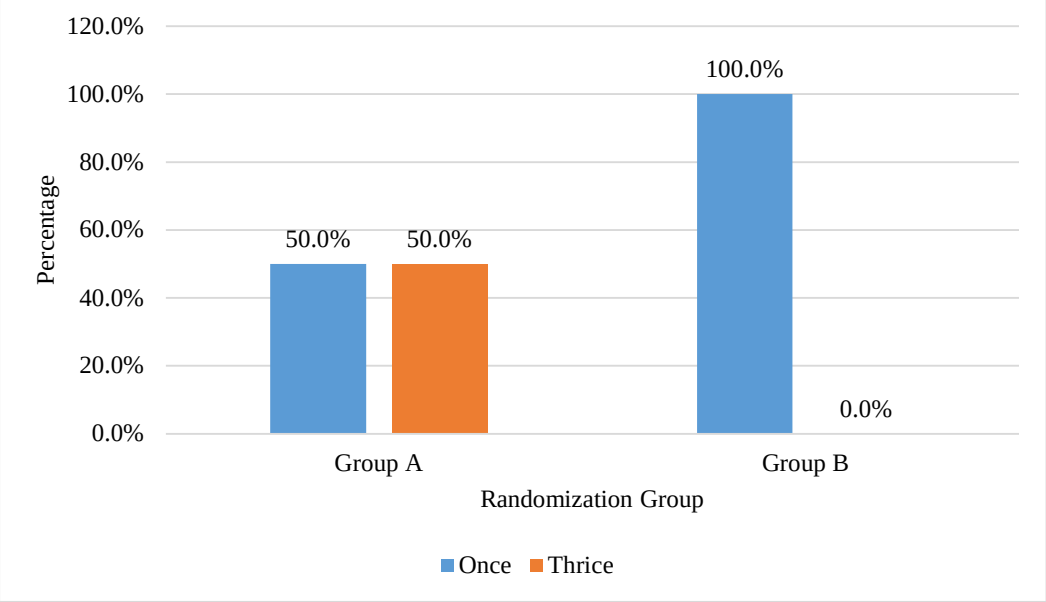


Table 31: Comparison of BEMPU parameters and across randomization group (N=90)

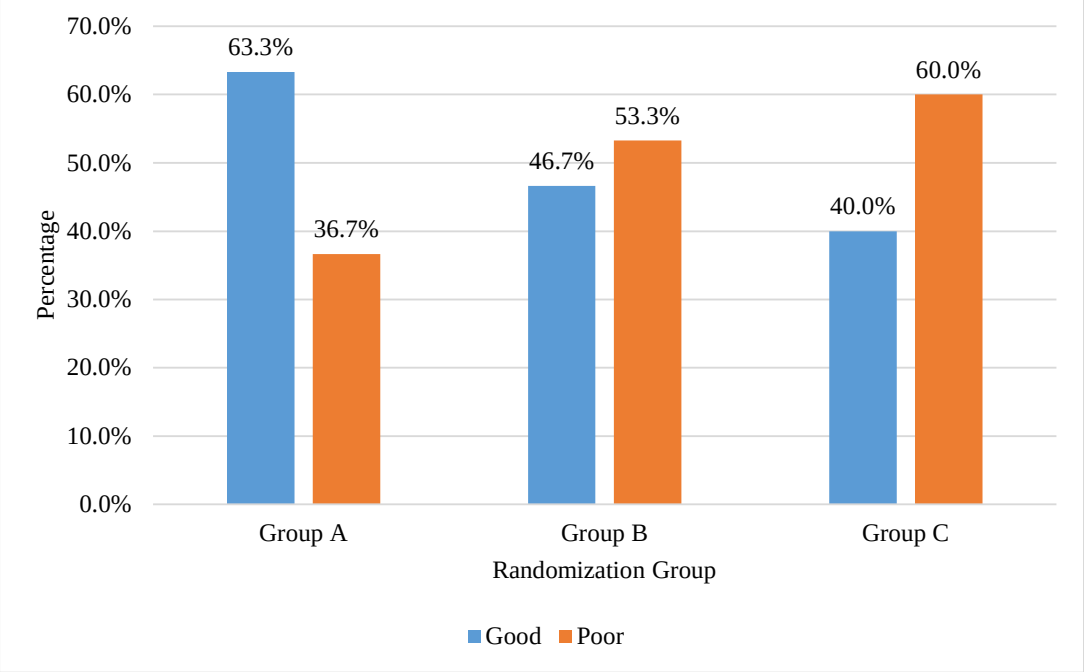
Parameter	Randomization Group			Overall (N=90	P Value
	Group A (N=30)	Group B (N=30)	Group C (N=30)		
Average Number of BEMPU Alarms Per Week on Follow Up	3.5 ± 0.78	3.6 ± 1.16	0 ± 0	3.55 ± 0.98	0.697

Pairwise comparison is not possible as group C has a mean of zero. The p-value reflects the comparison between group A and group B only.

Table 32: Comparison of comfort while practicing KMC across randomization group (N=90)

Comfort While Practicing KMC	Randomization Group			Overall (N=90	Chi square	P value
	Group A (N=30)	Group B (N=30)	Group C (N=30)			
Good	19 (63.33%)	14 (46.67%)	12 (40%)	45 (50%)	3.467	0.177
Poor	11 (36.67%)	16 (53.33%)	18 (60%)	45 (50%)		

Figure 27: Cluster bar chart of comparison of comfort while practicing KMC across randomization group (N=90)



DISCUSSION

Incidence of low birth weight in India is about 27%of total live births.80% of deaths occurs in low birth weight infants.[3]WHO strongly recommends KMC as a part of routine care of newborn in order to improve preterm birth outcomes. Ideally KMC should be practiced for 24 hours but due to lack of compliance it is practiced for 2-10 hours a day.Counselling of mothers and families along with training of health care workers about kangaroo mother care,improving their understanding about the problems with low birth weight newborns and benefits of KMC can help improve compliance to KMC.Various wraps and slings are used to improve compliance to KMC such as kangaroo pouch, thari, wrap and traditional wraps in the form of a long strip of fabric in Indonasia.Study by Sholihatul Amaliya et al found no significant difference in maternal comfort when practicing KMC with any of these KMC carriers[55]. Some countries and facilities have used customised wraps in the health care facility, without studying its effect on KMC; e.g., South Africa uses the Kalafong KMC Thari Wrap[56] and Bangladesh uses the KMC Binder.[57]

Difficulty in positioning the baby and discomfort using the traditional wrap is also identified as barriers to KMC practice. The KANGA SLING is sturdy, hand free,comfortable sling that can help better compliance to kangaroo care.BEMPU is a device that can pick up hypothermia early and can alert the mother to provide KMC hence can improve the compliance.

This study is a three arm Randomised control trial with 2 intervention groups and one control group on newborns admitted to neonatal intensive care unit,under KLES Dr. Prabhakar Kore hospital.

- Group A: LBW babies enrolled in this intervention group were given KANGA sling and BEMPU device.
- Group B: LBW babies enrolled in this group were given the BEMPU bracelet and the conventional cloth wrap for KMC.
- Control group: Babies enrolled in the control group used the conventional cloth wrap for KMC.
- For all 3 groups, routine neonatal care, monitoring and discharge instructions were provided. In routine care patients were counselled regarding how to practice KMC, including how to practice skin to skin contact ,how to care for the low birth weight babies including initiation of breast feeding, expressing breast milk, hygiene, importance of skin-to-skin position and hypothermia detection when the baby was initiated on KMC. Infants were monitored and information regarding temperature, blood glucose levels, heart rate ,respiratory rate and anthropometry along with the number of hours of KMC was recorded everyday until discharge. . Follow-up was conducted until the newborn reached either 40 weeks of age or a weight of 2.5kg, whichever occurred later The data obtained was tabulated into Microsoft excel sheets and IBM SPSS version 22 was used for statistical analysis.

RANDOMIZATION GROUPS:

In our study, randomization of participants into three groups (A,B and C) was executed successfully, with an equal distribution across all groups. Each group comprised of 30 participants, representing 33.33% of the total study population. This equal distribution was crucial as it ensured that each group had the same potential for receiving the intervention, thereby minimizing bias and enabling a fair comparison of outcomes across groups.

NEONATAL FACTORS:

GENDER**:**

The gender distribution in the study population shows a slightly higher proportion of male participants (56.67%) compared to female participants (43.33%). When further comparison of gender across the three randomization groups was done it was observed that group A and group C had similar proportion of males and femlaes (60%,40% respectively),with group B having higher proportion of females than males(53.3%,46.6%).This was however not statistically significant.

GESTATIONAL AGE:

In our study, majority of the newborns were between 34 and 37 weeks period of gestation.(65.56%) as we included newborns with birth weight between 1.5-2.5kg and only when they were clinically stable to initiate KMC. A significant portion (33.33%) had a gestational age of more than 37 weeks, while a small minority (1.11%) had a gestational age between 32 and 33 weeks 6 days.

When compared across randomization groups, group A had the highest proportion of newborns between 34-36 weeks 6 days period of gestation(80%), while group B and group C had the highest proportion of newborns beyond 37weeks gestation(40%).Their differences were not statistically significant, Gestational age of newborns in all three groups were comparable and did not significantly affect the outcome.

BIRTH WEIGHT:

In this study we included newborns having a birth weight between 1.5 to 2.5kg.On further categorising the newborns based on birth weight it was observed that majority of the newborns in our study weighed between 2-2.2kg birth weight(46.6%).There were similar proportion of newborns belonging to the other categories of weight. This indicates a relatively wide distribution of birth weights, with a concentration around the 2- 2.2kg range. Group C had the highest proportion of newborns with a birth weight of 2-2.2kg(56.67%) , while group A had the highest proportion of newborns with birth weight between 1.5-1.8kg(26.67%).However the distribution of newborns across all three groups was similar and the minor differences were not statistically significant.

NEONATAL PROBLEMS AT BIRTH:

Among the 90 newborns,15 newborns had problems at birth.RDS was seen among 4 newborns in group A,3 in group B and 1 newbrorn in group C.4.4% of newborns(4) had transient tachypnoea of newborn(TTNB) with 3 cases in group B and one in group C.Small proportion of newborns(2.2%) had feed intolerance with 1 case each in group B and C.1 newborn(1.11%) was found to have perinatal asphyxia belonging to group A.

All the above problems were observed before the initiation of KMC and hence did not interfere with the implementation of KMC.

Neonatal jaundice:

48.89% of the total newborns had neonatal hyperbilirubinemia. Majority of the cases (60%) were in group C followed by group B(46.67%) and group A(40%).Majority of the cases were seen between day 3 and day 6 of life and required phototherapy hence KMC could not be practiced in those neonates during that period. However number of newborns requiring phototherapy due to hyperbilirubinemia was not statistically significant and did not affect the outcome. The higher number of cases in group C could be due to longer time to reach full breastfeeding of the newborn and due to shorter duration of practice of KMC compared to the newborns belonging to groups A and B.

MODE OF DELIVERY:

In our study, the mode of delivery data indicates that a majority of the deliveries (63.33%) were via lower segment caesarean section(LSCS), while 36.67% were normal vaginal deliveries(NVD and this was across all groups with group C having the highest proportion(66.67%).This difference was statistically insignificant.

MATERNAL FACTORS:

Maternal factors like maternal age, parity and socioeconomic status were proportionately distributed across the groups. They were not found to be statistically significant and did not affect the outcome.

MATERNAL AGE:

The maternal age distribution shows that vast majority of mothers (82.22%) were between 20 to 30 years old. A smaller proportion (16.67%) were over 30 years and a very small number (1.11%) were under 20 years. This indicates that most mothers were within the optimal childbearing age and were capable of understanding and

taking the challenge of caring for low birth weight newborns. When compared across the groups, majority of participants in each group were aged 20-30 years, with a slightly higher proportion in group B and group C(83.33%) compared to group A(80%). The proportion of participants aged over 30 years was relatively small across all groups.

Maternal problems:

The proportion of mothers having Surgical site infection(SSI) was slightly higher(4.44%) when compared to postpartum hemorrhage(PPH) and postpartum blues(3.33%).

2 mothers in group B and 1 each in group A and C had SSI while 2 in group A and 1 in group B had PPH and 2 in group C had postpartum blues. These factors affected the compliance of mothers while providing KMC and required a surrogate to provide KMC. However, statistically significant difference of these problems were not present across the groups. Hence confounding bias of these factors on the outcome is minimised.

KANGAROO MOTHER CARE(KMC):

The overall mean age of initiation of KMC was 2.58 days of life with mean age of initiation being more in group A(3.03) when compared to group B(2.3) and C(2.4) which was statistically significant.This can possibly be attributed to more babies in group A having RDS requiring CPAP for 3-4 days.Secondly more number of babies had lower birth weight(1.5-1.8kg) and lesser gestational age(34 to 36 weeks6days) when compared to group B and C.

A Cochrane review by Sindhu Sivanandan et al in 27 facility based studies, found that the median age for KMC initiation varied between 3 and 24 days. KMC was started within 24 hours after birth in two studies, between 1 and 7 days in 10 studies, and after 7 days in 12 studies (3 studies did not report the time of initiation).[58]

The mean daily hours of KMC practiced by mothers during the hospital stay was higher in the intervention group A where mothers were provided with both the KANGA sling and BEMPU device(10.1hrs) when compared to group B mothers who were provided with only the BEMPU device and conventional cloth wrap(9.2hrs).Mothers belonging to both group A and B practiced KMC for longer hours each day when compared to mothers in group C who used only the conventional wrap(7.02hrs).This difference was statistically significant($p<0.001$).

Mothers in groups A and B took on an average of 4 days to reach their peak number of hours of KMC practiced each day which was between 9 to 12 hours for the majority of them while those in group C took 5days to reached their peak hours of KMC practiced which was between 5 to 8 hours per day during the hospital stay.

Hence use of KANGA sling with BEMPU device or BEMPU device alone promoted statistically significant higher mean daily hours of KMC and earlier attainment of peak hours of KMC.

As per the NHM criteria,it was observed that higher proportion of mothers in group A(96.6%) and group B(80%) practiced KMC long(9-12hrs) and continuous hours(>12hrs) compared to group C(13.3%).This difference was statistically significant($p<0.001$)

Following discharge,the overall average hours of KMC per day was still found to be higher in group A compared to group B and it was lowest among mothers

belonging to group C.The duration of KMC was however was reduced across all groups when compared to the hospital stay(7.28hrs vs 8.8hrs)

As per NHM criteria,Group A had equal proportion of participants(50%) practicing extended (5-8hrs)and long KMC while group B had majority of subjects(80%) practicing extended KMC and the rest 20% practicing long KMC.Most of the participants in group C(90%) practiced extended KMC while none of them practiced long KMC.

There was statistically significant difference across the groups with respect to the hours of KMC before discharge and on follow up($p<0.001$).

Hence our study shows that KANGA sling together with BEMPU device promoted better compliance to KMC at home when compared to use of BEMPU device with conventional wrap or the use of conventional wrap alone. The study also shows that compliance to duration of practice of KMC in mothers was reduced at home when compared to the hospital stay.

This could probably be due to the continuous monitoring of mothers in the hospital in the KMC ward.Secondly, at home many a times the mothers could get involved in household chores and the support to practice KMC at home is not adequate suggesting that home monitoring of KMC by the health care workers and community awareness of the importance of KMC in care of low birth weight babies is essential.

In a study conducted by Chavula K et al,46% of mothers practiced skin to skin contact between 11-19 hours using CarePlus wrap and 44% using the Chitenje traditional wrap in Malawi during the hospital stay.They did not have the documented number of hours of KMC post discharge but they observed that the daily duration of KMC remained high without a significant difference in the study groups[6]

Studies in Malawi and Nepal assessing the mother perception of KMC found women being overwhelmed with household responsibilities,developing anxiety and fatigue discouraging them from practicing KMC at home along with financial difficulties,lack of family support and social stigma.[49]

The overall mean duration of hospital stay was found to be 9.07days with longer duration of stay for group A(9.2) and B(9.2) compared to group C(8.8).There was no statistical significance across groups for the duration of stay.The longer duration of hospital in Groups A and B can be attributed to newborns with lower mean birth weight and gestational age in these groups.

BREASTFEEDING:

The overall time taken to reach full breastfeed was 9.2days. Participants belonging to group A took shorter time to reach full feeds(8.8) followed by group B(9) and then group C(9.9).However,their differences were not statistically significant.

Higher proportion of mothers in group A and B were compliant to breastfeeding(93.3%) compared to group C(76.6%) with overall compliance across the groups being 87.7%.This was not found to be statistically significant.Hence our study shows that KMC promoted compliance to breastfeed irrespective of the duration of KMC.

This could be due to the fact that we followed up the mothers and newborns for a short time,the maximum duration being 73 days.A longer follow up of the mothers and newborns would help to study the benefits of KMC on exclusive breastfeeding.

In a meta-analysis by Alemayehu Gonie Mekonnen et al,it was observed that the mean time to initiate breastfeeding in each study ranged from half day to five days with substantial heterogeneity across studies.The overall pooled mean time for initiation of breastfeeding from in KMC intervention group was 2.6 days earlier than conventional care method.[59]

In a RCT by Suman Rao et al,it was observed that more KMC babies were exclusively breasfed at the end of the study compared to the conventional group not practicing KMC(98% versus 76%).[53]

In a similar study by Geeta Gathwala et al,it was observed that the exclusive breastfeeding rate at the end of three months was 88% in the KMC group practicing KMC on an average of 9hrs per day when compared with the control group not practicing KMC(72%).[60]

In a study by Mohammad Heidarzadeh et al in Iran,it was observed that 62.5%(98) newborns receiving KMC were exclusively breastfed at the time of discharge compared to 37.5%(34) newborns in the control group not practicing KMC.[61]

ANTHROPOMETRY:

WEIGHT:

The mean birth weight across groups was 2050.44gms with group C having higher mean birth weight(2077gm) compared to group B(2055gm) and group A(2018gm).This was however not statistically significant.

The mean day of weight gain overall was 8.3days with group A and B having earlier weight gain at 7.5days and 7.9days respectively compared to group C being 9.5days.This was found to be statistically significant($p<0.001$).

For all 90 newborns, the average weight gain per day on follow up was 16.9gms with participants belonging to group A having higher average weight gain (20.1gm) compared to group B(17.4gm) and group C(13.2gm). There was statistically significant difference in weight gain per day across the groups which could be attributed to the longer duration of KMC being practiced in group A because of use of KANGA sling and BEMPU device compared to group B using BEMPU device with conventional wrap and group C where only conventional wrap was used.

Sukrutha Surandran et al observed that infants provided with 4hr/day of KMC had average weight gain of 10.5gm/day compared to 8hr/day of KMC having a gain of 15.02gm/day.[62]

Study by Nashwa M Samra et al observed that the average weight gain per day was significantly higher in group providing intermittent KMC where mothers practiced KMC for atleast 1hour twice a day(22.3gms) compared to control group not practicing KMC. (10.3gms).[63]

Similar study by Suman,Udani et al in western India reported average weight gain per day in the KMC babies practicing KMC for more than 3hours per day of 23.9gm versus 15.8gm in conventional care.[53]

Jagadish A.S. et al conducted a study in 2016 where they observed that the average weight gain per day was more in the BEMPU group(25.7gms)where average hours of KMC was 3.04 hours as compared to the control group(20.7gms) using only the conventional wrap where it was 2.38 hours.[9]

Somashekhar et al conducted a study to determine the compliance to KMC at home using the BEMPU device where they observed that the mean weight gain over four weeks in the BEMPU group was similar as compared to the control group [756 g vs 774g] even though the mean daily hours of KMC per week was higher in the

intervention group(4.5hours) compared to the control group using the conventional wrap only(2.84hours).[64]

According to study by Tournneux et al,the newborns energy expenditure is used in order of priority for basic metabolism,body temperature regulation and body growth.When KMC decreases the expenses needed for metabolism and thermoregulation,most of the energy is directed towards growth.

In our study, it was observed that the overall time taken to reach 2.5kg weight was 37.4days with newborns belonging to group A (32.3days) and group B(35.9days)taking shorter time compared to group C(44.1days) which was statistically significant.

In a study by Rekha H Udani et al it was observed that the days taken to reach 2.5kg weight in group practicing KMC for 6 to 12 hrs it was 36.1days(mean weight 1591gm) and 33.3days for the group practicing between 12 to 20hrs(mean weight 1537gm).[65]

This was similar to our study where the newborns in groups A and B practicing KMC between 6 to 12 hours had a mean time taken of 32.3 days and 35.9days respectively.

Studies have shown that KMC promotes better weight gain in babies.Our study also had similar observations.In the present study we also observed that longer duration of KMC promoted better weight gain as more mothers of group A and B had practiced continuous and long KMC.This better compliance to KMC was mainly due to use of the KANGA sling and BEMPU device.

LENGTH:

The mean length at birth across all groups was 45.6cm.Participants belonging to Group B had slightly higher length at birth(46.1cm) followed by group C(45.7cm) and group A(45.07cm).This was however not statistically significant.

On follow up, the overall average length gain per day was 0.11cm/day with better length gain per day in group A(0.12) compared to group B and C(0.1).This was found to be statistically significant.

HEAD CIRCUMFERENCE:

The mean head circumference at birth across all groups was 32.2cm.Participants belonging to Group A and C(32.3cm) had slightly higher head circumference at birth compared to group B(32cm).This was however not statistically significant.

The average gain in head circumference per day on follow up across al groups was 0.04cm/day with better gain per day in group A(0.05) compared to group B and C(0.04).This was however not statistically significant.

Sukrutha Surandran et al observed that the average gain in length and head circumference in participants practicing KMC for 4 hrs was 0.8cm/week and 0.62cm/week respectively.The group practicing KMC for 8hrs had a average length gain of 0.85cm/week and head circumference increase by 0.71cm/week.[62]

Study by Udani et al found that gain in length per day was 0.65cm/week and head circumference was 0.63cm per week when KMC was practiced more than 3hrs per day. [53]

Somashekhar et al in their study observed that the mean gain in length over 4weeks in BEMPU group was 4.28cm compared to control group having

4.41cm[p=0.84]. However, the mean gain in head circumference over four weeks was signifcantly less in the BEMPU group as compared to the control group [3.42 mm vs. 3.99 mm; p=0.01][64]

Our study shows that KMC when practiced for longer hours promotes better weight gain,increase in length and increase in head circumference.Use of KANGA sling with BEMPU device promotes practice of longer hours of KMC when compared to use of BEMPU device alone with convententional wrap or conventional wrap alone.Hence use of KANGA sling and BEMPU device together promotes better growth in low birth weight and preterm babies.

BEMPU alarms:

Group B had higher number of alarms(10) in the first 3 days compared to group A(5).

The number of alarms were significantly higher in group B between days 3 to 6 compared to group A.

The number of alarms reduced significantly as the days progressed with only 1 alarm in group A beyond 7 days of hospital stay.

This reduction in the number of alarms beyond 7 days hospital stay could be attributed to better compliance to KMC leading to fewer episodes of hypothermia.

Jagadish A.S. et al conducted a study in 2016 where they observed that the average number of hours of KMC per day over 4 weeks in the BEMPU device group was 3.04 hours as compared to the control group using only the conventional wrap where it was 2.38 hours.[9]

Somashekhar et al conducted a study to determine the compliance to KMC at home using the BEMPU device where they observed that the mean daily hours of KMC per week was higher in the intervention group(4.5hours) compared to the control group using the conventional wrap only(2.84hours).[64]

In a study by Vasanthan Tanigasalam et al to detect the prevelance of hypothermia using BEMPU device,hypothermia was observed at least once in 24 hours among 69.8%,64.7% and 45.7% of very preterm,moderately preterm and term neonates respectively.[47]

In a study by Muppidi Pranitha Reddy et al majority of the mothers (98%) were satisfied regarding the acceptability of the BEMPU watch and thought that it was helpful in the baby's transition from the hospital to home.[66]

50% of the total participants were comfortable while practicing KMC with higher proportion of participants in group A being comfortable(63.3%) compared to group B(46.6%) and group C(40%) mothers.This was however not statistically significant.

Kusum Thapa et al observed that 82 mothers(85%) were more comfortable with the new ergonomic wrap in Nepal compared to the traditional wrap for practicing KMC.[49]

Kondwani Chavula et al in their study noticed that significantly higher proportion of mothers using the CarePlus Wrap were comfortable practicing KMC compared to the the traditional Chitenje in Malawi(96% vs 71%)($p<0.03$).[6]

Hence our study shows that though the conventional sling is low cost and serves the purpose of KMC,mothers are not comfortable with the sling and hence a sling which is more secure and sturdy for the baby will make the mothers more

comfortable and also relieve the fear of the baby falling.This comfort will definitely increase the compliance of KMC.

Similarly the BEMPU device which helps in early diagnosis of hypothermia would help mothers intervene earlier and promote early skin to skin contact thus preventing hypothermia and it's complications. The device promotes a positive behavior change in the mothers motivating them to practice KMC for longer durations and hence improving their compliance to KMC.

Our study shows that use of KANGA sling along with BEMPU device promoted better compliance to KMC when compared to use of conventional wrap with or without BEMPU device.

LIMITATIONS

- The sample size of 90 newborns may be insufficient to detect smaller but clinically significant differences regarding compliance to KMC and other parameters like growth and breastfeeding. Larger sample sizes can help in confirming the findings.
- As most of the newborns in this study were between 2-2.2kg further studies with lower birth weight and gestational age can be done to look for the effect of compliance to KMC with other growth and feeding parameters of the newborn.
- As this study was conducted at a single centre, this might limit generalizability of the results in other populations or settings. Multicentre studies would provide a broader perspective.
- In this study mothers and newborns were followed up for shorter duration, maximum duration being 73 days. A longer follow up would help to study the benefits of duration of KMC on growth and exclusive breastfeeding of the baby.

CONCLUSION

This is a three arm randomised control trial conducted in the neonatal intensive care unit and KMC ward under the KLEH DR. Prabhakar Kore Charitable Hospital, Department of Pediatrics, Jawaharlal Nehru medical College, Belagavi.

We included 90 newborns in our study between 1.5-2.5kg birth weight to assess the compliance to Kangaroo mother care using the KANGA sling and the BEMPU device.

We divided the 90 newborns in the study into three groups: Group A, which used both the BEMPU device and KANGA sling; Group B, which used only the BEMPU device with conventional cloth wrap; and Group C, which used only conventional cloth wrap. We collected data regarding gender,gestational age,birth weight,mode of delivery,maternal problems and neonatal problems at birth and during the hospital stay.Number of hours of KMC per day was assessed along with anthropometry parameters and compliance to breastfeeding until discharge and on follow up until 40weeks gestation or 2.5kg weight

Neonatal factors like gender,gestational age,birth weight,mode of delivery along with newborn problems at birth like RDS,TTNB,perinatal asphyxia and during hospital stay like feeding intolerance and neonatal hyperbilirubinemia were proportionately distributed across the randomisation groups and their difference was not found to be statistically significant hence they did not significantly affect the outcome.

Maternal factors like maternal age,socioeconomic status,parity and maternal problems were comparable across the study arms and their differences were not statistically significant.

The mean age of KMC initiation was more in newborns belonging to group A(3.03days) when compared to newborns in group B(2.3days) and group C(2.4days).This difference was statistically significant.($p<0.002$)

The mean daily hours of KMC practiced by mothers during the hospital stay was higher in the intervention group A that was provided with both the BEMPU device and the KANGA sling when compared to group B that was provided with the BEMPU device and conventional cloth wrap. Mothers belonging to both group A and B practiced KMC for longer hours each day when compared to group C.

Mothers in groups A and B took on an average of 4 days to reach their peak number of hours of KMC practiced each day which was between 9 to 12 hours for the majority of them while those in group C practiced KMC on an average between 5 to 8 hours per day during the hospital stay.

The use of KANGA sling with BEMPU device or BEMPU device alone promoted statistically significant higher mean daily hours of KMC and earlier attainment of peak hours of KMC.

Following discharge, the overall average hours of KMC per day was reduced across all groups when compared to the hospital stay.(7.02hrs vs 8.8hrs)It was still found to be higher in group A compared to group B and it was lowest among mothers belonging to group C.($p<0.001$)

The study compared the average hours of KMC per day before discharge and on follow-up as per NHM guidelines across 90 randomization groups. Higher proportion of mothers in group A and B practiced long and continuous KMC compared to group C during the hospital stay.

On follow up,long KMC was practiced by majority of mothers in group A (50%) followed by group B(20%). Most of the mothers in group C(90%) practiced

extended KMC while none of them practiced long KMC. There was a statistically significant difference across the groups with respect to the hours of KMC before discharge and on follow-up.($p<0.001$)

Our study showed that KANGA sling together with BEMPU device promoted better compliance to KMC at home when compared to use of BEMPU device with conventional wrap or the use of comventional wrap alone.

Hence, the study shows that compliance to duration of practice of KMC in mothers is better in the hospital than at home.

The overall time taken to reach 2.5kg weight was shorter in group A compared to group B and was longest in group C.($p<0.001$)

Time taken to reach to full breastfeeds was shorter among newborns belonging to group A compared to group B and was longest among newborns in group C though not statistically significant.Hence our study showed that KMC promoted compliance to breastfeed irrespective of the duration of KMC.

Newborns belonging to group A took shorter time before they started gaining weight compared to newborns in group B.Newborns in group C took the longest time.($p<0.001$)

Our study showed that KMC when practiced for longer hours promotes better weight gain,increase in length and increase in head circumference.Use of KANGA sling and BEMPU device together promoted better growth in low birth weight and preterm babies.

The number of BEMPU alarms per day reduced progressively with very few alarms after day 7 of hospital stay.Newborns using both the KANGA sling and BEMPU device had fewer alarms during the hospital stay compared to newborns using BEMPU device only.

We conclude from our study that the use of KANGA sling along with BEMPU device promotes better compliance to KMC, better growth and better breastfeeding when compared to use of conventional wrap with or without BEMPU device.

We recommend the use of KANGA SLING together with the BEMPU device while practicing KMC for better compliance to KMC.

We recommend training of health care workers and ASHA workers regarding the importance of KMC in low birth weight babies to promote better compliance to KMC at home.

SUMMARY

The study aimed to investigate the impact of Kanga Sling (KANGA SLING) and Hypothermia Alert Device (BEMPU) on parent compliance to Kangaroo care in low birth weight babies between 1.5-2.5 kg. The study divided 90 newborns into three groups: Group A, which used both the KANGA sling and BEMPU device; Group B, which used only the BEMPU device with conventional cloth wrap; and Group C, which used only conventional cloth wrap.

Neonatal factors such as gender,gestational age, birth weight, mode of delivery along with newborn problems at birth like RDS, TTNB, perinatal asphyxia and during hospital stay like feeding intolerance, hypoglycemia and neonatal hyperbilirubinemia were proportionately distributed across the randomisation groups. Hence they did not have a role in the results of the study.

Maternal factors such as maternal age,socioeconomic status,parity and maternal problems were comparable across the study arms and did not affect the results of the study.

In the present study, it was observed that the KANGA sling together with the BEMPU device promoted significantly better compliance to KMC when compared to the BEMPU device with the conventional wrap or the use of conventional wrap alone.

Mothers in the intervention group using both the KANGA sling and BEMPU device practiced KMC for statistically significant($p<0.001$) longer duration and had earlier attainment of peak hours of KMC when compared to the mothers using BEMPU device with the conventional wrap or the conventional wrap alone.

We also observed in the study that the duration of KMC practiced per day was reduced at home when compared to the hospital stay.Mothers in group A were found

to have significantly better compliance to KMC even at home compared to group B and group C.

As per NHM criteria for the duration of KMC, mothers in group A were found to have statistically significant($p<0.001$) better compliance to KMC compared to mothers in group B and group C. More mothers in group A were observed to be practicing long and continuous KMC compared to mothers belonging to group B and group C.

Newborns belonging to group A took significantly shorter time to start gaining weight compared to newborns in group B and it was longest in group C.

It was observed in the study that newborns in group A that practiced KMC for longer hours had statistically significant($p<0.001$) better weight gain and increase in length compared to newborns belonging to group B and group C. Increase in head circumference was better in group A though it was not statistically significant.

The overall time taken to reach 2.5kg was significantly shorter among the newborns in group A compared to group B and was longest in group C($p<0.001$)

Time taken to reach to full breastfeeds was shorter among newborns belonging to group A compared to group B and was longest among newborns in group C though not statistically significant.

It was observed in our study that better compliance to KMC is associated fewer episodes of hypothermia in the newborn as the number of BEMPU alarms was found to be significantly lesser in group A that practiced KMC for longer duration compared to newborns in group B.

Hence, our study showed that the use of KANGA sling along with BEMPU device promoted better compliance to KMC,better growth and better breastfeeding of

the newborn when compared to use of conventional wrap with or without BEMPU device.

We recommend the use of KANGA sling together with BEMPU device together to practice KMC in low birth weight newborns.

However our study had limitations such as small sample size, single centre study and short term follow up of the LBW newborns. Hence, larger multicentric studies are required to generalise the results of our study and to study the benefits of the KANGA sling and BEMPU device on compliance and implementation of KMC.

BIBLIOGRAPHY

1. World health Organization. International statistical classification of diseases and related health problems, tenth revision, 2nd ed. World Health Organization; 2004.
2. Haram, K., Søfteland, E., & Bukowski, R. (2013). Intrauterine Growth Restriction: Effects of Physiological Fetal Growth Determinants on Diagnosis. Obstetrics and Gynecology International, 2013, 1–9.
3. Mishra, C., Kumar, R., & Khera, A. (2014). Kangaroo Mother Care & Optimal Feeding of Low Birth Weight Infants Operational Guidelines. In *Operational Guidelines*. Ministry of Health and Family Welfare, Government of India.
4. Liu L, Oza S, Hogan D, Chu Y, Perin J, Zhu J, et al. Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the Sustainable Development Goals. Lancet. 2016; 388(10063):3027–35.
5. WHO. WHO recommendations on interventions to improve preterm birth outcomes. Geneva: World Health Organization; 2015.
6. Chavula K, Guenther T, Valsangkar B, Lwesha V, Banda G, Bøe Wensaas M, et al. (2020) Improving Skin-to-Skin Practice for babies in Kangaroo Mother Care in Malawi through the use of a customized baby wrap: A randomized control trial. PLoS ONE 15(3): e0229720.
7. McCall, E. M., Alderdice, F., Halliday, H. L., Vohra, S., & Johnston, L. (2018). Interventions to prevent hypothermia at birth in preterm and/or low birth weight infants. *Cochrane Library*, *2018*(2).
8. Kumar V, Shearer JC, Kumar A, Darmstadt GL. Neonatal hypothermia in low resource settings: a review. J Perinatol. 2009 ;29:401–12.

9. S, J. A., Benakappa, A., Benakappa, N., & Morgan, G. (2019). A randomized control trial of hypothermia alert device in low birth weight newborns and the effect on kangaroo mother care and weight gain. *International Journal of Contemporary Pediatrics*, *7*(1), 52
10. Lei D, Tan K and Malhotra A (2021) Temperature Monitoring Devices in Neonates. Front. Pediatr. 9:732810.
11. Quinn J.A., Munoz F.M., Gonik B., Frau L., Cutland C., Mallet-Moore T., Kissou A., Wittke F., Das M., Nunes T., Pye S., Watson W., Ramos A.A., Cordero J.F., Huang W.T., Kochhar S., Buttery J., Brighton Collaboration Preterm Birth Working Group Preterm birth: Case definition & guidelines for data collection, analysis, and presentation of immunisation safety data. *Vaccine.* 2016;**34**(49):6047–6056.
12. WHO. Global nutrition targets 2025: low birth weight policy brief Geneva. World Health Organization; 2014.
13. Lawn J.E., Cousens S., Zupan J. 4 million neonatal deaths: when? Where? Why? *Lancet.* 2005;**365**(9462):891–900.
14. Villar J., Papageorghiou A.T., Knight H.E., Gravett M.G., Iams J., Waller S.A. The preterm birth syndrome: a prototype phenotypic classification. *Am J Obstet Gynecol.* 2012;**206**(2):119–123.
15. Sharma D., Shastri S., Sharma P. Intrauterine growth restriction: antenatal and postnatal aspects. *Clin Med Insights Pediatr.* 2016;**10**:67–83.
16. Goldenberg R.L., Culhane J.F., Iams J.D., Romero R. Epidemiology and causes of preterm birth. *Lancet.* 2008;**371**(9606):75–84.
17. Johnson C.D., Jones S., Paranjothy S. Reducing low birth weight: prioritizing action to address modifiable risk factors. *J Public Health (Oxf)* 2016

18. Romero R., Dey S.K., Fisher S.J. Preterm labor: one syndrome, many causes. *Science.* 2014;**345**(6198):760–765.

19. Romero R., Espinoza J., Goncalves L.F., Kusanovic J.P., Friel L., Hassan S. The role of inflammation and infection in preterm birth. *Semin Reprod Med.* 2007;**25**(1):21–39.

20. *Preterm birth*. (2023, May 10). https://who.int/news-room/fact-sheets/detail/preterm-birth

21. Alexander GR, Kogan M, Bader D, Carlo W, Allen M, Mor J. US birth weight/gestational age-specific neonatal mortality: 1995-1997 rates for whites, hispanics, and blacks. Pediatrics. 2003 Jan;111(1):e61-6. doi: 10.1542/peds.111.1.e61. PMID: 12509596; PMCID: PMC1382183.

22. Institute of Medicine (US) Committee on Understanding Premature Birth and Assuring Healthy Outcomes; Behrman RE, Butler AS, editors. Preterm Birth: Causes, Consequences, and Prevention. Washington (DC): National Academies Press (US); 2007. 10, Mortality and Acute Complications in Preterm Infants.

23. Stevens TP, Blennow M, Soll RF. Early surfactant administration with brief ventilation vs. selective surfactant and continued mechanical ventilation for preterm infants with or at risk for rds. Cochrane Database of Systematic Reviews (Online: Update Software). 2002

24. Vaucher YE. Bronchopulmonary dysplasia: An enduring challenge. Pediatrics in Review/American Academy of Pediatrics. 2002;23(10):349–358.

25. Finer NN, Higgins R, Kattwinkel J, Martin RJ. Summary proceedings from the apnea of prematurity group. Pediatrics. 2006;117:47–51.

26. Lemons JA, Bauer CR, Oh W, Korones SB, Papile LA, Stoll BJ, Verter J, Temprosa M, Wright LL, Ehrenkranz RA, Fanaroff AA, Stark A, Carlo W,

Tyson JE, Donovan EF, Shankaran S, Stevenson DK. Very low birth weight outcomes of the National Institute of Child Health and Human Development Neonatal Research Network, January 1995 through December 1996. Pediatrics. 2001;107:E1.

27. Cohen BA, Siegfried EC. Newborn skin: Development and basic concepts. In: Taeusch HW, Ballard RA, Gleason CA, editors. Avery's Diseases of the Newborn. 8th edition. Philadelphia, PA: Elsevier Saunders; 2005. pp. 1471–1483.
28. Repka MX. Ophthalmological problems of the premature infant. Mental Retardation and Developmental Disabilities Research Reviews. 2002;8(4):249–257.
29. De Vries LS, Groenendaal F. Neuroimaging in the preterm infant. Mental Retardation and Developmental Disabilities Research Reviews. 2002;8(4):273–280.
30. Malviya M, Ohlsson A, Shah S. Surgical versus medical treatment with cyclooxygenase inhibitors for symptomatic patent ductus arteriosus in preterm infants. Cochrane Reviews. 2006;1
31. Veerappan S, Rosen H, Craelius W, Curcie D, Hiatt M, Hegyi T. Spectral analysis of heart rate variability in premature infants with feeding bradycardia. Pediatric Research. 2000;47(5):659–662.
32. World Health Organization. Guideline: Delayed umbilical cord clamping for improved maternal and infant health and nutrition outcomes. World Health Organization; 2014
33. Askin DF. Complications in the transition from fetal to neonatal life. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 2002;31(3):318-27.

34. Mank A, van Zanten HA, Meyer MP, Pauws S, Lopriore E, Te Pas AB. Hypothermia in preterm infants in the first hours after birth: Occurrence, course and risk factors. PloS one. 2016;11(11):e0164817.

35. Raman TR, Devgan A, Sood SL, Gupta A, Ravichander B. Low birth weight babies: Incidence and risk factors. Medical Journal Armed Forces India. 1998;54(3):191-95

36. Lunze K, Bloom DE, Jamison DT, Hamer DH. The global burden of neonatal hypothermia: systematic review of a major challenge for newborn survival. BMC Med. 2013 Dec;11(1):24

37. Agarwal S, Sethi V, Srivastava K, Jha P, Baqui AH. Human touch to detect hypothermia in neonates in Indian slum dwellings. Indian J Pediatr. 2010 Jul 1;77(7):759-62.

38. Low birth weight country, regional, and global estimates, UNICEF, 2014.

39. Kumar, V., Shearer, J. C., Kumar, A. & Darmstadt, G. L. Neonatal hypothermia in low resource settings: A review. J. Perinatol. 29, 401–412 (2009)

40. Bhutta, Z. A. et al. What works? Interventions for maternal and child undernutrition and survival. Te Lancet 371, 417–440 (2008)

41. Jirapaet V, Jirapaet K. Comparisons of tympanic membrane, abdominal skin, axillary, and rectal temperature measurements in term and preterm neonates. Nurs Health Sci. (2000) 2:1–8. doi: 10.1046/j.1442-2018.2000.00034

42. Lei D, Tan K and Malhotra A (2021) Temperature Monitoring Devices in Neonates. Front. Pediatr. 9:732810. doi: 10.3389/fped.2021.732810

43. WHO. Thermal Protection of the Newborn: A Practical Guide. Geneva CH: WHO (1997).

44. Bailey J, Rose P. Axillary and tympanic membrane temperature recording in the preterm neonate: a comparative study. J Adv Nurs. (2001) 34:465– 74.

45. Agarwal S, Sethi V, Pandey RM, Kondal D. Human touch vs. axillary digital thermometry for detection of neonatal hypothermia at community level. J Trop Pediatr. (2008) 54:200–1

46. BEMPU. Technical Specifications—Bempu Hypothermia Device. Karnataka, IN: BEMPU Health

47. Tanigasalam V, Vishnu Bhat B, Adhisivam B, Balachander B, Kumar H. Hypothermia detection in low birth weight neonates using a novel bracelet device. J Matern Fetal Neonatal Med. (2019) 32:2653–6.

48. Sreekumar K, Nachinolkar P, Silveira MP. Preventing excessive postnatal weight loss in healthy new-borns. Will continuous temperature monitoring help? Int J Med Biomed Stud. (2019) 3:77–82. doi: 10.32553/ijmbs.v3i11.714

49. Thapa K, Mohan D, Williams E, Rai C, Bista S, Mishra S, et al. (2018) Feasibility assessment of an ergonomic baby wrap for kangaroo mother care: A mixed methods study from Nepal. PLoS ONE 13(11): e0207206.

50. Sharma M, Morgan V, Siddadiah M, Songara D, Bhawsar RD, Srivastava A. Impact of a novel hypothermia alert device on death of low birthweight babies at four weeks: A nonrandomized controlled community-based trial. Indian Pediatrics. 2020;57(4):305-09

51. Mohanasundari, S., & Padmaja, A. (2019). National Health Mission (NHM) and India Newborn Action Plan (INAP) Services in Newborn Health-An Overview. *International Journal of Advances in Nursing Management*, *7*(4), 366. https://doi.org/10.5958/2454-2652.2019.00086.6

52. Rehman MO, Hayat S, Gul R, Waheed KA, Victor G, Khan MQ. Impact of intermittent kangaroo mother care on weight gain of neonate in nicu: Randomized control trial. J Pak Med Assoc. 2020 Jun;70(6):973-7.

53. Suman Rao PN, Udani R, Nanavati R. Kangaroo mother care for low birth weight infants: a randomized controlled trial. Indian pediatrics. 2008;45(1):17.

54. Pal A, Manna S, Das B, Dhara PC. The risk of low birth weight and associated factors in West Bengal, India: a community based cross-sectional study. Egyptian Pediatric Association Gazette. 2020 Dec;68(1):1-1

55. Amaliya S, Rustina Y, Agustini N. Comparison of various Kangaroo mother care carriers on maternal comfort: a pilot study. *Compr. Child Adolesc. Nurs.* 2017;40(sup1):52–61.

56. Van Rooyen E. *Guidelines for mothers in KMC Unit*. Pretoria: University of Pretoria; 2007.

57. Hasan R, Alam R, Hossain S, Ahsan Z. *Facility readiness and initiation of Kangaroo mother care*. Dhaka: Save the Children Bangladesh; 2017.

58. Sivanandan S, Sankar MJ. Kangaroo mother care for preterm or low birth weight infants: a systematic review and meta-analysis. BMJ Glob Health. 2023 Jun;8(6):e010728. doi: 10.1136/bmjgh-2022-010728. PMID: 37277198; PMCID: PMC10254798.

59. Mekonnen, A.G., Yehualashet, S.S. & Bayleyegn, A.D. The effects of kangaroo mother care on the time to breastfeeding initiation among preterm and LBW infants: a meta-analysis of published studies. *Int Breastfeed J* **14**, 12 (2019).

60. Gathwala G, Singh B, Singh J. Effect of Kangaroo Mother Care on physical growth, breastfeeding and its acceptability. Trop Doct. 2010 Oct;40(4):199-202. doi: 10.1258/td.2010.090513. Epub 2010 Jul 28. PMID: 20667921.

61. Heidarzadeh M, Hosseini MB, Ershadmanesh M, Gholamitabar Tabari M, Khazaee S. The Effect of Kangaroo Mother Care (KMC) on Breast Feeding at the Time of NICU Discharge. Iran Red Crescent Med J. 2013 Apr;15(4):302-6. doi: 10.5812/ircmj.2160. Epub 2013 Apr 5. PMID: 24083002; PMCID: PMC3785903.

62. Surandran, S., & K, N. N. (2023). Impact of duration of kangaroo mother care on growth in preterm and low birth weight neonates: a prospective cohort study. *International Journal of Contemporary Pediatrics*, *10*(5), 680–684.

63. Samra NM, Taweel AE, Cadwell K. Effect of intermittent kangaroo mother care on weight gain of low birth weight neonates with delayed weight gain. J Perinat Educ. 2013 Fall;22(4):194-200. doi: 10.1891/1058-1243.22.4.194. PMID: 24868132; PMCID: PMC4010854.

64. Nimbalkar, S.M., Patel, V.T., Patel, D.V. *et al*. Impact of hypothermia alert device (BEMPU) on improvement of duration of Kangaroo Mother Care (KMC) provided at home: parallel-group randomized control trial. *Sci Rep* **13**, 4368 (2023).

65. Udani RH, Kabra N, Nanavati RN, VR A. Kangaroo Mother Care (KMC): A cohort follow up study on impact of duration of KMC on mortality, morbidity, hospital stay and breastfeeding. Journal of Neonatology. 2013;27(1):5-10. doi:10.1177/0973217920130102

66. Reddy MP, Murki S, Kiran S et.al. Neonatal hypothermia monitoring and alerting device, acceptability among mothers and caregivers. International Journal of Research and Review. 2019; 6(12):217-220.

ANNEXURES – I

INFORMED CONSENT FORM

"IMPACT OF HYPOTHERMIA ALERT DEVICE(BEMPU) AND WRAP (KANGA SLING) ON PARENT COMPLIANCE TO KANGAROO CARE IN LOW BIRTH WEIGHT BABIES BETWEEN 1.5-2.5KG COMPARED TO THE CONVENTIONAL KANGAROO MOTHER CARE. A ONE YEAR HOSPITAL BASED THREE ARM RANDOMIZED CONTROL TRIAL."

Name of Student/Principal Investigator:

Name of Guide/Co Investigators:

Objective: Assess to parent compliance to kangaroo mother care (KMC) with BEMPU device and kanga sling in low birth weight babies between 1.5-2.5kg compared to the conventional kangaroo mother care.

Introduction: WHO strongly recommends KMC as a part of routine care of newborn in order to improve preterm birth outcomes. Ideally KMC should be practiced for 24 hours but due to lack of compliance it is practiced for 2-10 hours a day. The utilization of traditional cloth wrap has certain disadvantages that impede the appropriate adherence to KMC.The KANGA SLING is sturdy, hand free, comfortable sling that can help better compliance to kangaroo care. BEMPU is a device that can pick up hypothermia early and can alert the mother to provide KMC hence can improve the compliance.

Explanation of procedure: 90 newborns in the study Will be divided into three groups: Group A, which used both the KANGA sling and BEMPU device; Group B, which used only the BEMPU device with conventional cloth wrap; and Group C, which used only conventional cloth wrap. Data regarding gender,gestational age,birth weight,mode of delivery,maternal problems and neonatal problems at birth and during the hospital stay

will be recorded into a structured proforma.. Number of hours of KMC per day will be assessed along with anthropometry parameters and compliance to breastfeeding until discharge and on follow up until 40weeks gestation or 2.5kg weight whichever happens later.

Withdrawal from participation in the study: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: REG NO BM0121004 Department of pediatrics, KLE Academy of Higher Education and Research, Jawaharlal Nehru Medical College, Belagavi-590010, Karnataka.

If you have any question or complaints with regard to your right as study participant you may contact **Dr. Harsha Hegde,** Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights.

ANNEXURE – II – PROFORMA

PROFORMA FOR DATA COLLECTION

PROFORMA		
To be filled with mother of LBW/Preterm babies during stay at healthcare facility		
Study group : A ☐ B ☐ C ☐		
1. Background information		
1.1. NAME	1.2. IP no.	
1.3. Age of mother(completed years)	1.4 Date of birth of the baby	
1.5 Gestation age	1.6 Socio Economic status	
1.7Type of Delivery	Normal Vaginal delivery ☐	
	LSCS ☐	
1.8 Birth weight (grams)	1.9 Sex :	Male ☐
		Female ☐
1.10 Contact number:		

EXAMINATION AT BIRTH-

General physical examination	**HEAD TO FOOT EXAMINATION**
Active/lethargic- Vitals- HR RR TEMP CFT ANTHROPOMETRY- Weight- Length- Head circumference-	Head moulding/fontanelle/caput/cephalhematoma- Eyes-heamorrhage/any abnormality Ears-position/shape- Nose-abnormal shape/size- Mouth-lips/gums/patate/natal teeth- Skin-jaundice/cyanosis/rashes/hemangioma- Umbilicus- Genitalia- Hip/Back and spine- Any other finding-

R/S: -
CVS: -
PA: -
CNS: -

2. KMC related information	
2. 1. Date of KMC admission	2. 2. Age/CGA of KMC admission

EXAMINATION ON ADMISSION-

General physical examination	**Systemic examination**
AF PF Back and spine Genitals: - Anal opening Other significant: - Vitals- Temp RR HR Pulse CFT Weight Length Head circumference	R/S: - CVS: - PA: - CNS: -

EXAMINATION ON ADMISSION-

General physical examination	**Systemic examination**
AF PF Back and spine Genitals: - Anal opening Other significant: - Vitals- Temp RR HR Pulse CFT Weight Length Head circumference	R/S: - CVS: - PA: - CNS: -

Monitoring of the infant:

DAY OF LIFE	HOURS OF KMC	NUMBER OF BEMPU DEVICE BEEPS	RBS	WEIGHT	MODE OF FEEDING	TYPE OF FEED

Total no of hospital stay days:

Age at discharge:

Weight of baby at discharge:

Length of baby at discharge:

Head circumference of baby at discharge:

Section F: To be filled during PNC follow up	
1. Background Information	
1.1.ID no	1.2.Date of Follow up
1.3.Weight of baby	1.4. Attended PNC YES NO
Follow up questions	
2. Condition of mother and baby	

How are you?	Week 1	Week 2	Week 3	Week 4
Fine				
Not feeling well				

	Week 1	Week 2	Week 3	Week 4
Fever				

What are the health problems? (multiple response)				
Pain in wound				
Breast engorgement				
Loose motion				
Vomiting				
Cough and congestion				
Others specify……				

Are you exclusively breastfeeding your baby?	Week 1	Week 2	Week 3	Week 4
3. KMC practice				
3.1.How many hours do you practice KMC per day (including both day and night) in this week.	WEEK 1	WEEK 2	WEEK 3	WEEK 4

3.2.How many times did the BEMPU device beep per day this week?				

Perception of KMC wrap	**Agree**	**Unsure**	**Disagree**
1.1. It is comfortable to perform KMC with chosen wrap.			
1.2.The chosen wrap can hold the baby securely during KMC.			

4. Family and Community acceptability		
4.1.Is your husband also providing KMC? (doing KMC during your time for dinner, toilet, bathing, rest etc)	Yes ☐	No ☐
4.2. Is your family member also providing KMC? (doing KMC during your time for dinner, toilet, bathing, rest etc)	Yes ☐	No ☐
5. ANTHROPOMETRY		
Age of the baby: CGA- Weight of baby : Length of baby: Head circumference of baby:		

6. Satisfaction and Recommendation		
a. Are you satisfied with the chosen wrap?	Yes ☐	No ☐
b. Do you recommend BEMPU device to other mothers with preterm/LBW babies?	Yes ☐	No ☐
c. Do you recommend the selected KMC wrap to other mothers with preterm/LBW babies?	Yes ☐	No ☐

Thank participant for the continuing support from the beginning of the study and ask if she wants to share something important about the perception, usefulness and challenges or story/ verbatim of KMC practice that she might think has not been covered by the conversation till date.

……
……
……
……

ANNEXURE 3 – PHOTOGRAPHS

Figure no 28. KMC using KANGA sling

Figure no 29. Conventional KMC

Figure no 30. Conventional wrap vs KANGA sling

Figure no 31. BEMPU device

						Weight (grams)					Length (cm)			Head circumference (cm)																			Number of hours of KMC practiced each day								
IP_number	Randomization_group	maternal_age	DOB	Gender	mode of delivery	At birth	At discharge	At follow up	Time taken to reach 2.5kg weight	Gestational age	At birth	At discharge	At follow up	At birth	At discharge	at follow up	age_kmc_initiation	Average hours of kmc per day before discharge	number of BEMPU alarms per day before discharge	time taken to reach full breastfeeding	day of weight gain	duration of hospital stay	neonatal jaundice	hypoglycemia	average duration of kmc per day on follow up	average number of BEMPU alarms per week on follow up	average weight gain per day on follow up	compliance to breastfeed	PARITY	MATERNAL COMPLICATIONS	FETAL COMPLICATIONS	SOCIOECONOMIC	day 1	day2	day 3	day 4	day 5	day 6	day 7	day 8	Comfort while practicing KMC
10002116	A	24	20-09-2023	M	NVD	2300	2220	2510	22days	36W1DAY	46	46	49	34	34	36	DAY 2 OF LIFE	10	NIL	5DAYS	DAY 5	4DAYS	NO	NO	7HRS	4	17GMS	YES	PRIMI	NIL	NIL	lower middle	nil	8	10	12	10				GOOD
10019995	A	27	11-11-2023	M	LSCS	2300	2296	2520	23days	36WEEK	47	47	49	34	34	36	DAY 2 OF LIFE	9	ONCE DAY 2	7	8	8DAYS	YES	NO	6.5HRS	3	15gms	YES	G2P1L1	NIL	NIL	lower middle	nil	6	8	PT	PT	10	11	9	GOOD
10028572	A	29	08-08-2023	M	LSCS	2300	2298	2510	21days	36W5D	46	46	49	34	34	36	DAY 2 OF LIFE	11.5	NIL	6	7	8DAYS	NO	NO	8HRS	4	18gms	YES	PRIMI	NIL	NIL	lower middle	nil	7	11	13	12	14	13	12	GOOD
10020261	A	28	15-11-2023	F	LSCS	2280	2290	2540	25days	37W4D	45	45	48	34	34	36	DAY 2 OF LIFE	8.5	ONCE DAY2 AND 5	8	9	9DAYS	YES	NO	6HOURS	3	16gms	YES	G3P2L2	SSI	NIL	lower	nil	7	9	11	6	PT	PT	9	GOOD
10008246	A	24	20-09-2023	M	NVD	2300	2250	2530	23days	36W1DAY	47	47	49	34	34	36	DAY 2 OF LIFE	7.5	NIL	6	9	5DAYS	NO	NO	5.5HRS	3	15gms	YES	PRIMI	NIL	NIL	lower middle	nil	7	8	9.5	9				POOR
10008851	A	32	22-09-2023	M	LSCS	1520	1620	2510	52days	34W4D	42	43	48	30	31	35	DAY 3 OF LIFE	11	ONCE DAY 4,5	15DAYS	7	14DAYS	YES	NO	9HRS	5	23gms	YES	G2P1L1	NIL	RDS	middle	nil	nil	6	8	9	PT	PT	11	GOOD
10010636	A	30	30-09-2023	F	LSCS	1700	1720	2520	44days	35WEEK	43	43	47	33	33	36	DAY 3 OF LIFE	10.5	ONCE DAY 3	8	6	6DAYS	NO	NO	8HRS	4	21gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	7	11	12	11			GOOD
11205888	A	23	28-08-2023	M	LSCS	1920	1884	2550	42days	34W6D	45	45	50	32	32	36	DAY 3 OF LIFE	8.5	NIL	9	7	9DAYS	YES	NO	7HRS	5	20gms	YES	PRIMI	NIL	NIL	lower	nil	nil	8	9	PT	PT	9	8	POOR
11206168	A	26	30-08-2023	M	NVD	1800	1866	2510	37days	35W3D	46	46	50	32	32	35	DAY 2 OF LIFE	11	TWICE DAY 3,4	9	5	8DAYS	NO	NO	9HRS	3	23gms	YES	PRIMI	NIL	NIL	lower middle	nil	8	9	8	11	13	12	14	GOOD
11206521	A	33	31-08-2023	M	LSCS	2200	2220	2540	23days	37W1D	51	51	54	32	32	34	DAY 4 OF LIFE	10	ONCE DAY 5,6	9	7	9DAYS	NO	NO	8HRS	4	21gms	YES	G4P3L3	NIL	NIL	lower	nil	nil	nil	7	9	11	12	10	GOOD
11203510	A	32	17-08-2023	F	LSCS	2100	2120	2530	25days	37W5D	48	49	52	32	32	34	DAY 4 OF LIFE	9.5	TWICE DAY 4,5	12	10	13DAYS	YES	NO	7HRS	4	19gms	YES	PRIMI	PPH	NIL	lower middle	nil	nil		PT	PT				POOR
11204014	A	23	19-07-2023	F	NVD	1950	1984	2520	29days	37W5D	48	49	51	32	32	34	DAY 3 OF LIFE	11	IRICE DAY 3,ONCE DAY	10	8	9DAYS	YES	NO	9HRS	3	25gms	NO(ON BF AND LACTOGEN)	PRIMI	NIL	NIL	middle	nil	nil	5	PT	PT	9	13	12	GOOD
10006710	A	28	11-09-2023	F	LSCS	2200	2160	2540	28days	35W2D	44	44	47	32	32	34	DAY 2 OF LIFE	9	NIL	8	6	8DAYS	YES	NO	9HRS	3	18gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	7	PT	PT	10	11	12	GOOD
10006221	A	31	09-09-2023	M	LSCS	2100	2100	2550	25days	36W2D	47	47	50	33	33	35	DAY 1 OF LIFE	12.5	NIL	9	8	9DAYS	YES	NO	10HRS	3	20gms	YES	G3P2L2	NIL	NIL	lower middle	6	9	11	PT	PT	12	14	13	GOOD
11005885	A	23	28-08-2023	F	LSCS	1800	1750	2510	42days	34W6D	44	44	49	31	31	34	DAY 3 OF LIFE	8.5	TWICE DAY 3,4	9	10	9DAYS	YES	NO	6HRS	5	22gms	NO(ON BF AND LACTOGEN)	PRIMI	NIL	RDS	lower	nil	nil	8	9	PT	PT	10	9	POOR
10004702	A	28	03-09-2023	F	NVD	2100	2040	2530	34days	35W4D	45	45	48	34	34	36	DAY 3 OF LIFE	8.5	TWICE DAY 3,5	8	6	7DAYS	YES	NO	8HRS	4	17gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	7	PT	8	10	9		POOR
10004880	A	23	04-Sep	F	NVD	2000	1980	2540	31days	36W3D	47	47	50	32	32	34	DAY 3 OF LIFE	11	ONCE DAY 3	5	5	6 DAYS	NO	NO	10HRS	3	22gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	8	PT	PT	12	13	11	GOOD
10002842	A	23	13-08-2023	M	NVD	1800	1920	2520	42days	36W	46	47	51	33	34	36	DAY 3 OF LIFE	10	NIL	13	9	13DAYS	NO	NO	9HRS	3	20gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	8	9	11	11	12	10	POOR
10001063	A	27	18-08-2023	M	NVD	2200	2200	2530	26days	35W2D	48	49	51	33	33	35	DAY 4 OF LIFE	9	ONCE DAY 7	11	9	11DAYS	NO	NO	8HRS	4	21gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	nil	nil	7	9	8	12	GOOD
10001663	A	25	21-08-2023	M	NVD	2080	2060	2540	28days	37W	51	51	54	33	33	35	DAY 2 OF LIFE	10	ONCE DAY 2	5	6	7DAYS	NO	NO	11HRS	2	23gms	YES	PRIMI	NIL	NIL	lower	nil	7	9	12	10	13	11	10	POOR
10007214	A	23	13-09-2023	M	NVD	2140	2320	2530	20days	36W6D	47	47	49	32	32	33	DAY 2 OF LIFE	11	NIL	8	8	10DAYS	NO	NO	9HRS	4	20gms	YES	PRIMI	NIL	NIL	lower middle	nil	8	9	11	14	12	11	10	GOOD
10003754	A	23	30-08-2023	F	LSCS	1790	1810	2550	40days	34W1D	46	46	50	31	31	34	DAY 2 OF LIFE	11.5	NIL	10	7	10DAYS	NO	NO	11hrs	3	24gms	YES	PRIMI	NIL	NIL	lower middle	nil	7	7.5	10	13	12	14	13	GOOD
10004679	A	23	03-09-2023	F	LSCS	1520	1480	2530	53days	34W	40	41	47	30	31	34	DAY 5 OF LIFE	12	NIL	13	10	14DAYS	NO	NO	10HRS	2	25gms	YES	PRIMI	NIL	RDS	lower middle	nil	nil	nil	nil	nil	11	13	12	GOOD
10001450	A	29	19-08-2023	M	LSCS	1750	1990	2560	48days	35W4D	42	44	48	31	32	34	DAY 5 OF LIFE	9	TWICE DAY6	16	15	21DAYS	YES	NO	8HRS	3	20gms	YES	PRIMI	NIL	RDS	lower middle	nil	nil	nil	PT	PT	7	9	10	POOR
10000713	A	28	18-08-2023	M	LSCS	2000	1910	2510	37days	35W2D	41	41	45	32	32	34	DAY 4 OF LIFE	11	NIL	9	8	10DAYS	NO	NO	9HRS	3	22gms	YES	G3P2L2	NIL	NIL	lower	nil	nil	nil	nil	8	10	12	13	GOOD
10003989	A	31	31-08-2023	F	LSCS	2140	2200	2510	25days	36W3D	43	43	46	34	34	35	DAY 3 OF LIFE	10.5	NIL	8	6	8DAYS	NO	NO	8HRS	4	18gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	7	9	11	10	13	12	POOR
10002142	A	31	21-08-2023	M	NVD	2070	2040	2530	35days	36W1DAY	41	41	45	33	33	35	DAY 3 OF LIFE	9	ONCE DAY 3,4	7	6	7DAYS	NO	NO	9HRS	3	17gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	6	7	10	12	11		POOR
10012211	A	30	07-10-2023	M	LSCS	2000	1960	2540	32days	35W2D	41	41	44	31	31	33	DAY 3 OF LIFE	11.5	NIL	6	6	7DAYS	NO	NO	10HRS	4	23gms	YES	G3P1L1A1	NIL	NIL	lower middle	nil	nil	9	11	13	12	12		GOOD
10003982	A	29	31-08-2023	M	NVD	2180	2180	2520	22days	37W1D	43	44	46	32	32	33	DAY 3 OF LIFE	12	NIL	7	5	7DAYS	NO	NO	9HRS	3	22gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	10	12	14	13	13.5		GOOD
10002924	A	26	26-08-2023	M	LSCS	2010	2170	2520	35days	36W2D	42	43	47	31	31	33	DAY 4 OF LIFE	9	ONCE DAY 5,6	10	7	10DAYS	YES	NO	7HRS	4	18gms	YES	PRIMI	PPH	NIL	lower middle	nil	nil	PT	PT	7	9	11	10	POOR
1198959	B	27	27-07-2023	F	LSCS	1800	1740	2580	55days	36W5D	42	43	48	32	32	36	DAY 2 OF LIFE	9	ONCE DAY 2,3	11	10	10DAYS	YES	NO	7HRS	4	18gms	YES	G2P1L1	NIL	RDS	lower middle	nil	6.5	7	PT	PT	9	11	12	GOOD
10004383	B	34	01-09-2023	M	NVD	1700	1760	2520	53days	35W6D	48	49	53	33	33	35	DAY 2 OF LIFE	9.5	ONCE DAY2 AND 5	12	11	13DAYS	YES	NO	8HRS	3	18gms	YES	G3P2L2	NIL	TTNB	lower middle	nil	7	PT	PT	8	10	12	11	POOR
10007832	B	23	16-09-2023	F	LSCS	2100	2060	2510	30days	36W4D	45	45	48	32	32	34	DAY 3 OF LIFE	10	NIL	8	7	8DAYS	YES	NO	8HRS	3	20gms	YES	PRIMI	NIL	NIL	lower	nil	nil	8	PT	PT	10	11	13	GOOD
1188701	B	28	14-07-2023	M	LSCS	2200	2090	2550	35days	39W2D	45	45	48	34	34	35	DAY 2 OF LIFE	7	ONCE DAY 3,4	8	8	7DAYS	NO	NO	5.5HRS	5	16gms	YES	G3P2L2	SSI	NIL	lower middle	nil	6	7	6.5	8	9	7		POOR
1195870	B	25	15-07-2023	F	LSCS	2100	2140	2530	30days	37W3D	45	45	49	33	33	35	DAY 3 OF LIFE	9	WICE DAY 3,ONCE DAY	7	6	7DAYS	NO	NO	7HRS	5	17gms	YES	PRIMI	NIL	NIL	mddle	nil	nil	6.5	8	10	11	10		GOOD
10010537	B	23	29-09-2023	F	NVD	2000	2030	2550	41days	35W3D	47	48	51	31	31	33	DAY 2 OF LIFE	9.5	ONCE DAY 4	12	7	11DAYS	YES	NO	9HRS	4	17GMS	YES	PRIMI	NIL	NIL	lower	nil	7	9	PT	PT	10	11	10	GOOD
10001774	B	25	21-08-2023	F	NVD	2100	2060	2530	30days	36W	47	47	50	33	33	35	DAY 3 OF LIFE	10	NIL	6	7	7DAYS	NO	NO	8HRS	4	20gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	8	10	11	10.5	11		GOOD
10007493	B	21	15-09-2023	M	NVD	2000	2120	2520	32days	37W2D	45	46	48	32	32	34	DAY 2 OF LIFE	9	WICE DAY 3,ONCE DAY	9	8	10DAYS	YES	NO	6HRS	5	18gms	YES	PRIMI	SSI	NIL	mlddle	nil	7	7.5	PT	PT	9.5	11	12	POOR
10007469	B	27	14-09-2023	M	NVD	2100	2200	2570	30days	36W3D	46	46	49	32	32	34	DAY 2 OF LIFE	8.5	ONCE DAY 2,3	7	6	7DAYS	NO	NO	7HRS	3	16gms	YES	G2P1L1	NIL	NIL	lower middle	nil	6	8	9	10	9.5	9		POOR
10002371	B	24	24-08-2023	F	NVD	2360	2330	2540	17days	39W6D	50	50	52	32	32	33	DAY 1 OF LIFE	10	NIL	4	5	5DAYS	NO	NO	9HRS	3	18gms	YES	PRIMI	NIL	NIL	lower middle	8	9	8.5	10	12				POOR
10006724	B	26	09-09-2023	M	LSCS	2180	2140	2560	30days	35W2D	47	47	50	33	33	35	DAY 2 OF LIFE	11	NIL	8	7	9DAYS	NO	NO	9HRS	1	20gms	YES	PRIMI	NIL	NIL	lower middle	nil	7	9	10	12	11	13	12	GOOD
10005037	B	24	04-09-2023	F	LSCS	1900	1870	2530	42days	36W6D	46	47	50	30	30	33	DAY 2 OF LIFE	11.5	ONCE DAY 4	12	9	12DAYS	YES	NO	8HRS	2	22gms	YES	PRIMI	NIL	TTNB	lower	nil	9	11	8	PT	PT	12	13	GOOD
10005532	B	23	06-09-2023	M	LSCS	1650	1680	2580	49days	34W5D	44	44	48	30	30	33	DAY 2 OF LIFE	12	ONCE DAY 3	9	8	10DAYS	NO	NO	9HRS	3	23gms	YES	PRIMI	NIL	RDS	lower middle	nil	9	11	13	12	11	12	13	GOOD
10004761	B	28	03-09-2023	M	LSCS	1960	2020	2510	36days	34W5D	45	45	48	32	32	34	DAY 3 OF LIFE	9.5	ONCE DAY 3	8	7	9DAYS	NO	NO	7HRS	3	17GMS	YES	PRIMI	NIL	NIL	lower middle	nil	nil	8	9.5	11	10	12	11	POOR
10007941	B	32	17-09-2023	M	NVD	1900	2040	2550	35days	37W2D	46	46	49	32	33	35	DAY 2 OF LIFE	10	NIL	8	6	8DAYS	NO	NO	8HRS	4	18gms	YES	G3P2L2	NIL	NIL	lower middle	nil	7	10	12	11	12	9	11	GOOD
1203760	B	19	18-07-2023	F	LSCS	1580	1640	2540	61days	35W6D	47	48	53	29	30	33	DAY 2 OF LIFE	7.5	ONCE DAY 2,5,6	17	11	13DAYS	YES	NO	5.5HRS	6	16gms	NO(ON BF AND LACTOGEN)	PRIMI	postpartum blues	feed intolerance	lower middle	nil	6	8	PT	PT	9	8	10	POOR
10006733	B	27	11-09-2023	F	LSCS	2100	2120	2570	40days	36W	48	49	53	32	32	34	DAY 3 OF LIFE	8	ONCE DAY 3,5	9	9	10DAYS	NO	NO	7HRS	3	15gms	YES	G3P1L1A1	NIL	NIL	lower middle	nil	nil	7	9	8	10	10.5	9	POOR
1388692	B	28	26-07-2023	F	NVD	2200	2180	2540	38days	38W1D	44	44	48	33	33	35	DAY 2 OF LIFE	9	ONCE DAY 3,5	8	9	9DAYS	YES	NO	8HRS	4	17GMS	YES	G2P1L1	NIL	NIL	lower	nil	7	8	PT	PT	10	9	10	POOR
10017751	B	25	02-11-2023	F	LSCS	2000	2030	2580	41days	37W	46	47	50	32	32	35	DAY 2 OF LIFE	10	NIL	10	8	11DAYS	NO	NO	7HRS	4	18gms	YES	PRIMI	NIL	NIL	lower middle	nil	7	9	11	10	12	9	11	GOOD
10017724	B	24	12-10-2023	M	NVD	2300	2280	2520	25days	37W3D	49	49	51	33	33	34	DAY 3 OF LIFE	7	WICE DAY 3,ONCE DAY	10	9	9DAYS	YES	NO	5HRS	5	14gms	NO(ON BF AND LACTOGEN)	PRIMI	NIL	NIL	lower middle	nil	nil	6	PT	PT	7	9	8	POOR
10016956	B	28	29-10-2023	F	LSCS	2100	2180	2540	29days	36W6D	47	47	50	32	32	33	DAY 2 OF LIFE	10.5	ONCE DAY 3	9	8	10DAYS	NO	NO	7HRS	3	19gms	YES	G3P2L2	NIL	NIL	lower middle	nil	7	8	11	10	12	10.5	11	GOOD
10016913	B	23	22-10-2023	M	LSCS	2120	1970	2530	42days	37W4D	46	47	51	32	32	34	DAY 3 OF LIFE	9	ONCE DAY 5	10	11	11DAYS	YES	NO	8HRS	4	17GMS	YES	PRIMI	NIL	TTNB	lower	nil	nil	7	PT	PT	10	11	9.5	POOR
10016239	B	29	25-10-2023	M	LSCS	2300	2330	2580	23days	37W4D	48	48	50	32	32	33	DAY 2 OF LIFE	8.5	ONCE DAY 3,6	8	9	10DAYS	YES	NO	7HRS	4	18gms	YES	G2P1L1	NIL	NIL	lower middle	nil	6.5	7	PT	PT	8	10	11	POOR
10019456	B	22	09-11-2023	F	NVD	2310	2370	2510	17days	39W1D	46	46	48	33	33	34	DAY 3 OF LIFE	10	ONCE DAY 4	8	7	9DAYS	NO	NO	8HRS	3	17gms	YES	PRIMI	NIL	NIL	lower	nil	nil	8	7	10	11	12	12.5	GOOD
10018713	B	33	06-11-2023	F	LSCS	2200	2180	2540	30days	36W2D	47	47	50	32	32	34	DAY 3 OF LIFE	9	ONCE DAY 4,5	7	8	8DAYS	NO	NO	9HRS	2	16gms	YES	G4P2L2A1	NIL	NIL	middle	nil	nil	7	8	6.5	9	11	12	POOR
10010537	B	27	29-09-2023	F	NVD	2000	2020	2550	38days	33W5D	45	46	50	32	32	34	DAY 2 OF LIFE	11	ONCE DAY 4	8	7	9DAYS	NO	NO	10HRS	2	18gms	YES	PRIMI	NIL	NIL	lower	nil	9	10	8	12	11	11.5	11	GOOD
10002311	B	31	23-08-2023	M	LSCS	1800	1870	2530	51days	35W3D	42	43	48	30	30	35	DAY 2 OF LIFE	10	ONCE DAY 3,6	11	9	13DAYS	YES	NO	8HRS	3	17GMS	YES	G2P1L1	NIL	RDS	lower middle	nil	8	7	PT	PT	9	11	12	GOOD
10019948	B	24	11-11-2023	M	LSCS	2100	2060	2590	43days	36W3D	46	46	50	32	32	34	DAY 2 OF LIFE	8	ONCE DAY 4,5	9	7	8DAYS	YES	NO	7HRS	4	15gms	YES	PRIMI	NIL	NIL	lower middle	nil	7	9	8	7	PT	PT	10	POOR
10021507	B	28	20-11-2023	M	LSCS	2300	2270	2520	23days	38W3D	49	49	52	33	33	34	DAY 2 OF LIFE	8.5	ONCE DAY 2,3	8	7	5DAYS	NO	NO	5.5HRS	6	14gms	YES	G3P2L2	PPH	NIL	lower	nil	6	8	9	11				POOR
10021082	B	23	17-11-2023	F	LSCS	2200	2180	2550	32days	36W6D	47	47	50	32	32	34	DAY 3 OF LIFE	7	ONCE DAY 3	9	8	8DAYS	YES	NO	7HRS	3	15gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	6	PT	PT	8	8.5	8	POOR
10004764	C	22	03-09-2023	F	LSCS	2300	2220	2530	33days	36W1DAY	47	47	51	32	32	34	DAY 3 OF LIFE	6		8	9	9DAYS	YES	NO	5HRS		12gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	5	6	PT	PT	7	6	GOOD
10006282	C	22	09-09-2023	M	NVD	2120	1980	2570	53days	35W3D	46	46	51	32	32	35	DAY 2 OF LIFE	7		9	10	8DAYS	YES	NO	6HRS		13gms	YES	PRIMI	NIL	NIL	lower	nil	6	7	PT	PT	6.5	7	7	GOOD
10004802	C	25	04-09-2023	M	LSCS	2210	2190	2530	36days	36W	49	49	52	32	32	34	DAY 3 OF LIFE	5		10	11	10DAYS	NO	NO	5.5HRS		13gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	4	6	5	7	5.5	6	POOR
10008645	C	25	23-09-2023	M	NVD	2200	2220	2550	30days	37W	47	47	50	32	32	34	DAY 2 OF LIFE	8		8	7	8DAYS	NO	NO	6.5HRS		15gms	YES	PRIMI	NIL	NIL	lower middle	nil	7	6	8	7	9	8	8.5	POOR
10008764	C	23	23-09-2023	F	LSCS	2060	2020	2550	51days	37W1D	43	43	49	33	33	35	DAY 3 OF LIFE	6		10	8	9DAYS	YES	NO	5HRS		12gms	NO(ON BF AND LACTOGEN)	PRIMI	NIL	NIL	middle	nil	nil	5	6	PT	PT	7	6.5	POOR
10009909	C	25	27-09-2023	F	LSCS	1880	1900	2540	68days	36W	46	46	52	30	30	34	DAY 2 OF LIFE	5		12	11	8DAYS	NO	NO	4.5HRS		10gms	NO(ON BF AND LACTOGEN)	G2A1	NIL	feed intolerance	lower middle	nil	5	4	6	6	5	4	6	POOR
10007685	C	24	21-09-2023	F	LSCS	2150	2180	2570	35days	38W2D	45	45	48	33	33	34	DAY 2 OF LIFE	9		8	7	9DAYS	NO	NO	7HRS		14gms	YES	PRIMI	NIL	NIL	lower middle	nil	6	8	7	9	10	8	9	GOOD
1207144	C	25	03-08-2023	M	LSCS	2200	2160	2540	35days	35W4D	49	49	52	33	33	34	DAY 3 OF LIFE	7		9	10	7DAYS	YES	NO	6HRS		13gms	YES	PRIMI	SSI	NIL	lower	nil	nil	6	PT	PT	7	6	8	GOOD
1205269	C	21	25-07-2023	M	NVD	2130	1910	2550	64days	36W5D	46	46	52	33	33	36	DAY 3 OF LIFE	6		10	12	9DAYS	YES	NO	5HRS		11gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	4	6	PT	PT	8	7	POOR
1206519	C	33	04-08-2023	M	LSCS	2200	2050	2510	45days	37W2D	51	52	54	32	32	34	DAY 3 OF LIFE	6.5		11	9	10DAYS	YES	NO	5.5HRS		13gms	NO(ON BF AND LACTOGEN)	PRIMI	NIL	NIL	lower	nil	nil	5	7	PT	PT	6	8	GOOD
1196081	C	27	15-07-2023	M	LSCS	1640	1630	2590	68days	35W4D	48	48	53	31	31	35	DAY 1 OF LIFE	7		13	10	7DAYS	NO	NO	7HRS		15gms	NO(ON BF AND LACTOGEN)	PRIMI	NIL	NIL	middle	5	6	8	7	7.5	8	9		GOOD
1188673	C	28	11-07-2023	M	LSCS	2100	2080	2530	42days	36W3D	43	43	47	33	33	35	DAY 3 OF LIFE	6		12	9	9DAYS	YES	NO	5HRS		13gms	YES	G2P1L1	NIL	NIL	lower middle	nil	nil	5	6	PT	PT	7	6	POOR
10031985	C	24	07-01-2024	F	LSCS	2140	2150	2560	37days	37W	44	44	47	32	32	34	DAY 2 OF LIFE	8		9	8	10DAYS	YES	NO	7HRS		14gms	YES	PRIMI	NIL	NIL	lower middle	nil	4	6	PT	PT	7	8	9	GOOD
10030305	C	26	29-12-2023	F	LSCS	1680	1750	2570	73days	35W1D	41	41	49	31	31	34	DAY 3 OF LIFE	9		12	9	11DAYS	YES	NO	6HRS		12gms	YES	PRIMI	postpartum blues	RDS	lower middle	nil	nil	7	PT	PT	8	9	10	GOOD
10030853	C	24	02-01-2024	F	LSCS	1840	1830	2650	58days	35W5D	42	42	48	32	32	35	DAY 2 OF LIFE	7.5		10	11	8DAYS	NO	NO	7HRS		16gms	NO(ON BF AND LACTOGEN)	PRIMI	NIL	NIL	middle	nil	5	6	8	7	7	9	8.5	POOR
10032712	C	31	09-01-2024	F	LSCS	2120	2140	2540	38days	37W2D	45	45	49	33	33	35	DAY 3 OF LIFE	6.5		9	10	8DAYS	YES	NO	5HRS		13gms	YES	G4P2L2A1	NIL	NIL	lower middle	nil	nil	4	6	PT	PT	7	8	POOR
10032561	C	33	09-01-2024	M	LSCS	2200	2170	2520	33days	39W5D	47	47	50	33	33	35	DAY 2 OF LIFE	5.5		10	11	10DAYS	YES	NO	6HRS		14gms	YES	G3P1L1A1	NIL	NIL	lower	nil	5	7	PT	PT	5	6	6	POOR
10023525	C	25	29-11-2023	M	LSCS	2100	2150	2550	38days	37W3D	45	45	49	33	33	35	DAY 3 OF LIFE	7		8	10	9DAYS	NO	NO	6.5HRS		13gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	5	7	6	6	8	7	POOR
10023764	C	23	30-11-2023	F	NVD	2060	2100	2550	45days	35W4D	44	44	48	32	32	34	DAY 3 OF LIFE	6.5		10	12	11DAYS	YES	NO	6HRS		12gms	NO(ON BF AND LACTOGEN)	G2A1	NIL	NIL	middle	nil	nil	6	PT	PT	7	7	6.5	POOR
10024022	C	27	01-12-2023	M	LSCS	1900	1870	2570	57days	36W2D	44	45	51	32	32	35	DAY 2 OF LIFE	8		9	10	10DAYS	YES	NO	7HRS		14gms	YES	PRIMI	NIL	NIL	lower middle	nil	5	7	6	PT	PT	9	8	GOOD
10024432	C	29	02-12-2023	M	LSCS	2050	2020	2530	45days	34W	45	45	50	33	33	35	DAY 2 OF LIFE	7		8	9	8DAYS	NO	NO	5.5HRS		13gms	YES	G2P1L1	NIL	NIL	lower middle	nil	6	6	7	6	8	8	9	POOR
10022888	C	24	25-11-2023	F	LSCS	2180	2220	2540	28days	36W1DAY	44	44	47	33	33	34	DAY 3 OF LIFE	8.5		7	7	10DAYS	NO	NO	7.5HRS		16gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	6	7	9	8	8	9	GOOD
10025834	C	28	09-12-2023	F	NVD	2320	2290	2530	25days	38W	47	47	50	33	33	34	DAY 3 OF LIFE	7		11	9	8DAYS	YES	NO	5.5HRS		13gms	YES	PRIMI	NIL	NIL	lower	nil	nil	5	PT	8	9	8	9	POOR
10025369	C	25	06-12-2023	F	LSCS	1800	1790	2580	56days	36W	42	43	49	32	32	35	DAY 3 OF LIFE	9		10	11	14DAYS	YES	NO	8HRS		17GMS	YES	G2A1	NIL	TTNB	lower middle	nil	nil	9	8	PT	PT	8	9	GOOD
10025628	C	23	08-12-2023	M	NVD	2360	2300	2530	30days	39W3D	51	51	54	34	34	35	DAY 3 OF LIFE	6		13	10	8DAYS	YES	YES	4HRS		10gms	NO(ON BF AND LACTOGEN)	PRIMI	postpartum blues	NIL	middle	nil	nil	5	PT	PT	6	5	7	POOR
10026901	C	26	14-12-2023	M	LSCS	1980	1960	2510	44days	35W6D	44	44	48	32	32	34	DAY 2 OF LIFE	7.5		12	9	6DAYS	YES	NO	6.5HRS		14gms	YES	PRIMI	NIL	NIL	lower middle	nil	5	7	6	PT	PT	8		POOR
10027171	C	31	15-12-2023	M	NVD	2210	2190	2540	38days	38W	48	48	51	33	33	35	DAY 3 OF LIFE	5.5		10	11	9DAYS	YES	NO	4HRS		11gms	YES	G2P1L1	NIL	NIL	lower	nil	nil	4	PT	PT	6	5	6	POOR
10027454	C	33	16-12-2023	M	NVD	1970	1950	2560	47days	36W6D	46	46	50	32	32	35	DAY 2 OF LIFE	8		9	9	8DAYS	NO	NO	7HRS		15gms	YES	G3P2L2	NIL	NIL	lower middle	nil	5	6	8	8	7	9	8	GOOD
10027388	C	23	16-12-2023	M	NVD	2200	2210	2540	31days	34W6D	47	47	50	33	33	35	DAY 3 OF LIFE	7.5		9	7	7DAYS	NO	NO	6.5HRS		13gms	YES	PRIMI	NIL	NIL	lower middle	nil	nil	6	8	9	8	8		POOR
10027651	C	25	17-12-2023	M	NVD	2030	2000	2530	42days	38W6D	45	45	49	32	32	35	DAY 2 OF LIFE	8		11	9	6DAYS	NO	NO	7HRS		14gms	YES	PRIMI	NIL	NIL	lower middle	nil	6	5	7	8	9			POOR