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ORIGINAL PAPER

Reducing Early Neonatal Heat Loss in a Low Resourced Context: An Indian Exemplar

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Abstract

Background Although there has been a favorable trend in the Infant Mortality Rate in India in the last decade, the country is still unlikely to meet the Millennium Development Goal #4. Of significance, there has been minimal improvement in the early neonatal mortality rate, which is an indicator of quality of perinatal care. In the efforts to address this aspect, a range of efforts and interventions have been considered. One such effort is in addressing and reducing hypothermia in neonates. Two low tech strategies, professional mummying/swaddling (PM/S) and 'Kangaroo mother care' (KMC), are seen as critical in the continuum of neonatal care.

Objective: This study compared the effects of KMC and professional mummying/swaddling (PM/S) on select neonatal outcomes (temperature and weight) in a postnatal hospital unit in Chennai India.

Methodology: This quasi-experimental study used a repeat measures time series approach monitoring weight and temperatures for neonates across the two interventions.

Results: Significant findings were found in the retention of temperature which indicated that the KMC intervention aligned with higher neonatal temperatures than the PM/S interventions. Further, neither maternal or neonate indicators were found to impact significantly on weight or temperature changes in either group.

Conclusions: KMC was found to provide a viable and meritous alternative to PM/S as a thermoregulatory strategy for full term neonates in a low resource setting. The study suggest that ongoing research will be necessary to ascertain the optimal approaches and potentials in both methods with such culturally diverse populations.

Keywords: Professional mummying/swaddling; Kangaroo Mother Care; skin-to-skin care; newborn/neonatal mortality rates; India

Introduction

Neonatal care is of prime importance in reducing mortality and morbidity rates in this at risk group. One of the most critical factors in the survival of the newborn babies is the satisfactorily maintenance of their body temperature to prevent hypothermia as one of the major complications in newborn period. Transition from intrauterine to extrauterine fetal environment is a critical period demanding behavioural and physiological newborn adjustment at birth and immediate newborn period. As a result, newborns need to be cared for and protected through the maintenance of an optimal thermal environment.

Hypothermia, a significant contributory element in NMR, is preventable with minimal technological and training interventions. The World Health Organization (WHO) (xxxx) estimates that globally 18 to 42 percent of annual infant deaths are caused by hypothermia. Although in India the trend (see Table 1) is towards a considerable reduction in the NMR over the past 50 years, there remains significant unnecessary loss of life and human capital. India, like many emerging countries, is challenged by traditional practices, rurality, and lack of health literacy which all impact on addressing such issues.

When considering neonatal hypothermia, the current trends of practice in the prevention are based on "warm chain" indices. The warm chain is a set of ten interlinked procedures carried out at birth and during newborn period towards preventing and minimizing of neonatal hypothermia. The warm chain indices includes warm delivery room, immediate drying, skin-to-skin contact, breastfeeding, bathing and weighing postponed, appropriate clothing and bedding, mother and baby together, warm transportation, warm resuscitation, and training/awareness raising.

Recognizing the traditional practices in India, which focused on drying, covering, and wrapping (swaddling) of the infant, it was felt that the optimal possibility to intercede would be to find a practice which bridged tradition and modern interventions for neonatal hypothermia. As a result, the third warm chain interlinked procedure of skin to skin contact was highlighted as the most appropriate, with the Kangaroo Mother Care (KMC) approach being selected for introduction in a single unit in a hospital in Chennai, India. Such an intervention was seen as culturally acceptable, cost effective, and appropriate in a low-resource context.

Research Question and Hypothesis

The essential research question for this study was to determine the effects during the first 3 days of life on body temperature and weight of professional mummying/swaddling versus kangaroo maternal care for neonates. The research hypothesis was a non-directional complex statement that PM/S and KMC will result in different body temperature and weight trends in neonates in early days of life. The results will inform the possibility of an alternative thermo-regulative strategy for neonates born at Sri Ramachandra Hospital.

Background

One of the most important relationships in our lives rests in the mother-child dyad at birth, which not only impacts on the physical and physiological outcomes (Bauer, Sontheimer, Fischer & Linderkamp, 1996; Tornahage, Serenius, Uvnas-Moberg & Lindberg, 1998), but also on psychological outcomes (Fischer, Sontheimer, Scheffer, Bauer & Linderkamp, 1998). There are a number of interventions and strategies which have variably been introduced and offered to enhance these outcomes in low resource settings in the immediate newborn period. Of interest in this research are two such approaches - PM/S and KMC.

Immediate Newborn Care

Before reflecting on these two techniques, it is important to reflect on the challenges of heat and weight loss in newborns. It is noted that nearly two-thirds of all neonatal morality occurs in the first week of life (Moss, xxxxx) primarily due to asphyxia, hypothermia and hyperthermia. Heat loss in newborns is explored extensively in the literature. From the early work of Scopes (1975), we learned that the newborn is physiologically homeo-thermic with the hypothalamus managing internal thermo-regulation. However, external temperature gradients on the neonate's skin leads to a physiological triggering of noradrenaline thereby quickly oxidizing the brown fat triglycerides in an effort to maintain body temperature. Waldron & MacKinnon (2007) described the four means of heat loss (i.e., evaporation, convection, conduction, and

radiation) and discussed the body temperature of the newborn falling immediately after delivery between 2° and 3°C with the first few minutes being the most critical. Many researchers (Tafari, 1985; Chritensson et al, 1988) have highlighted that incidence and prevalence of hypothermia in developing contexts and the range of morbidities (i.e., infections, delayed circulatory adjustment, coagulation/hemorrhaging issues). But, equally as revealing is the easy of intervention with simple steps and simple awareness, which are found to be lacking in many developing countries.

Further, postnatal weight loss is a consideration in thermoregulation. Generally, there is an understanding that this phenomenon is a combination of fluid loss and loss of fat stores (Brace, 1992). According to Wright & Parkinson (2004), this weight loss is usually of brief duration and generally inconsequential. This finding mirrors the much earlier work of Mcharban (1985) which suggested a 5-8% weight loss in the first 72 hours of life, followed by a rapid recovery within the first 7 days. However, this author emphasized that weight reduction can be further aggravated with over-exposure to cold. Moss, Darmstadt, Marsh, Black & Santosham (2002) stated that due to the relationship between skin temperature and calorie burn in immediate newborn period, it is critical to ensure that thermal protection be undertaken to minimize newborn weight loss.

In reflecting on PM/S, this highly traditional, low-tech technique is described extensively in the literature (LeBlanc, 1991; Lang, Bromiker, & Arad, 2004; Holzman, 1985; Ghai, 2000). Professional mummying/swaddling is a simple and traditionally practiced thermoregulative strategy. Essentially, mummy restraint is one of the technique of covering the baby with a towel or sheet or blanket, in which extremities are held secured in flexed posture with the head covered/ uncovered, in order to retain warmth and prevent heat loss. This traditional care approach is in continued use today as a means of neonatal thermoregulation. It ranges from rapid drying and wrapping in a dry (often warmed) towel (Ghai, 2000; Suraj, 1998) to layering in cloths and using mummy restraints (May, 1994).

KMC was introduced in the late 1970s, which has been conceptualized and operationalized in a number of ways in the literature and practice (Boo & Jamli, 2007; Suman, Udani, & Nanavati, 2008). The origins of KMC were rooted in the work of Edgar Rey, a Columbian paediatrician, in search of a technically simple solution to mother-infant care. Within these humble beginnings, KMC was rooted with three major components (i.e., thermal care through continuous skin-to-skin contact; exclusive breastfeeding; and rapid redress of neonatal complications) (Lawn, Mwansa-Kambafwile, Horta, Fernando, Barros & Cousens, 2010). The KMC method has increasingly been defined as: 'Early, prolonged, and continuous skin-to-skin contact between a mother and her newborn low birth-weight infant (<2500 g, viz. preterm and / or low birth weight infant), both in hospital and after early discharge, with (ideally) exclusive breastfeeding, and proper follow-up'. (World Health Organization, 2005). This definition was extended beyond low birth weight infants by Nyqvist and an expert group of the International Network on Kangaroo Mother Care (2010), who stated that "all intrapartum and postnatal care should adhere to a paradigm of non-separation of infants and their parents. KMC should be used for warming, comfort, physiological and psychological benefits, growth, development, and the psychosocial needs of the family, and to promote lactation, breastfeeding initiation and longer breastfeeding duration" (p. 814).

The term KMC is reflects skin to skin contact (SSC) which includes practices of both continuous and intermittent SSC. In describing KMC, the work of Ludington-Hoe, Nguyen, Swinth, & Satyshur (2000) emphasized the benefit of 30 minutes of direct skin to skin contact between the mother and infant to reduce heat loss, extend heat retention, and minimize weight loss in the early newborn period. This is reiterated by the World Health Organization (1997) in a recommendation that SSC be a routine care element immediately post-delivery and in the early neonatal period. It is this philosophical perspective that is used in this study.

Some studies claim that KMC reduces newborn mortality (NMR) and infant mortality (Lawn, Mwansa-Kambafwile, Horta, Fernando, Barros & Cousens, 2010), however, most agree that the evidence is insufficient regarding the effects of KMC on mortality (Conde-Agudelo, Diaz-Rossello, & Belizan). The use of KMC in community based and low resource applications

has been studied (Quasem, Sloan, Chowdhury, Ahmed, Winikoff, & Chowdhury, 2003; ORC Macro, 2004) with evidence suggesting improved thermal regulation, breastfeeding uptake and neonatal mortality rates. (UNICEF and Bangladesh Bureau of Statistics, 2005) The potential effect of KMC is expected to be greatest in low-income countries (Lawn et al.) However, some researchers have the appropriateness of scaling up of KMC due to questionable evidence (Miller, Sloan, Langer, Winikoff, & Fikree, 2003) and a sense of enthusiasm and optimism (Ahmed, Mitra, Chowdhury, Camacho, Winikoof, & Sloan 2011).

While considering traditional Indian child care practices with regard to temperature regulation, the PM/S technique has been accepted as one of the cost effective and easily measured. However, it is recognized that an alternative cost effective measure to PM/S is KMC. Generally, the implementing of KMC in low socio-economic context promises a range of potential benefits; however, often there is a failure to consider the local context and cultural aspects (Lincetto, Nazir, & Cattaneo 2000) of neonatal care before introducing this approach. This study recognizes that the mothers seeking treatment at the specified unit at the Sri Raachandra Hospital are from lower socio-economic backgrounds. Even the affordability of the coverings used for the neonates vary with some using very light or very small towels which are insufficient to complete cocoon the child. Others use bed sheets and saris to achieve this end. As a result the wrapping is often inadequate and contributes to the unnecessary exposure to atmospheric air and breezes – equating to the exacerbation of heat loss - while handling the neonate. As a result the introduction of KMC as an alternative method was seen as an opportunity to potentially impact on two of the risks known to be associated with heat loss (i.e., decreased temperature and weight loss).

Methodology

This quasi-experimental study research used a comparative repeat measures time series. Observations of measuring parameters (i.e., temperature and weight) was performed twice daily for three consecutive days with specified timings of selected manipulations (i.e., KMC and PM/S).

Ethical Considerations: Ethics approval was sought and secured from the Hospital Ethical Review Committee and permission was granted by the Head of Gynaecology.

Setting: This study was conducted over a one month period on the New Block Third Floor - Postnatal Ward of the Sri Ramachandra Hospital, in Chennai, India. At the time of the study, patients in this block were provided with free food, bed charge, and consultation with free and assessed minimal charges for investigations and medications. The mothers opting for low cost care will get admitted into this block, resulting in a specific socio-economic and demographic profile of the patients. Physically, the postnatal ward consists of 16 beds with a 100% bed occupancy rate. The ward presents with two cubicles, each having eight cots, arranged in two parallel rows. The ward is designed with large windows and short partitions to provide adequate ventilation, but consequently potentiating the neonates to atmospheric air.

Sampling: This study included term neonates born and received with their mother sin the Postnatal Ward from the Labour Unit of the Sri Ramachandra Hospital during the study period. Table 2 reflects the sampling criteria used in this study. In total 60 newborns met the criteria; yield 30 in the KMC group and 30 in the PM/S group.

Intervention: Two different thermal control measures were used in this study. PM/S and KMC techniques are described in Table 3. The former intervention is the current standard of practice in the unit at the Sri Ramachandra Hospital. Specifically, neonates are protected from unnecessary exposure by PM/S. Operationally, PM/S is a thermoregulative technique in which the neonate is snugly wrapped with a towel, covering the head, and encircling the cloth over the neonate's body, securing the extremities in normal anatomical position, for the period of 30 minutes twice daily for 3 consecutive days in postnatal ward. Operationally, KMS is a thermoregulative technique in which the mother cuddles her diaper–clad neonate over her chest in direct SSC while remaining on bed. A top sheet is used to cover the baby together with mother exposing only the face for 30 minutes twice daily for 3 consecutive days.

Measurements: Both maternal and neonatal demographics were captured. In the first

instance, age, educational status, religion, and gravida were measured. Neonates were assessed for gestational age, birth weight, anthropometric measures (i.e., length, head circumference, and chest circumference). During the intervention phase, measurements of neonatal weight and temperature were aligned with the age of the neonates in hours. Weight was measured (in grams) on an electronic scale daily for three days. Temperature was captured twice daily for three days - pre-intervention and post-intervention. This was achieved using a liquid crystal ultra-forehead thermometer. The post-intervention temperature was captured at four intervals – just prior to exposure, immediately after exposure, post-15 minutes, and post-30 minutes.

Consent: The investigator provided each mother (on an individual basis) with an explanation of the study, all procedures, and the possible risks/benefits. Upon receipt of a verbal consent (as literacy is an issue), the neonate-mother dyad was assigned to either the PM/S or the KMC intervention group.

Data Collection: The protocols were initiated in both groups. A sample of the protocol is given in Table 4. There was no deviation from the protocols in the execution of the study.

Results

The characteristics of maternal and neonatal participants are featured in Tables 5 and 6. It is noted that most women were Hindu and between 20-25 years of age across both intervention groups. Nearly two-thirds of women in the PM/S group were primigravida and had secondary education in comparison to less than half for the KMC group. In terms of the neonatal profile, nearly three-quarters were gestationally between 38 and 40 weeks. Over half were 45-49 cm in length with chest circumferences between 29 and 32 cm.

Table 7 and Figure 1 reflect the effects of the two interventions on neonate temperature measurements. These findings indicate no significant difference in pre intervention observations except for the first day ($p<0.05$). Comparison of the post before exposure between the two intervention groups shows a high level of significance ($p <0.001$) on day one second observation, with significance on day 1 first observation ($p<0.01$) and on day 3 sixth observation ($p<0.05$), on the third day sixth observation. The remaining observations showed no significant difference in the effect of the select interventions on temperature in both groups. After post exposure in both intervention groups show a highly significant difference in temperature ($p<0.001$), for three consecutive days, for four observations; as well as on first observations on second and third days indicating improved retention of heat in the KMC neonates in all cases. With regard to the post 15 minutes and post 30 minutes temperature in both intervention groups a highly significant difference ($p<0.001$) in favor of the KMC group in all six observations was noted. Across all significant findings, the KMC neonates retained heat for a longer period of time than the PM/S cohort. In terms of mean weights over each of the first three days, there was no significant difference between intervention groups with t-values of 0.144, 0.173, and 0.333 respectively (see Table 8).

In terms of weight reduction, findings shows that the weight reduction in both interventions within groups changes are highly significant ($p<0.001$). However, between groups changes were not found to be significant (See Table 9).

Further, no significant association was found between maternal or neonate indicators and either temperature or weight in either the PM/S or KMC groups.

A number of limitation were noted in the course of this study. Of note, it was not possible to keep the age of the neonate constant across groups due to a single data collector. Birth weights were measured by the staff and not verified by the investigator. Additionally, the recording of room temperature was not done. It is also not clear if the 3 day measurement period is sufficient to determine the effects of these interventions.

Table 1. Neonatal Mortality Rate Trends in India

Year	1951	1961	1971	1981	1991	1996	2001	2012
NMR (per 1000 births)	148	138	120	110	80	72	52.4	31

Adapted from National Institute of Medical Sciences, Indian Council of Medical Research, and UNICEF India. (2012).

Table 2: Intervention Description: Professional Mummying/Swaddling Waddling and Kangaroo Maternal Care of Neonates

Procedure: Professional Mummying/Swaddling Technique	**Procedure: Kangaroo Maternal Care Technique**
1. Make a fold in one corner of square sheet in desired layers. 2. Place the neonate diapered in the centre of sheet, head over the corner fold. 3. Cover the head of the neonate similar to capping. 4. Fold the right corner of the towel by securing the right limbs tucked firmly under the body from left side leaving the left arm free. 5. Fold the foot end corner over the body of the neonate tucking the corner into the first fold. 6. Folding the left corner of the towel by securing the left limbs firmly and bring that corner over the baby tucking from right side of the neonate. 7. Place the mummified neonate on the cot.	1. Assist the mother to sit with two pillows. 2. Cover the mother with a top sheet up to the shoulder level. 3. Expose the mother's chest under the sheet. 4. Place the diaper clad neonate over the mother chest in prone position between the mother's breasts. 5. Instruct the mother to encircle her arms over the diaper clad neonate under the sheet. 6. Ensure mother and neonate comfort. 7. Enable kangarooing for 30 minutes.

Table 3: Study Research Criteria for Neonates and Mothers

***Neonates*:**	a) born between 38 to 40 weeks of gestation
	b) weighing 2,500 to 3,500 grams
	c) born by spontaneous vaginal delivery with/without simple episiotomy
	d) APGAR score above 8/10 in 5 minutes after birth
	e) non-hyperthermic
	f) not requiring continuous monitoring
Mothers:	a) both mentally and physically fit
	b) willing to participate in the study

Table 4: Schematic Representation of Data Collection

Day	Time	Age (hrs)	Temperature in Degrees					
			Weight (g)	Pre-intervention	Post Interventional			
					End of Intervention		After exposure	
					Just Pre-exposure	Immediately Post Exposure	15 Min	30 Min
1	OB1	✓	♦1	**O1**	**O7**	**O13**	**O19**	**O25**
	OB2	✓		**O2**	**O8**	**O14**	**O20**	**O26**
2	OB1	✓	♦2	**O3**	**O9**	**O15**	**O21**	**O27**
	OB2	✓		**O4**	**O10**	**O16**	**O22**	**O28**
3	OB1	✓	♦3	**O5**	**O11**	**O17**	**O23**	**O29**
	OB2	✓		**O6**	**O12**	**O18**	**O24**	**O30**

Table 5: Frequancy, Percentage Distribution of Maternal Variable among Kangarooed and Mummying/Swaddling Neonates

Maternal Variables	KMC n=30		PM/S n = 30	
	No.	%	No.	%
Age (yrs.)				
20-25	19	63.3	24	80.0
26-30	11	36.7	4	13.3
> 30	-	-	2	6.7
Education				
Illiterate	3	10.0	5	16.7
Primary	2	6.7	2	6.7
High school	10	33.3	14	46.7
Higher secondary	8	26.7	5	16.7
College	7	23.3	4	13.2
Religion				
Christian	2	6.65	3	10.0
Hindu	26	86.7	27	90.0
Muslim	2	6.65	-	
Gravida				
One	13	43.4	20	66.6
Two	8	26.6	8	26.6
Three	7	23.4	1	3.4
Four	2	6.6	1	3.4

Table 5: Frequancy, Percentage Distribution of Neonatal Variable among Kangarooed and Mummying/Swaddling Neonates

Neonatal Variables	KMC n=30		PM/S n = 30	
	No.	%	No.	%
Gestational age (Weeks)				
38 - 40	22	73.3	21	70.0
41 – 42	8	26.6	9	30.0
Birth weight (g)				
2,500 – 3,000	15	50	14	46.6
3,000 – 3,500	15	50	16	53.4
Length (cm)				
45 - 49	19	63.3	18	60.0
50 - 53	11	36.7	12	40.0
Head circumference (cm)				
30 - 33	14	46.6	20	66.6
34 - 36	16	53.4	10	33.4
Chest circumference (cm)				
29 - 32	18	60.0	24	80.0
33 - 35	12	40.0	6	20.0

Table 7: Mean, Standard Deviation and 't' Value of Temperature between Neonates by Intervention Group

Day	Observation (OBS)	KMC n = 30		PM/S n = 30		t-values
		Mean	SD	Mean	SD	
FIRST	**OBS 1**					
	Pre-intervention	100.83	0.70	100.43	0.77	2.101*
	Post Before Exposure	101.87	0.35	101.50	0.57	3.003**
	Post After exposure	101.83	0.38	101.10	0.84	4.338***
	Post 15 minutes	101.73	0.52	100.77	0.77	5.676***
	Post 30 minutes	101.47	0.68	100.47	0.73	5.484***
	OBS 2					
	Pre-intervention	100.73	0.69	100.53	0.68	1.128 NS
	Post Before Exposure	101.90	0.31	101.47	0.63	3.396***
	Post after exposure	101.90	0.31	101.10	0.66	6.013***
	Post 15 minutes	101.73	0.52	100.63	0.72	6.790***
	Post 30 minutes	101.53	0.68	100.50	0.73	5.663***
SECOND	**OBS 1**					
	Pre-intervention	100.93	0.78	100.67	0.76	1.338N.S
	Post Before Exposure	101.77	0.50	101.63	0.67	0.872N.S
	Post After exposure	101.73	0.58	101.27	0.64	2.953 **
	Post 15 minutes	101.57	0.68	100.63	0.61	5.581***
	Post 30 minutes	101.47	0.73	100.50	0.63	5.491***
	OBS 2					
	Pre-intervention	100.63	0.61	100.50	0.63	0.830NS
	Post Before Exposure	101.77	0.50	101.63	0.56	0.973NS
	Post After exposure	101.73	0.52	101.17	0.70	3.561***
	Post 15 minutes	101.37	0.72	100.70	0.70	3.635***
	Post 30 minutes	101.23	0.73	100.40	0.86	4.065***
THIRD	**OBS 1**					
	Pre-intervention	100.80	0.13	100.70	0.79	0.513NS
	Post Before Exposure	101.77	0.09	101.80	0.55	0.245NS
	Post After exposure	100.73	0.10	101.20	0.71	3.304**
	Post 15 minutes	101.63	0.10	100.63	0.67	6.553**
	Post 30 minutes	101.53	0.11	100.50	0.53	5.869**
	OBS 2					
	Pre-intervention	100.60	0.67	100.40	0.62	1.194NS
	Post Before Exposure	101.83	0.38	100.63	0.53	2.484*
	Post After exposure	101.87	0.35	101.10	0.66	5.624***
	Post 15 minutes	101.73	0.52	100.73	0.64	6.640***
	Post 30 minutes	101.53	0.57	100.57	0.73	5.722***

*** $P < 0.001$ ** $P < 0.01$ * $P < 0.05$ NS Non- significant

Table 7: Mean, Standard Deviation and 't' Value of Weight between KMC and PM/S Neonates

Day	Maternal kangarooed n = 30		Professional mummified n =30		't' value
	Mean	SD	Mean	SD	
First	2.947	0.296	2.958	0.313	0.144 NS
Second	2.896	0.299	2.882	0.334	0.173 NS
Third	2.852	0.2999	2.878	0.321	0.333 NS

NS – Non significant

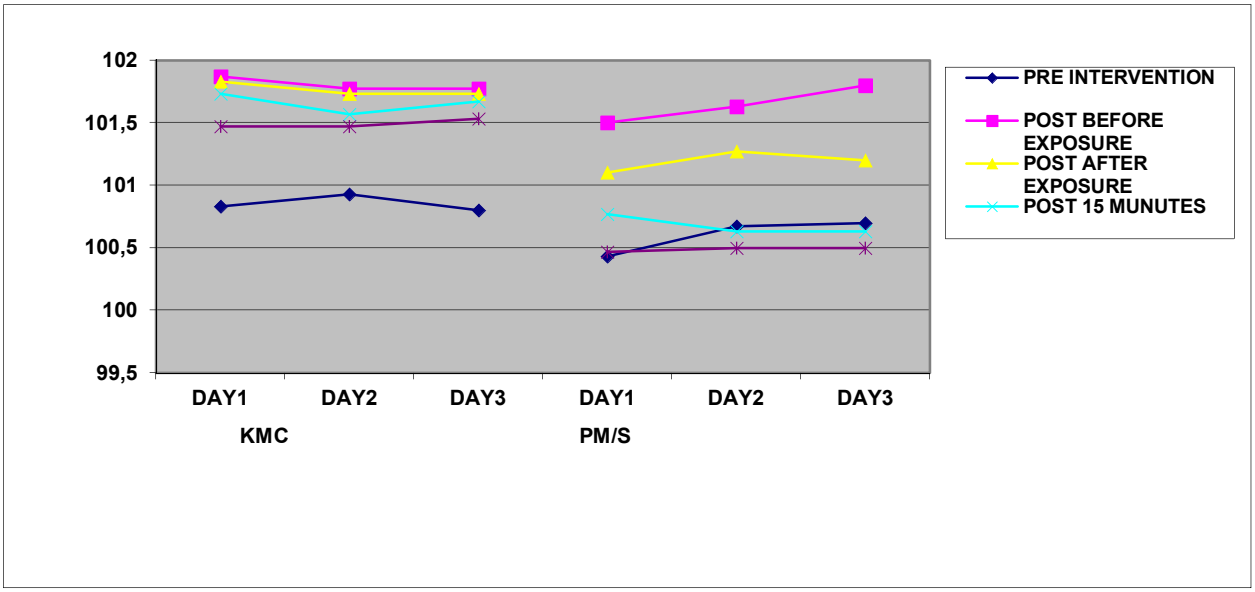

Figure 1: Mean, Standard Deviation and 't' Value of between Temperatures for KMC and PM/S

TABLE 9. Mean Distribution of Neonatal Weight Days One to Three Across Interventions

Days	KMC n = 30			PM/S n =30			Student's t-test
	Difference			Difference			
	Mean	SD	Paired t-values	Mean	SD	Paired t-values	
1-3	0.0953	0.416	12.56***	0.080	0.519	8.438 ***	1.96 NS

*** p<0.001
NS non-significant

Discussion

This study focused on the effects of KMC and PM/S on neonatal temperature and weight in the Newblock post natal ward at Sri Ramachandra Hospital, Chennai. Data collection was done via a convenience sampling for neonate-mother dyads. The intention was to capture temperature and weights over the first three days of life for each neonate group depending upon the heat retention intervention strategy (i.e., PM/S or KMC).

Based on the findings, the potential for KMC in this setting was supported as a viable alternative and/or augmentation to the traditional PM/S approach. The implications of this finding is critical for the practice in the global efforts to reduce heat loss as a contributing fact to neonatal morbidities and mortality. The patterns observed in temperature and weight losses in this study reiterate the thermo-regulatory imperative in the neonatal care plan. It also re-enforced that thermal protective efforts do not require expensive or technological complexities but rather a protocol and policy standard which embeds and operationalizes the evidence.

This study yielded preliminary findings in a unique population. It is important for a larger replication of this study to validate the findings and potentially expand beyond the term neonates. There was interest generated in the KMC method amongst the staff, which was not addressed in this study. It is possible that a study is warranted to assess the receptiveness and perceptions of the staff in the unit on the appropriateness and effectiveness of the introduction of KMC in conjunction with traditional modes of care. There is a lack of evidence on the cultural aspects of KMC which is another area of future study.

In conclusion, KMC was found to provide a viable and meritous alternative to PM/S as a thermoregulatory strategy for neonates. The findings would suggest that neonates enjoyed a higher level of retention of temperature in the KMC group than in the PM/S group. The research continues to have conflicting results with respect to this issue. The current findings align with those of Ludington-Hoe (1995), but conflict with those of Roberts, Paynter and McEwan (2000). There is a need for ongoing research to ascertain the optimal approaches and potentials in both methods.

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