Original Research Article

Extent of thermal stress in newborns in maternity wards and factors affecting it

Sakshi Ojha, Yogendra S. Verma*

Department of Pediatrics, Gajra Raja Medical College, Gwalior, Madhya Pradesh, India

Received: 18 April 2018

Accepted: 24 April 2018

***Correspondence:**

Dr. Yogendra S. Verma,

E-mail: ysverma86@gmail.com

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ABSTRACT

Background: The objective was to assess thermal stress in newborns on mother side in maternity wards and various neonatal and maternal characteristics affecting it.

Methods: It was a Hospital based analytical study carried out at Maternity ward of Medical College Hospital (Tertiary health center) and Maternity ward of Prasutigraha under department of health (Primary health center) in central part of India. Participants were 960 neonates on mother side in maternity wards (480 in each health center) upto first seven days of life (168 hours) were studied for a duration of one year. Newborns were enrolled twice a week alternatively in the two health centers throughout the year. Various neonatal and maternal characteristics of the enrolled newborns were noted as per the proforma and neonatal body temperature was recorded.

Results: Almost half of the newborns (47.08%) were found in thermal stress. More than one third (37%) were hypothermic and 9.4% were hyperthermic. Incidence of hypothermia found in primary health center (44.4%) was significantly higher than in tertiary health center (30.8%) ($P < 0.001$). Incidence of hyperthermia was nearly same (9.4-9.6%). Hypothermia was more in pre terms ($P = 0.031$), in neonates of mothers belonging to lower socioeconomic status ($P = 0.049$), in neonates of young mothers with age < 25 years ($P = 0.011$), when breastfeeding was delayed (> 1 hour) ($P = 0.006$) and when cloth score was < 5 in coldest quarter of the year, (November to February) ($P < 0.001$). No significant correlation was seen with hyperthermia and above factors.

Conclusions: No significant correlation was found with maternal literacy, parity, mode of delivery, frequency of breastfeeding, birth weight, oil application, proximity with mother, sex and age of the baby.

Keywords: Hypothermia, Neonates, Postnatal wards, Thermal stress

INTRODUCTION

Concerns about thermal stress and its link to morbidity and mortality in neonates were first documented in 1907, but it was not until 1958, that Silverman et al. demonstrated the association between more effective temperature regulation and decreased mortality.¹ Neonatal hypothermia is an important contributing factor to neonatal mortality and morbidity in both developed and developing countries.² A foetus in uterus is generally 0.5°C higher than mothers' temperature and rapid cooling occurs after delivery, resulting in cold stress.

On the other hand, rise in temperature are seen occasionally on third or fourth day of life in newborns who are otherwise well, and overheating and sepsis as causes of fever must be excluded.³ Dehydration is perhaps an infrequently recognized cause of fever in newborn period. Sweating can occur in term and late preterm infants (35 weeks onwards), therefore they are able to raise their evaporative losses. However, maximal sweating rate is again related to gestational age.⁴

Due to the launch of various schemes under National Health Mission, total number of institutional deliveries

has increased over the years, leading to an overall increase in burden over facility based care, which provides care in the form of SNCU, NBSU, NBCC and postnatal ward care. Thermal care of newborns especially in hours immediately after birth i.e. in postnatal or maternity wards is essential to protect the newborns from thermal stress and its complications, further decreasing the burden of critical care units. Neonatal health promotion programmes need to focus on behavioural changes necessary to optimize thermal care in post natal wards especially of low resource settings. Keeping these facts in mind this study is being conducted.

METHODS

The present study was conducted in two different government health centers of one of the city of Central India: Maternity ward, of Medical College Hospital (tertiary health centre) and maternity ward of, prasutiग्रah under department of health (primary health centre) between August 2014 to July 2015. Ethical approval for this study was obtained from Institutional Ethical Committee of hospital. The study was conducted in newborns with their mothers, in first week of life, in maternity wards of the health centers. Written and informed consent was obtained from the parents or legal guardians prior to study.

Inclusion criteria

- All neonates with their mothers in postnatal ward.
- All neonates upto first seven days of age (168 hours).

Exclusion criteria

- Neonates admitted in NICU/SNCU.
- Neonates beyond seven days of age.

Digital thermometers were used to take the axillary temperature of the neonates, which were timely standardized with mercury thermometers for accuracy

Readings were taken on a randomly selected day, twice a week, alternatively in the two institutions, thus 8 times in a month, throughout the year. Each time 10 neonates were enrolled by random selection method in maternity wards. Thus making 20 each week and 80 each month with an enrollment of total 960 neonates for the whole year (480 in each health center). Baseline characteristics of the neonate i.e. (postnatal age, birth weight, gestational age at birth, sex, time of initiation of breast feeding, layers and types of cloth worn and wrapped, use of cap and socks, frequency of feeding, frequency of micturition) and mother, i.e (age, education, working status, parity, mode of delivery, socioeconomic profile) and other habits (application of oil, bathing, proximity with mother) were noted down in the proforma. Conclusions were drawn statistically to correlate the outcome.

RESULTS

$p < 0.001$ - significantly more hypothermia in Primary health center.

Figure 1: Incidence of thermal stress in the two health centres.

Table 1: Temperature status of neonates throughout the year.

Institute	Normal	Cold stress	Moderate hypothermia	Severe hypothermia	Hyperthermia	Total
Medical college hospital	286 59.6%	111 23.1%	37 7.7%	0 0.0%	46 9.6%	480 100.0%
Prasutiwing	222 46.3%	122 25.4%	89 18.5%	2 0.4%	45 9.4%	480 100.0%
Total	508 52.9%	233 24.3%	126 13.1%	2 0.2%	91 9.5%	960 100.0%
P value	<0.001	0.41	<0.001	0.15	0.91	

Incidence of hypothermia in tertiary health center and primary health centre was 30.8% and 44.40%

respectively with a $P < 0.001$, showing significantly more hypothermia in primary health centre. Incidence of

hyperthermia was 9.6% and 9.4% in tertiary health centre and primary health centre respectively with a P= 0.91 (Figure 1, Table 1).

Table 2: Gestational age and mean body temperature.

Gestational age (weeks)	No. of new borns	Mean body temperature	±SD
<37 [preterm]	55	36.35	1.45
≥37 [term]	905	36.64	0.91
P value		0.031	

Hypothermia was significantly high in preterm in comparison with term neonates.

The mean neonatal body temperature was found significantly lower in pre terms (mean NBT = 36.350C) than in terms (mean NBT = 36.640C) with a P = 0.031 (Table 2).

Kuppuswami scale for socioeconomic classification was used, based upon the details given by the parents of the neonates and hypothermia was significantly found more in neonates of mothers belonging to low socioeconomic status i.e, lower and upper lower class (P = 0.049) (Table 3) and in mothers whose age was <25 years (P=0.011) (Table 4).

Table 3: Socioeconomic status and thermal stress.

Socioeconomic status	Normal		Hypothermia		Hyperthermia		Total	
	No.	%	No.	%	No.	%	No.	%
Lower	399	51.6	302	39.11	71	9.19	772	100
lower	187	50.1	155	41.55	31	8.31	373	100
upper lower	212	53.1	147	36.84	40	10.02	399	100
Upper	109	57.97	59	31.38	20	63.82	188	100
lower middle	99	56.57	57	32.57	19	10.85	175	100
upper middle	9	81.81	1	9.1	1	9.11	11	100
upper	1	50	1	50	0	0	2	100
total	508	52.91	361	37.6	91	9.47	960	100
p value			0.049		0.540			

Table 4: Maternal age and thermal stress of newborns.

Mothers age (years)	Normal		Hypothermia		Hyperthermia		Total	
	No.	%	No.	%	No.	%	No.	%
<20	29	59.2	16	32.7	4	8.2	49	100
20-24	317	51.5	246	39.9	53	8.6	616	100
P value			0.011					
25-29	121	51.5	85	36.2	29	12.4	235	100
>30	41	68.3	14	23.3	5	8.3	60	100
total	508	52.9	361	37.6	91	9.5	960	100

Hypothermia was seen higher in newborns of young mothers, (<25 years). No correlation was seen with hyperthermia and maternal age.

Table 5: Time of first feed and thermal stress.

Time of first feed (hours)	Normal		Hypothermia		Hyperthermia		Total	
	No.	%	No.	%	No.	%	No.	%
Early initiation								
<1	57	64.77	21	23.86	10	11.36	88	100
Late initiation	Normal		Hypothermia		Hyperthermia		Total	
	No.	%	No.	%	No.	%	No.	%
1-3	317	52.05	234	38.42	58	9.52	609	100
4-24	117	53.66	80	36.69	21	9.63	218	100
>24	3	20	11	73.33	1	6.66	15	100
Not fed	14	46.66	15	50	1	3.33	30	100
total	508	52.91	361	37.60	91	9.47	960	
P value			0.006		0.97			

Incidence of hypothermia was found less when breastfeeding got initiated within 1 hour ($P = 0.006$). No significant correlation of the above factors was seen with hyperthermia (Table 5).

A cloth score was formulated, taking into consideration the layers and types of cloth worn and wrapped and considering the presence of cap and socks, substituting 1

for cotton layer, 2 for woolen layer, 1 for the presence of cap and 1 for socks. Throughout the year, the cloth score ranged from 2 – 12. Hypothermia was significantly more when the cloth score dropped below 5 during winters (November - February) ($P < 0.001$). No such correlation of cloth score was found in the other months and with hyperthermia (Table 6).

Table 6: Cloth score.

Season	Cloth score	Normal		Hypothermia		Hyperthermia		Total
		No.	%	No.	%	No.	%	
Nov-Feb	1--4	5	13.5	32	86.48	0	0	37
	≥ 5	131	46.2	141	49.82	11	3.8	283
	total	136	42.5	173	54.06	11	3.8	320
P value		<0.001						
March-June	1--4	116	61.3	40	20.7	37	18.13	193
	≥ 5	82	64.56	30	23.62	15	11.81	127
	total	198	61.87	70	21.87	52	16.25	320
P value		0.097						
July-Oct	1--4	31	44.28	33	47.14	6	8.57	70
	≥ 5	143	57.2	83	33.2	24	9.6	250
	total	174	54.37	116	36.25	30	9.37	320
Total	1--4	152	50.66	105	35	43	14.33	300
	≥ 5	356	53.93	254	38.48	50	7.57	660
	total	508	52.91	361	37.6	9	9.47	960

$P < 0.001$, if cloth score < 5 in months of November – February

No significant correlation was found with maternal literacy, parity, mode of delivery, frequency of breastfeeding, birth weight, oil application, proximity with mother, sex and age of the baby.

DISCUSSION

Incidence of hypothermia reported in the present study is very high which ranges from 30.8% - 44.4% (Figure 1) in the maternity wards of the study hospitals which is similar to the incidence (37%) found in a hospital based study done by Suman RP et al in Mumbai.⁵ Incidence of moderate hypothermia ranges from 7.7%-18.8% in the present study (Table 1) which is higher than those reported by Kaushik et al in Shimla (2.9%).⁶ This could be because of lesser sensitivity to ambient temperature variability in central part of the country. A more recent population based study done by Darmstadt et al in Uttar Pradesh, reported hypothermia in 45% of the infants which is higher than the incidence found in this study, which could be the effect of institutional care of the neonates in this study.⁷

The study found significant difference in incidence of hypothermia in the two study health centers with a $P < 0.001$. This may be attributable to the low resource

availability at health centre 2 and in comparison to 1 (Figure 1).

Preterms were found more hypothermic than terms (Table 2) showing their lower abilities to maintain body temperatures which was similar to that reported by Mullany LC in Nepal.⁸

No significant correlation of hypothermia was found with birth weight of the neonates, which is in contrast to other studies which reports hypothermia more in low birth weight children.^{9,10} This can be attributed to the exclusion of VLBW neonates who require admission in NICU and inclusion of only LBW and normal birth weight neonates in the study.

In the present study, we found significant correlation of lower socioeconomic status of mothers and incidence of hypothermia in their babies. ($P = 0.049$) (Table 3) which may be due to poor resource availability. Also, newborns of younger mothers were found more hypothermic ($P = 0.011$) (Table 4) suggesting ignorance and less awareness regarding newborn care which is similar to the observations of Mullany LC.⁸

Incidence of hypothermia was found more if breastfeeding was initiated after 1 hour which is similar

to that reported in other studies showing benefits of colostrum (Table 5).⁸ But no such correlation was seen with the frequency of breast feeding, probably due to variability in the amount taken during each feed according to the body weight.

The present study also suggested a correlation of lower cloth score (<5) with hypothermia during the months of November – February (P <0.001) showing the significance of more layers of cloth in maintaining body temperature during winters. No correlation of cloth layers with hyperthermia was seen which is in contrast to the study done by Basil et al in Iraq (Table 6)¹¹

Overall incidence of hyperthermia in this study ranges from 9.4% - 9.6% and cases were found throughout the year, with no significant difference seen in both institutes which can be attributable to the presence of sepsis (Figure 1).

No correlation was found in the prevalence of thermal stress (both hypothermia and hyperthermia) with maternal literacy, sex of the neonate, mode of delivery, birth order, practices like oil application, proximity of baby with their mothers and frequency of breast feeding.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. Ajay Gaur and Dr. Neelam Rajput for their support during this study.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Ojha S, Verma YS. Extent of thermal stress in newborns in maternity wards and factors affecting it. *Int J Contemp Pediatr* 2018;5: 1207-11.