



## PROFILE OF NEONATES WITH FEVER ADMITTED IN NICU OF A TERTIARY CARE TEACHING HOSPITAL: A STUDY TO FIND EFFECT OF ENVIRONMENTAL HEAT ON NEONATAL AETIOLOGY OF FEVER

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### ABSTRACT

**Background:** Fever in the neonates generally indicate systemic infections but one more emerging cause towards fever in the neonatal period is the escalating environmental temperature and humidity. The present study was carried out to find out various causes of fever in neonates and to study various factors associated with the effect of environmental heat on neonatal hyperthermia.

**Methods:** A prospective record based cross-sectional study was carried out on neonates with body temperature >100°F during the summer months at a tertiary care teaching hospital. The Study was approved by the institutional review board and data was collected after informed written consent of the parent/guardian.

**Results:** From the total 319 neonatal admissions, a total of 51 neonates were meeting the inclusion criteria and 37(72.5%) neonates were diagnosed as having environmental hyperthermia. As the daily maximum temperature and the risk category due to heat wave increases from normal to orange, there are higher proportion of total neonates with environmental hyperthermia.

**Conclusion:** Environmental hyperthermia is found to be the most common cause of hyperthermia in neonates during the summer months at a tertiary care teaching hospital. Neonate are at the higher risk of developing environmental hyperthermia as the daily maximum environmental temperature rises and the heat wave risk category increases.

**KEYWORDS :** Neonates, Hyperthermia, Environmental Heat

### INTRODUCTION

The rising trend in the neonatal mortality is a major public health concern.<sup>1</sup> A few most frequent causes of increased neonatal mortality have been identified as preterm birth complications, sepsis and pneumonia among the other infective illness.<sup>2</sup> Most of these causes present in the clinical setting as increased in the body temperature and thus finding out and enlisting the causes fever in neonates is essential in order to provide prompt and adequate treatment.

Thermoregulation is the ability of the body to maintain a balance between heat production and heat loss in order to keep the body temperature within the normal range.<sup>3</sup> Under normal circumstances the ability to maintain the body temperature is seen more efficiently in the adults. The newborns on the other hand face a major challenge to maintain a normal body temperature. The uterine environment is also warmer compared to the cooler, drier external environment.<sup>4</sup> Due to poor thermo-regulating ability, neonates and premature neonates in particular tend to lose heat more rapidly after delivery and are often found to be hypothermic. Ordinarily a wet newborn has a higher surface area to volume ratio. Hence, the newborn rapidly loses heat by evaporation, convection, conduction, and radiation depending on the humidity and temperature of the external space and many of them present with hypothermia (<36.3°C, N=37°C).<sup>5</sup>

Recent trend however suggests that a concourse of neonates have paradoxically shown hyperthermia. While fever in the neonatal period generally point out towards systemic infections but one more emerging cause towards fever in the neonatal period is the escalating environmental temperature and humidity.<sup>6</sup> On multiple different occasions it has been observed that the neonatal hyperthermia was not due to any other defined specific cause but rather was a consequence of the increasing environmental temperature especially during the summer months.<sup>7</sup> In a study conducted at a tertiary care teaching hospital from Gujarat, India, concluded that an increasing number of fever cases are in fact occurring due to the effect of the environmental temperature and not due to some systemic disease as used to be the case earlier.

Climate change is an international concern. A study from USA focusing on effect of temperature on mortality rates have concluded that neonates are among the most vulnerable group to the environmental temperature.<sup>8</sup> A study from Taiwan has also documented association of infectious diseases like diarrhoea with rise in environmental temperature.<sup>9</sup> Studies around the world have documented that extremes of climatic condition is related to the poor birth outcomes and neonatal mortality.<sup>10</sup> A study from Barcelona shown that the environmental temperature beyond a certain limit,

reduces the gestational duration leading to premature birth and in turn increasing the neonatal mortality.<sup>11</sup> In a study from Nigeria, neonates protected by temperature control mechanisms showed lower mortality rates. The study also points out that although hypothermia was noticed more frequently than hyperthermia but the fatality was more in hyperthermia highlighting its severity in comparison to hypothermia.<sup>12</sup>

### OBJECTIVES

Keeping the above facts in mind, the present study was carried out with the following objectives

1. To find the most frequent causes of fever in the neonates
2. To study the effect of environment heat on the neonatal body temperature.

### MATERIALS & METHOD

**Study design:** The present study was a prospective record based cross-sectional study to find out the various causes of fever in the neonates.

### Study period:

Data collection was carried out during the months of May and June 2019, an ideal time to study effect of environmental heat, as these months are reported to be the warmest in the western part of India where the study was carried out.

### Definition of Fever in neonates:

In neonates, fever is considered to be present when the body temperature is more than 100.4 °F. In order to identify hyperthermia at an early stage and not to miss any borderline case, the cut off for body temperature in our study was considered as 100 °F.

### Inclusion criteria:

All the neonates admitted in the NICU with temperature above 100 °F, whose parents/caretaker give informed written consent for the purpose of the study.

### Exclusion Criteria:

Since it was a record-based study, there were no exclusions once the neonates fulfilled the inclusion criteria.

### Informed Consent:

A written informed consent from the parent/guardian accompanying the neonate was collected before the data collection

### Ethical Considerations:

Permission from Institutional Review Board was taken before the start of the study.

**Methods:**

Tertiary care teaching hospitals have a policy of keeping all newborn babies in the postnatal ward for at least 24-48 hours after the delivery. As a standard protocol at the Department of Pediatrics, any neonate with more than 100°F in the postnatal ward is managed initially at the postnatal ward itself for the first hour. The management in initial hours includes treatment as per the consultant's guidance along with providing a cooler environment with the standard nursing care which includes hourly temperature monitoring and charting of the temperature. If the neonate does not respond to the primary first hour treatment or does not show any signs of improvement in the next three hours, then the neonate is shifted to the NICU. Neonates not having any systemic cause of fever, neonates responding quickly to the prescribed treatment (recovering stage) and neonates having environmental hyperthermia as their provisional diagnosis are sometimes kept in the Back to Mother (BTM) room along with the mother/caretaker. BTM is just like the neonatal ward or a step-down nursery. Since BTM room is in close vicinity to the NICU and provides frequent monitoring, neonates in the BTM room are equally closely supervised just as in the NICU. Sometimes, even when the NICU is fully occupied, such neonates are also kept in the BTM room. This is the reason why we have also included neonates from the BTM room who are matching with the inclusion criteria. Data was collected on a daily basis from the Neonatal Intensive Care Unit (NICU) and Back to Mother room (BTM room) based on a daily proforma.

The diagnosis considered by the pediatrician consultant based on history, clinical findings and laboratory investigations was recorded as final diagnosis and eventually also as a cause of fever. In the case of absence of any predisposing infection, when all other possible causes of fever in neonate are excluded, the environmental hyperthermia was considered as the underlying cause of fever by the consultant and recorded as such.

A specially designed proforma validated through pilot testing, was used for the purpose of the study. All the details of the proforma was filled from the case record sheet. NICU new admission, discharge, death and transfer data was collected on daily basis. Maximum environmental temperature recorded in the city was also noted down from the Indian Metrological department on daily basis. This environmental temperature is categorized by the Heat action Plan of the city on the basis of the risk of heat wave into Yellow Alert (41.1-43°C), Orange Alert (43.1-44.9°C) and Red Alert (> 45°C) and the same was used to analyze the relation between the greater number of admission and the environmental temperature.

**Data Analysis:**

All the data was entered and analyzed in Microsoft Excel. Appropriate statistical tests were used to find the significance of the difference observed. The data was represented in the form of frequency tables, graphs and charts. The information obtained from this data was used to give a conclusive statistic.

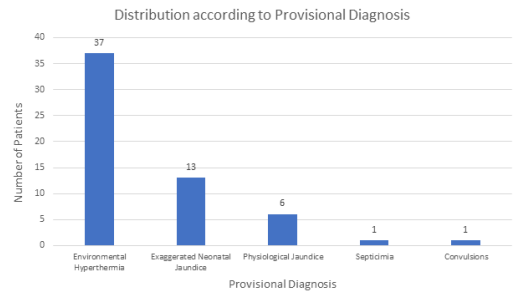
**RESULTS**

In the period of two months, there were 319 new admissions in the NICU. A total of 266 neonates were discharged and 40 neonates expired during the two-month study period. a total of 51 neonates were admitted meeting the inclusion criteria during the study period, 47 neonates were from the NICU and 4 were from the BTM room. The major characteristics of these 51 neonates are summarized in the following table.

**Table 1: Characteristics of neonates with hyperthermia (n=51)**

	No	Percentage
Age group		
Early neonate (0-7 days)	46	90.2
Late neonate (7-28 days)	5	9.8
Gender		
Male	26	50.98
Female	25	49.02
Term of Delivery		
Full term	44	86.27
Pre term	7	13.73
Type of Delivery		
Normal Delivery	27	52.94
LSCS	24	47.06
Breastfeeding status (started or not)		

Yes	48	94.12
No	3	5.88
Admission status		
NICU	47	92.16
BTM	4	7.84



**Figure 1: Distribution of neonatal hyperthermia cases according to their diagnosis**

Distribution of neonates according to their diagnosis is shown in the figure-1. Some neonates had more than one diagnosis assigned to them by the consultant and such neonates have been considered individually in each respective provisional diagnosis while analyzing the report. 37 (72.5%) neonates with the presenting complain of fever were diagnosed to have 'Environmental Hyperthermia' and rest had other diagnosis as shown in the figure-1. The body temperature in the neonates with environmental hyperthermia ranged from 100.1°F - 104°F with an average of 101.8°F

The maximum environmental temperature in the two-month study period ranged from 32.2°C-44.4°C. The average maximum temperature during the study period was 40.4°C. The daily maximum temperature recorded by the Indian Meteorological Department determines the alert status for the environmental heat. Number of cases recorded on each day was compared with the temperature (and thus the alert status) of that day to check the association. The comparison of cases as per the alert status of the day is given in the following table.

**Table 2: Heat alert status of the Day and cases of heat related neonatal hyperthermia**

Alert Category	No. of Days	No of cases of heat hyperthermia
Normal	27	6
Yellow (41.1-43oC)	14	10
Orange (43.1-44.9oC)	19	21

As seen in table-2 there were 27 days which had temperature in the normal range and these days recorded only 6 cases of heat hyperthermia. There were 14 days with yellow alert i.e. 41.1-43°C and these 14 days recorded a total 10 cases of heat hyperthermia. There were 19 days with orange alert (43.1-44.9°C) and most of the cases (21) of heat hyperthermia were recorded on these 19 days. The data suggests that majority of the neonates were admitted when there was a yellow or orange alert. A total of 31 of 37 neonates with environmental hyperthermia in the study were admitted during the yellow/orange alert. This helps in establishing the hypothesis that a warmer external temperature in the summer months is directly related to greater number of neonates with environmental hyperthermia.

The environmental hyperthermia cases were more in the males (22 cases) as compared to females (15 cases) whereas exaggerated neonatal jaundice occurs more in the females (9 cases) as compared to males (4 cases) however, the difference was statistically not significant (P=0.21). 57.14% of the preterm neonates and 75% of the full-term neonates were diagnosed with environmental hyperthermia. Whereas 42.8% preterm neonates and 22.72 full term neonates suffered from exaggerated neonatal jaundice. Thus, in this study, incidence of Environmental hyperthermia was more in the full term and that of exaggerated jaundice was more in the preterm neonates but statistically this is not significant. (P=0.55)

**CONCLUSION**

The risk of environmental hyperthermia is greater during the summer months. Since this study was conducted during the summer months and diagnosis of environmental hyperthermia is made by exclusion it

points out that the majority of the hyperthermia cases in this study could be attributed to the warmer environmental temperature. This risk is reflected by the data which suggest that as the daily maximum temperature and the risk category due to heat wave increases, there is greater risk of developing environmental hyperthermia in neonate

During this period, majority (37, 72.5%) neonates with the presenting complaint of fever were diagnosed to have 'Environmental Hyperthermia' which is the most common cause of hyperthermia in neonates during the summer months at the tertiary care teaching hospital. This denotes that the neonates are at the higher risk of developing environmental hyperthermia as the daily maximum environmental temperature rises and the heat wave risk category increases.

## REFERENCES

1. Kumar, C., Singh, P. K., Rai, R. K., & Singh, L. (2013). Early neonatal mortality in India, 1990–2006. *Journal of community health*, 38(1), 120-130.
2. Million Death Study Collaborators. (2010). Causes of neonatal and child mortality in India: a nationally representative mortality survey. *The Lancet*, 376(9755), 1853-1860.
3. Education, I. Research Committee of the Champlain Maternal Newborn Regional Program (CMNRP). Newborn thermoregulation: A self-learning module [Internet]. Ottawa ON: CMNRP; 2013 Jun [cited 2019 Dec 15].
4. Visscher, M. O., Adam, R., Brink, S., & Odio, M. (2015). Newborn infant skin: physiology, development, and care. *Clinics in dermatology*, 33(3), 271-280.
5. Hey, E. N., & Katz, G. (1970). The optimum thermal environment for naked babies. *Archives of disease in childhood*, 45(241), 328.
6. Khyati, K., Jay, S., & Pallvi, D. (2014). Study of clinical profile of hyperthermia in neonate admitted in NICU during summer months 2010. *NHL Journal of Medical Sciences*, 3(1).
7. Pandya, N., & Mehta, K. G. (2019). Clinical profile of neonates admitted with hypernatremia in NICU at tertiary hospital in Vadodara, Gujarat, India. *Int J Contemp Pediatr*, 6, 436-9.
8. Basu, R. (2009). High ambient temperature and mortality: a review of epidemiologic studies from 2001 to 2008. *Environmental health*, 8(1), 40.
9. Phung, D., Huang, C., Rutherford, S., Chu, C., Wang, X., Nguyen, M., ... & Nguyen, T. H. (2015). Association between climate factors and diarrhoea in a Mekong Delta area. *International journal of biometeorology*, 59(9), 1321-1331.
10. Strand, L. B., Barnett, A. G., & Tong, S. (2011). The influence of season and ambient temperature on birth outcomes: a review of the epidemiological literature. *Environmental research*, 111(3), 451-462.
11. Sedin, G., Hammarlund, K., & Nilsson, G. E. (1979). The influence of environment, activity and gestational age on evaporative water loss. *Pediatric Research*, 13(1), 80-80.
12. Amadi, H. O., Olateju, E. K., Alabi, P., Kawuwa, M. B., Ibadin, M. O., & Osibogun, A. O. (2015). Neonatal hyperthermia and thermal stress in low-and middle-income countries: a hidden cause of death in extremely low-birthweight neonates. *Paediatrics and international child health*, 35(3), 273-281.