

# Impact of Seasonal Variation in Temperature on Dehydration in Neonates

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## ABSTRACT

The study was conducted to compare the incidence and severity of dehydration in newborns admitted during warmer and cooler months. 55 out of 941 (5.8%) neonates were admitted with dehydration during the study duration. Dehydration warranting medical support was common in both cooler and warmer months of the year. 26 (47.2%) neonates were admitted in the cooler months and 29 (52.7%) in the warmer months. The severity of dehydration was marginally higher in warmer months ( $P = 0.09$ ).

**Keywords:** Dehydration, Newborns, Warm, Hyponatremia.

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Weight loss of up to 10% in the immediate postnatal period, with its nadir around 3 to 4 days of life, is an established phenomenon. Factors like inadequate milk in the initial days, wrong feeding technique and increased ambient temperature can aggravate the above phenomenon [1].

*In vitro* studies have suggested that high temperatures (39°C) induce high lactation whereas long-term exposure to 41°C leads to a decline in milk production [2]. These findings lead to the possibility of ambient temperature playing a significant role in the development of postnatal dehydration needing medical management. Hence, this study was planned to compare the incidence and severity of postnatal dehydration during warmer and cooler months.

We conducted a prospective study wherein we assessed the impact of ambient temperature caused by seasonal variation on the incidence of severe dehydration in term neonates between July 2021 to June 2022. We included neonates delivered at term gestation and admitted with severe dehydration to the neonatal intensive care unit of JSS Hospital, Mysuru, a tertiary care unit in South India. Severe dehydration was defined as cumulative weight loss > 10% of birth weight, weight loss (<10%) associated with hyponatremia and/or increase in blood urea [2]. We excluded septic newborns and neonates with congenital malformations including renal and endocrinal

abnormalities from the study. The study was approved by the institutional ethics committee. Informed consent was obtained from the parents or immediate caregivers. Based on the convenient sampling method, all babies admitted during this period and fulfilling the inclusion and exclusion criteria were recruited in the study.

The average ambient temperature at the study location during the study period was 24.6°C. Furthermore, the Government of India has declared an indoor ambient temperature of 24°C to be comfortable for humans. Accordingly, February to June were considered as warm months (26.1°C) and July to January were considered cool months (23.9°C) for this study.

A total of 55 neonates out of the total NICU admissions ( $n = 941$ ) 5.8% were admitted with significant weight loss during this study period. Among these, 26 (47.2%) were admitted in the cooler months and 29 (52.7%) in the warmer months. 32 (58.2%) were females and 42 (76.3%) babies were delivered by caesarean section. Nearly 80% of the babies were born to first-time mothers. 35 (63.6%) babies were exclusively breastfed and 20 (36.3%) had been receiving some top feeds. The top feeds could not be quantified as these babies had been referred from another hospital. The baseline characteristics of the neonates are depicted in **Table I**.

Out of the 55 neonates, 47 (85.4%) had hyponatremia; 5 (9%) of them had very high sodium levels (>170 mmol/L), 25 (45.4%) had fever, 9 (16.3%) had hypoglycemia and 8 (14.5%) had decreased activity.

### Cool vs Warm months

The median (IQR) weight at admission was 2540 (2350 - 2720) g in the cooler months and 2720 (2080 - 2940) g in

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**Table I Characteristics of Babies Admitted During Cool and Warm Months**

	Cool (n=26)	Warm (n=29)	P value
<i>Qualitative variables<sup>a</sup></i>			
<i>Parity</i>			
Primi	23 (88.5)	21 (72.5)	0.06
Multi	3 (11.5)	8 (27.5)	
<i>Mode of delivery</i>			
Cesarean section	19 (73)	23 (79.3)	0.35
Vaginal	7 (27)	6 (20.7)	
<i>Gender</i>			
Male	9 (34.6)	14 (48.2)	0.15
Female	17 (65.4)	15 (51.8)	
<i>Source of admission</i>			
Outborn	10 (38.4)	14 (48.2)	0.27
Inborn	16 (61.6)	15 (51.7)	
<i>Quantitative variables<sup>b</sup></i>			
Maternal age (y)	28 (26 - 29)	26 (24 - 29)	0.24
Weight on admission (g)	2540 (2350 - 2720)	2720 (2080 - 2940)	0.47
Age on admission (d)	4.5 (3 - 7.8)	4 (2 - 6)	0.34
Duration of stay (d)	3 (3 - 4)	3 (2 - 5)	0.34
Discharge weight (g)	2750 (2485 - 2900)	2900 (2200 - 3160)	0.52
Total weight loss (g)	400 (300 - 455)	480 (300 - 620)	0.09
Weight loss (%)	12.9 (11.7 - 14.1)	15 (10.7 - 17.7)	0.15
Weight loss per day (%)	2.7 (1.7 - 4.1)	3.6 (2 - 5.7)	0.09

Values expressed as an (%) or bmedian (IQR)

the warmer months. The median (IQR) weight loss (g) in cooler months was lesser compared to that in warmer months [400 (300 - 455) vs 480 (300 - 620);  $P = 0.09$ ]. The difference in the average weight loss between the cooler and warmer months was a marginal 2% (**Table I**).

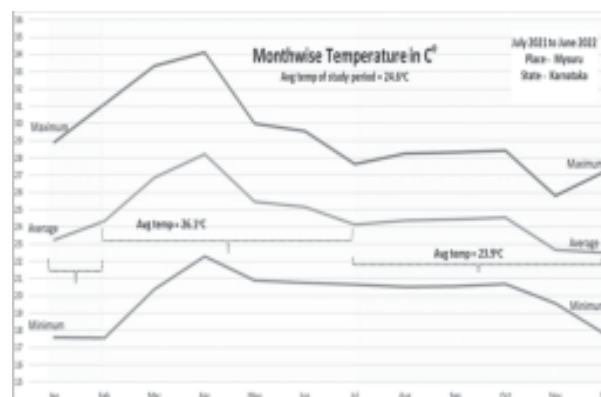
The incidence of dehydration needing medical support in the immediate postnatal period was 5.8%. The incidence did not differ significantly between the cooler and the warmer months. Few studies have shown that newborn babies maintain their hydration status and no supplemental feeds are required even in hot environments (3)]. Overall the incidence of postnatal weight loss and dehydration has been shown to vary widely from as low as 0.2% [4] to 19.7% [5]. This wide variation across the world is likely due to the cultural differences and postnatal management plans of supplemental feeds adopted by various units till breastfeeding are satisfactorily achieved [6]. Dehydration needing medical intervention and leading

to morbidity is reported in hotter months in adults and older children [6,7]. Applying the same understanding to neonates who are further disadvantaged by precarious fluid intake during their initial few days of life makes one believe that the problem of weight loss and dehydration is higher in warmer months compared to cooler months. This is further accentuated by the fact that with an increase in temperature, the duration of breastfeeding decreases whereas insensible water loss increases [8,9]. Contrary to this, we did not find any statistically significant difference in the incidence of dehydration between cooler and warmer months.

In our study, the average maximum temperature in warmer months was 31.6°C and that in cooler months was 27.7°C with the difference being 3.9°C. The average minimum temperature in warmer months was 20.4°C and that in cooler months was 19.6°C with the difference being 0.8°C (**Fig.1**). A significantly higher percentage of weight loss in warm months was also noticed by Kusuma et al [9] in late preterm babies and by Rekha et al [2] in term babies. Zia et al reported no difference in the incidence of significant dehydration with seasonal variation in temperature in their study. However, their study environment was thermally regulated as per the legal norm [10].

Our findings suggest that babies who are nursed in cotton cloth cocoons, regardless of the ambient temperature, keep the babies warm. Such cocoons are common practice in our set-up. These thermal nests create their inner milieu negating the effect of ambient temperature

In our study, out of 50 babies born to primigravida, 47 (85.4%) babies had high sodium levels (serum sodium > 145 mEq/L). The high incidence of breastfeeding-associated hyponatremia among infants born to first-time mothers may be attributed to the fact that primiparous women produce significantly less milk than multiparous

**Fig. 1** Month-wise temperature in °C

women during the first postpartum week, with a subset of primiparous women having very low production of breastmilk in initial postnatal days [2].

Though we noted a higher degree of weight loss in warmer months compared to cooler months, the frequency of significant weight loss was not significantly different between these two months. Thus, suggesting that significant dehydration is equally common in both cooler and warmer months, the degree of dehydration being marginally higher in warmer months. Though this does not achieve statistical significance, it is important for clinical management. Our findings must be interpreted keeping in mind the location of the study centre as India is a vast country and temperature extremes are related to the latitude. Northern India which has much higher maximum temperatures reaching up to 45°C in summer and often 2-4°C in winter, may witness a difference in incidence of dehydration due to seasonal variation, although the same is not seen in South India. The study was limited by its small sample size and inability to measure breastmilk sodium levels.

In conclusion, dehydration needing medical support is common in both cooler and warmer months of the year. The severity of dehydration is marginally higher in warmer months.

*Ethics clearance:* Institutional Ethics Committee, JSSMC; No. JSSMC/IEC/050722/13NCT/2022-2023), dated July 08, 2022.

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