

## Seasonal Trend of Neonatal Dehydration in Hot Climatic Conditions of Southern Rajasthan, India

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### Abstract

**Objective:** Dehydration in neonates is a potentially serious condition. The healthy neonates on exclusively breast feed were found to be dehydrated, especially in summers. The objective is to determine the incidence of dehydration and biochemical changes which occur in these neonates in summer, rainy and winter months of the year.

**Methodology:** Hospital based prospective study on term neonates (>37 week gestation and >2 kg birth weight) admitted with dehydration (signs/symptoms of dehydration/ >10% weight loss after birth in neonatal period) during the study period of 1 year in a tertiary care centre located in Udaipur, India. Informed consent was taken. Neonates with sepsis/asphyxia/anomalies were excluded.

**Result:** A total of three hundred and eighty four term neonates with dehydration were enrolled during study period of 1 year. Number of cases during winter months were 51(13.2%). in summer months were 249 (64.9%) and rainy months were 84(21.9%). The number of neonates with hypernatremic dehydration in summer, winter and rainy months was 172(69.1%), 18(35.3%) and 48(57.1%) respectively. Mean weight loss, mean blood urea, mean serum creatinine, mean serum sodium were significantly elevated in neonates admitted during summer months in comparison to winter and rainy months. 5 neonates admitted during summer months expired due to various complications. All neonates admitted during winter and summers were successfully discharged.

**Conclusion:** The number of neonates getting admitted due to dehydration in summers increases rapidly with most neonates among them having serious renal parameters derangement. Countries with hot climatic conditions must emphasize on problem of neonatal dehydration. Proper maternal counselling regarding breastfeeding adequacy must be given. Daily weight monitoring and frequent follow up in first few weeks of birth will help in early diagnosis of dehydration and thus will help in preventing the morbidities and mortalities associated with it.

**Keywords:** Exclusive breastfeeding; Hypernatremic dehydration

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## Introduction

Dehydration in apparently healthy breastfed neonates is not uncommon and has been described in literatures in past from countries with hot climatic conditions [1-5]. Dehydration in neonates in India has not been given much importance apart from few case reports and research articles [6-8]. Dehydration is a potentially serious condition which has been reported to occur in neonatal period in exclusively breast fed neonates [9-12].

Many mothers continue exclusive breast feeding without a watch on its adequacy and weight gain in the baby despite excessive neonatal weight loss, leading to dehydration. Due to the demand supply mismatch, or inadequacy of quantity required, healthy neonates on exclusively breast feed were found to be dehydrated, especially in summers.<sup>6</sup> The typical signs of dehydration are not found in case of neonates, and are often missed if mild. They often presented with irritability, refusal to feed, excessive cry or lethargy which are signs mimicking a broad spectrum of diseases in neonates such as sepsis, meningitis, abdominal colic or just hunger cries. When treated as sepsis, the antibiotics often worsen the already impaired renal functions. The lack of knowledge of adequacy on the mother's part and the loss to frequent follow ups for weight gain has lead to under diagnosis of dehydration.

The present study was undertaken to determine the incidence of dehydration and biochemical changes which occur in these neonates in summer, rainy and winter months of the year. Thus will help in highlighting the need to be vigilant for prompt diagnosis and treatment of dehydration and prevent serious complications, educate the parents and have more frequent weight checks, especially during the summer months.

## Material and Method

This was a hospital based prospective study conducted for period of one year in a

tertiary care centre, Udaipur, Rajasthan, India. The study group included all term neonates with birth weight of more than 2kg admitted with dehydration during the study period.

Term neonates were defined as neonates with gestational age of 37 week or more at birth. Gestation age was calculated using LMP.

Dehydration was defined as neonate with weight loss of more than 10% after birth and/or clinical signs of dehydration like hyperthermia, dry mucosa, decreased skin turgidity, depressed anterior fontanel associated with inadequate breast feeding.

Sick neonates with history of birth asphyxia, sepsis, congenital anomalies and neonates <37 weeks of gestation and birth weight < 2kg and those refusing to give consent or withdrawing consent during study period were excluded. Sepsis ruled out by clinical evaluation and sepsis screening.

Meticulous record of neonates in form of age (in days) at admission, birth and admission weight (in grams using electronic weighing machine) were kept.

November, December, January and February were taken as winter months and March, April, May and June were taken as summer months. July, August, September and October were taken as rainy months. Weather conditions like mean temperature and mean humidity for the month were recorded from regional meteorological centre, Dabok, Udaipur on worldweatheronline.com. Mean seasonal temperature is calculated as mean of mean temperatures of months of that season.

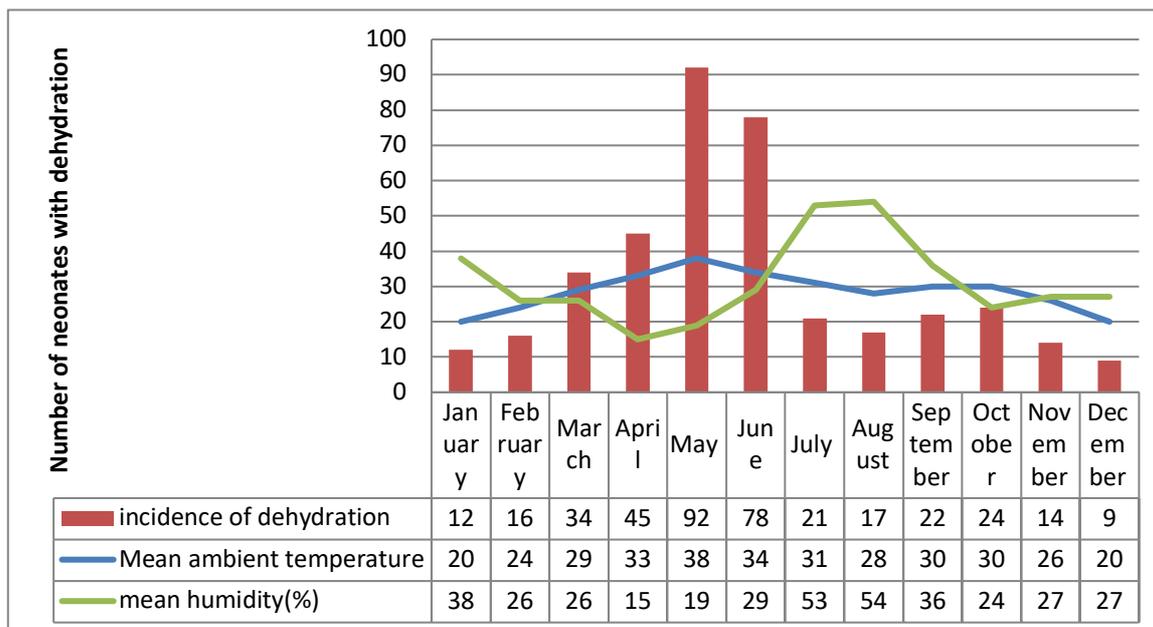
Biochemical evaluations of neonate in form of serum electrolytes (sodium/potassium), blood urea, serum creatinine and Arterial blood gases at admission were done. X-ray chest, cranial imaging studies, CSF examinations and other investigations were performed as and when required.

Hypernatremia is defined as serum sodium levels of >145 meq/L. Neonates were managed as per standard protocols. Data analysis was done using SPSS v21.

**Results**

A total of three hundred and eighty four term neonates with dehydration were enrolled during study period of 1 year. Among them, 234 were male (60.9%) and

150 (39.1%) were female. Monthly distribution of these neonates with mean temperature of each month is shown in figure 1. The total number of neonates admitted with dehydration are 12(3.1%), 16(4.1%), 34(8.85%), 45(11.71%) , 92(23.95%), 78(20.31%), 21(5.4%), 17(4.45%), 22(5.72%), 24(6.25%), 14(3.64%) and 9(2.34%) respectively from January to December.



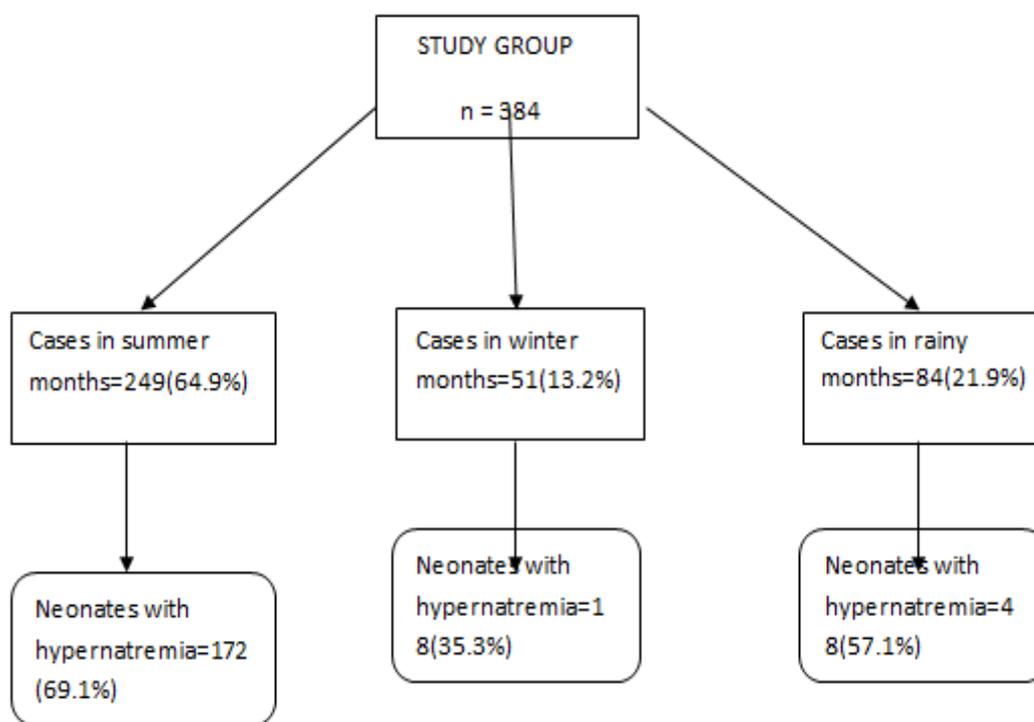
**Figure 1: Monthly distribution of neonates with dehydration and mean temperatures and humidity in respective months.**

In the study, number of cases during winter months were 51(13.2%). in summer months were 249 (64.9%) and rainy months were 84(21.9%). The mean temperature of the winter, summer and rainy months was 22.5, 33.5 and 29.7 degree centigrade, respectively. The mean humidity (%) for these months was 29.5, 22.2 and 41.7 percent respectively. The number of neonates with hypernatremic dehydration in summer, winter and rainy months was 172(69.1%), 18(35.3%) and 48(57.1%) respectively. Figure 2

The number of dehydrated neonates with 10 -<15 % weight loss after birth were 288, with 15 -<20 % weight loss after birth were 81 and with >20 % weight loss after birth were 15. Seasonal distribution of these neonates has been summed up in table 1.

**Table 1**

Weight loss after birth in percent	Summer months	Winter months	Rainy months
10- <15%	174(60.4%)	47(16.3%)	67(23.2%)
15-<20%	60(74%)	4(4.9)	17(20.9%)
≥20%	15(100%)	0	0
	249	51	84



**Figure 2: Distribution of cases according to the season and hypernatremia.**

The number of neonates with dehydration in summers, winter and rainy month with serum sodium level between 145 - 160 mEq/L at admission is 87(34.9%), 15(29.4%) and 30(35.7%) respectively. The dehydrated neonates in summer, winter and rainy months with serum sodium levels between 160-175 mEq/L were 70(28.1%), 3(5.9%) and 18(30.5%) respectively. None of the dehydrated neonate in winter and rainy months had serum sodium levels >175 mEq/L. 15(6.02%) neonates in summer months had serum sodium levels >175 mEq/L. Table 2

**Table 2: Distribution of study population according to serum sodium levels at admission for the respective seasons**

Serum sodium levels at admission (meq/L)	Number of Neonates in Summer months	Number of Neonates in Winter months	Number of Neonates in Rainy months
130-145	77(30.9%)	33(64.7%)	36(42.9%)
146-160	87(34.9%)	15(29.4%)	30(35.7%)
161-175	70(28.1%)	3(5.9%)	18(21.4%)
>175	15(6%)	0	0
	249	51	84

Other findings have been summed up in the table 3.

The number of dehydrated neonates with raised blood urea level in summer, winter and rainy months are 247(99.2%), 45(88.2%) and 80(95.2%) respectively.

The number of dehydrated neonates with raised serum creatinine level in summer, winter and rainy months are 218(87.6%), 28(54.1%) and 54(64.3%) respectively.

Out of 249 dehydrated neonates admitted in summer months, 244 (97.9) were successfully discharged and 5 (2.1%) neonates with dehydration died during course of treatment due to complications of dehydration. All neonates admitted with dehydration in winter and rainy months i.e. 51 and 84 respectively were discharged successfully

**Table 3: Various Parameters observed according to seasons**

	Summer months	Winter months	Rainy months	P value
Number of dehydrated neonates	249 (64.8%)	51(13.3%)	84(21.9%)	
Mean Age (SD) at admission in days	4.65(2.2)	4.67(0.99)	4.76(1.34)	0.91
Mean Birth weight (SD) in kg	2.671(0.368)	2.512(0.292)	2.484(0.270)	<0.00001
Mean Weight (SD) at admission in kg	2.290(0.332)	2.194(0.259)	2.149(0.237)	0.0005
Mean Weight loss (SD) after birth in percent	14.28(3.6)	12.67(1.52)	13.47(1.74)	0.0014
Mean serum sodium level (SD) at admission in mEq/L	157.59(10.5)	150(6.1)	154.8(7.7)	<0.00001
Mean serum potassium (SD) levels at admission in mEq/L	5.06(0.69)	4.57(0.27)	4.77(0.29)	<0.00001
Mean blood urea (SD) at admission in mg/dL	113.66(77.37)	70.46(19.21)	89.01(28.02)	<0.00001
Mean serum Creatinine (SD) levels at admission in mg/dL	1.96(1.06)	1.48(0.35)	1.71(0.3)	0.0005
Mean(SD) stay at hospital in days	4.05(1.40)	3.25(1.01)	3.82(0.75)	0.0005
Outcome discharge/death	244/5	51/0	84/0	

## Discussion

In our study, winter months were taken as November, December, January and February. The mean temperature was below 26°C and number of cases during winter months was 51(13.2%). Summer months were taken as March, April, May and June. The mean temperature in these months was above 30°C and had low humidity; and numbers of neonates with dehydration in these months were 249 (64.9%). Rainy months were taken as July, August, September and October. The mean indoor ambient temperature was higher with high humidity in these months. The neonates with dehydration in these months were 51(13.2%).

In healthy term newborns, insensible water loss through respiratory tract and skin increases several fold in hot and dry weather. The water loss through the respiratory tract is approximately half the total insensible water loss if the ambient air temperature is 32.5°C and the humidity is 50%. Normally, it is one third of total insensible water loss [13]. The present study clearly shows that the incidence of dehydration increases with increase in

environmental temperature and dry weather/low humidity as it leads to increase in physiological insensible loss through skin and respiratory tracts. The number of neonates with dehydration is drastically more in summers as compared to winters and rainy season. Though the temperature was a bit more in rainy season but humidity was more and thus physiological water losses were not higher as compared to summer months. So the incidence of dehydration in rainy season was low as compared to summer months.

The incidence dehydration in newborn is more significant in hot climate and this had been explained in some literatures [6,7,14]. The mean age of presentation and birth weight was not significant among different season of the year.

The mean weight loss percent after birth was more in summer months which were significant in comparison to winter and rainy season. This explains the higher environmental temperature and low humidity leads to more severe dehydration. The number of dehydrated neonates with

higher weight loss was also significantly more in summer months.

Hypernatremic dehydration has been discussed in literature [1-8]. Hypernatremic dehydration was also encountered more in summers as compared to winter and rainy season. The mean sodium levels were also more in those neonates who were admitted with dehydration in summers. The higher range of serum sodium levels ( $>175$  mEq/L) were only reported in summer months. The renal functions were also more deranged in summer months. The mean blood urea and serum creatinine and serum potassium were significantly higher in summer month as compared to winter and rainy months, this is because of higher prevalence of severe dehydration in summer months.

Similarly metabolic acidosis was encountered more in summer months and also the severity of metabolic acidosis was more in summer as compared to winter and rainy months. Those neonates who were admitted in summer months for dehydration had more stay in hospital as compared to winter and rainy months.

Outcome of neonates with dehydration in winter and rainy months was excellent and all of the neonates admitted in these months were successfully discharged. Neonates with dehydration in summer months were severely dehydrated and had 5 of them underwent serious complication like acute renal failure, disseminated intravascular haemorrhage, intraventricular haemorrhage and expired during the course of treatment. Exclusive breastfeeding till 6 months of life has been recommended universally and undoubtedly provides health advantages to both infant and mother. But often exclusivity is not met with adequacy. 'Adequacy' implies sufficient quality and quantity. The summer season in a country like India lying in tropical zone, many states like Rajasthan, Gujarat, Madhya Pradesh and parts of Maharashtra experience high soaring temperatures and dry and arid climatic conditions. Often in summers,

temperature reaches up to 50 degree centigrade in parts of India. In such conditions, it has been seen that there is surge in neonates being brought to hospital with complaints of fever, excessive cry, lethargy, some are brought in more serious conditions like convulsions, cyanosis, anuria, acidosis and shock.

The milk supply from mother does not match with increased neonate's demand in hot climatic conditions due to excessive water losses through skin and respiratory tract and ultimately leading to water deficit in neonate's body which increases day by day and thus leads to impaired renal functions and other biochemical reactions.

Thus it is important to address the problem of dehydration in neonates more vigilantly especially in summer months. We cannot rely on exclusiveness of breast milk in already water deficient status of neonate. Prompt action is required to counter the deficit so that it does not hamper the renal functions of neonates.

Each and every mother should receive reassurance and counselling about techniques of breast feeding and environmental manipulation for hot and dry weather. Daily weight monitoring of the neonates for first few weeks and early follow up (more frequent follow ups in summer months) after discharge will help detecting the problem in early stage and prevent neonates from fatal complications of dehydration

### Conclusion

Is the term "Exclusive breastfeeding" misleading? Exclusivity must meet adequacy. Exclusive adequate breastfeeding should be the gateway to neonatal health. Countries with hot climatic conditions must emphasize on problem of neonatal dehydration. Proper maternal counselling regarding breastfeeding adequacy must be given. Daily weight monitoring and frequent follow up in first few weeks of birth will help in early diagnosis of dehydration and

thus will help in preventing the morbidities and mortalities associated with it

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