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# Newborns Presenting with Hyperthermia: Impact of Climate Change on Newborn Health

Hypothermia is an underlying cause of many neonatal deaths. Keeping babies warm is therefore considered critical for promoting the health, well-being, and survival of newborns. However, there is limited recognition of hyperthermia as a cause of neonatal morbidity and mortality. Rajasthan is well known for its hot weather. This year (May and June 2022) as in many other parts of India, Rajasthan reported a very hot summer with temperatures as high as 45°C–48°C. A study was conducted by the United Kingdom's Meteorological Office to assess the impact of climate change on the heat wave observed in India and Pakistan. One of the many salient conclusions was that human-caused climate change had increased the likelihood of the heat wave in Northwest India by hundred-folds.<sup>[1]</sup>

We run a network of primary healthcare clinics in South Rajasthan, called AMRIT Clinics. Each clinic serves a remote, rural, and tribal community of about 12000–15000 population, living in the hilly terrains of the Southern Aravalli range of Mewar. These regions are generally cooler than the desert districts of Jaisalmer, Barmer, and Jodhpur that fall in the region of Marwar. While most villages are electrified, the supply is erratic, and most households do not own electric fans. During this peak summer, we saw an alarming rise in the number of young infants presenting with hyperthermia.

We present two such newborns in this article, and through their clinical details and outcomes, aim at highlighting the challenges faced in the management of this frequently overlooked problem. We also frame a pathway through which global climate change affects the well-being and survival of newborns in the rural and tribal communities.

## CASE STUDIES

### Case 1

On a hot afternoon in May, when the temperatures were around 45°C an old woman came to our clinic in panic about the condition of her 3-day-old grandson. Baby of Surya was a 3-day-old baby boy born at the AMRIT clinic at Manpur by a normal delivery. There were no risk factors for sepsis such as maternal fever, diarrhea, and leaking per vaginam. The baby, of second birth order, had cried immediately after birth, was kept for postnatal care for 48 h, and had been discharged once breastfeeding was initiated and both mother and baby deemed healthy by our team.

The following day, the family noticed that the baby did not appear well, felt hot to touch, had stopped breastfeeding, and was crying excessively. The family called up our clinic, and being aware of the rising cases of infant hyperthermia in nearby villages, our staff were immediately dispatched to make a

home visit and evaluate the baby. They found the mother-son duo lying on a *khaat* (cot) in the verandah outside their mud house, with the baby wrapped in a thick woolen cloth, as per the customs of this region, i.e., newly delivered mothers are not kept inside the house.

Upon evaluation, the baby appeared irritable. His temperature was recorded as 103.6 °F, heart rate 146/min, respiratory rate 58/min, and there were no chest retractions. The remaining examination was normal, thus confirming the suspicions of hyperthermia. The team sat with the family and explained the reason for the baby's distress, while simultaneously removing the coverings and initiating sponging of the infant with tepid water. Within a short period of this intervention, the baby stopped crying and fell asleep [Figure 1]. We brought the baby and his mother to the clinic, where they were kept in a cool place. By the time, the baby awakened the temperature had dropped to 99.2 °F, the respiratory rate was 36/min, the heart rate 120/min and he started suckling well. The mother and baby were observed round the clock by our team. The next day when the baby was feeding well and afebrile, and the mother was reassured; we sent the baby home with a health worker and staff nurse who ensured that the family kept both mother and son indoors in a cooler place, and that the baby was not excessively clothed.

### Case 2

Babies of Lalki were twin boys who had been born at term through cesarean section in a nearby hospital for being a primipara with twin pregnancy. There was no history of delayed cry in either. The first and second twins weighed 1.8 and 2 kg, respectively, at birth. The second twin had been discharged 48 h after birth. The first twin was kept in the neonatal intensive care unit (NICU) for Intrauterine Growth



**Figure 1:** Baby with hyperthermia in clinic

Retardation and poor feeding that was managed as presumptive sepsis and was discharged after a week. The AMRIT Clinic staff had conducted a postnatal check-up on the 8<sup>th</sup> day of life, when both babies were found to be healthy, were exclusively breastfed, and feeding well.

Coincidentally, just 2 days after managing the previous infant, our clinic staff got a call from one of our *Swasthya Kirans* (community health volunteers) who was concerned about the recent decrease in oral acceptance of the twins (who were now 16-day-old) and wanted us to make a home visit. When the team reached the house, they were surprised to see the babies lying in a bed [Figure 2] in a cowshed adjacent to their home, with a pedestal fan placed nearby. Although the mother was unhappy with this arrangement, she explained that it was nonetheless better than staying in their cemented house that had become unbearably hot.

The smaller baby was crying excessively and we were told that he had hardly breastfed since the morning. On examination, the baby appeared plethoric, had a temperature of 101.6°F and was dehydrated. At home, faced with the excessive heat and with urgency to manage the baby in the nonconductive environment, the team did not record the vitals, but ascertained that the babies were otherwise hemodynamically stable and there were no gross abnormalities in the examination. Making a diagnosis of environmental hyperthermia, we began sponging the baby until he became consolable and started breastfeeding. In order to keep the babies and mother cool, we showed the family how to drape saris around the cot, and keep them wet by sprinkling frequently with water [Figure 3]. We also instructed the mother to breastfeed frequently, change the babies' clothes to more breathable cotton, and sponge them whenever they felt excessively hot.

## DISCUSSION

Newborns do not sweat and their temperature regulating mechanisms are not fully developed. Hence, they are at high risk of developing hyperthermia when faced with high

environmental temperatures or heat waves, as was seen in rural Mewar. Climate change is causing rise in environmental temperatures across the globe with associated implications on health. For example, there is scientific evidence of the ill effects of global warming on pregnancy outcomes. A meta-analysis of 14 studies concluded that for every 1° rise in environmental temperature, the risk of still births and premature births was rising by 5%.<sup>[2]</sup> However, there is limited documentation of the impact of environmental temperatures on neonatal survival and well-being, especially in the rural areas in India.

A study conducted in an Ahmedabad hospital in the harsh summer of 2010 reported a strong association between rising temperatures and NICU admissions of inborn newborns. Above the cut-off of 42°C, each increase of a degree of the daily maximum temperature was associated with a 43% increase in hyperthermia-related admissions. When exploring the possible reasons for this unusual phenomenon, it was noted that the maternity ward was on the top floor and thus became very hot. In the subsequent year, ward was shifted to the ground floor, following which there was a tangible reduction in NICU admissions due to hyperthermia.<sup>[3]</sup>

A review of climate change and its impact on newborn health in Africa cautioned that whatever gains were attained in improving newborn survival in the continent, would be reversed in the future due to the ill effects of climate change. The hypothesized pathways that linked climate change with newborn health included rising environmental temperatures and consequent hyperthermia, as well as droughts and consequent food insecurity.<sup>[4]</sup> This case report reveals how such a pathway is also playing out in rural and tribal hinterlands of India, where there are rising temperatures and high levels of food insecurity. We documented this in a study of child malnutrition in the select villages of this region: 56% of the families surveyed did not have any pulses and 26% did not have any cooking oil at home on the day of visit. Even those families did possess these items, had them in very small amounts. Very few households had any vegetables (14.4%), fruits (2.4%), and almost none had milk, eggs, or meat.<sup>[5]</sup>



**Figure 2:** Twin babies at home



**Figure 3:** Mother and babies cot draped with wet sheets



While global warming is probably the primary underlying reason for the unusually high ambient temperatures in this region, other attributable factors include deforestation and poor housing designs (i.e., cemented, poorly ventilated ill-planned houses). Since these regions have not faced such high temperatures historically, families have not been able to evolve ways or strategies of their own to help adapt to the high temperatures.

While the global warming needs to be tackled at international levels such as by reducing the consumption of nonessential goods, and reducing emissions of carbon dioxide and other greenhouse gases, there is also a strong felt need to improve the microclimate at the local level. Reforestation, growing trees, and using traditional designs and building material (i.e., wood and mud) would go a long way in reducing the ambient household temperatures. Furthermore, families and healthcare providers working in such areas need to be equipped with knowledge and skills to protect their newborns from high body temperatures like the simple but effective strategies that were employed in the management of both cases. Like hypothermia, health care workers, nurses, and pediatricians need to be sensitized to the manifestations, consequences, and management of hyperthermia in the Indian setting. In addition, for the sake of our newborn patients, we pediatricians as a community need to raise our voices against climate change, deforestation, and unbridled urbanization.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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