



ORIGINAL ARTICLE

Thermal status and clinical condition of referred neonates at arrival in a tertiary care referral nursery in Pakistan.

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ABSTRACT... Objective: To determine the thermal status and associated clinical conditions of referred neonates at arrival in a tertiary care referral nursery in Pakistan, and to assess their associations with short-term outcomes. **Study Design:** Observational Cohort study. **Setting:** Department of Neonatology, Children's Hospital & Institute of Child Health, Faisalabad. **Period:** 1st January to 30th June 2025. **Methods:** A total of 355 consecutively referred neonates ≤ 28 days were enrolled. Axillary temperature was measured within 15 minutes of arrival. Other variables included gestational age, birth weight, mode of delivery, clinical colour, feeding ability, blood glucose, referral reason, oxygen support, and need for IV resuscitation. Outcomes at 48 hours were categorized as alive, expired, or left against medical advice (LAMA). Statistical analysis was performed using SPSS v26. Descriptive summaries and chi-square tests assessed associations ($p < 0.05$ considered significant). **Results:** Of 355 neonates, 148 (41.7%) were preterm. Hypothermia was present in 112 (31.5%) including mild (28.5%) and severe (3.1%). Hypothermia was significantly associated with mortality ($p = 0.000$). Hypoglycemia occurred in 41 (11.5%) neonates and was also linked to mortality ($p = 0.029$). Oxygen delivery method and IV bolus administration were both associated with poor outcomes ($p = 0.000$). At 48 hours, 275 (77.5%) survived, 65 (18.3%) expired, and 15 (4.2%) left against medical advice. **Conclusion:** Hypothermia, hypoglycemia, invasive ventilation, and IV bolus administration were significantly associated with mortality among referred neonates. Findings emphasize strengthening of referral stabilization practices—thermal protection, glucose monitoring, safe oxygen delivery, and rational fluid therapy.

Key words: Neonatal Referral, Hypothermia, Risk Factors, Neonatal Mortality.

INTRODUCTION

Neonatal hypothermia remains a major contributor to neonatal morbidity and mortality, particularly in low- and middle-income countries (LMICs). According to the World Health Organization (WHO), normothermia is defined as an axillary temperature between 36.5–37.5 °C, while hypothermia is < 36.5 °C and categorized as mild, moderate, or severe.¹ Global prevalence of neonatal hypothermia remains high; studies from Nepal report that over 90% of neonates experience hypothermia during the first month.² In Ethiopia and Sri Lanka, admission hypothermia prevalence ranges between 60–70%.^{3,4} In Pakistan, despite a national neonatal mortality rate of 39 per 1000 live births⁵, systematic data on thermal status at referral is scarce.

Preterm and low-birth-weight infants are especially prone to hypothermia due to larger surface-area-to-volume ratios, thin skin, and limited brown fat.⁶ Contributing factors include inadequate thermal protection during transport, delayed initiation of breastfeeding, and lack of pre-referral stabilization. While multiple studies from South Asia report high inborn hypothermia rates, few have explored referred neonates' thermal conditions in Pakistan.^{5,7} This study was designed to document the thermal status and clinical profile of referred neonates and to identify factors associated with short-term outcomes at a tertiary referral nursery. Understanding these factors can guide evidence-based improvements in neonatal referral practices.

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METHODS

This observational cohort study was conducted at the Department of Neonatology, Children's Hospital and Institute of Child Health, Faisalabad, from January 1 to June 30, 2025. Ethical approval was obtained from the Institutional Review Board (Ref. No. 2949/CH & ICH/FSD, dated 6th Oct, 2025). A total of 355 consecutive neonates ≤ 28 days of age referred from other facilities were enrolled. Neonates older than 28 days or received dead on arrival were excluded. The Axillary temperature was measured within 15 minutes of admission using calibrated digital thermometers. Thermal categories were based on WHO criteria: normothermia (36.5–37.5 °C), mild (36.0–36.4 °C), moderate (32.0–35.9 °C), and severe (<32.0 °C). Other variables included gestational age, sex, birth weight, mode of delivery, feeding ability, blood glucose level, referral reason, oxygen delivery method, and IV bolus administration. Outcome at 48 hours was categorized as alive, expired, or LAMA. Data were analyzed in SPSS v26 using descriptive and chi-square analyses; $p < 0.05$ was considered statistically significant.

RESULTS

A total of the 355 neonates ($n=355$) were enrolled in study, 239 (67.3%) were male and 116 (32.7%) female. Preterm neonates comprised 148 (41.7%) while 207 (58.3%) were term. Spontaneous vaginal delivery accounted for 53.5%, cesarean section 46.2%, and instrumental 0.3%. The mean admission temperature was 37.07 ± 4.56 °C. Hypothermia was present in 112 (31.5%) neonates, including mild (28.5%) and severe (3.1%) forms. One neonate (0.3%) was hyperthermic.

Hypothermia showed a significant association with mortality at 48 hours ($p=0.000$). Respiratory distress was observed in 90.7%, most commonly moderate (75.2%). Clinical colour was pink in 77.5%, cyanosed in 19.2%, and pale in 3.4%. Blood glucose was normal in 79.7%, low in 11.5%, and unrecorded in 8.7%. Hypoglycemia was significantly linked to mortality ($p=0.029$). Only 9% were feeding normally, 86.2% were not feeding, and 4.8% unable to feed. Referral reasons included suspected sepsis (37.2%), confirmed sepsis (31.3%), prematurity (19.2%), jaundice (7.3%), and others (4.2%). Birth weights were normal in 39.2%, low in 51.3%, very low in 7.9%, and extremely low in 1.4%. Oxygen support was required in 90.7%: nasal prongs (46.2%), bubble CPAP (40.8%), NCPAP (2.0%), invasive ventilation (2.8%), and others (8.2%). Oxygen delivery method and IV bolus administration were both significantly associated with outcome ($p=0.000$). Overall survival at 48 hours was 77.5%, mortality 18.3%, and LAMA 4.2%.

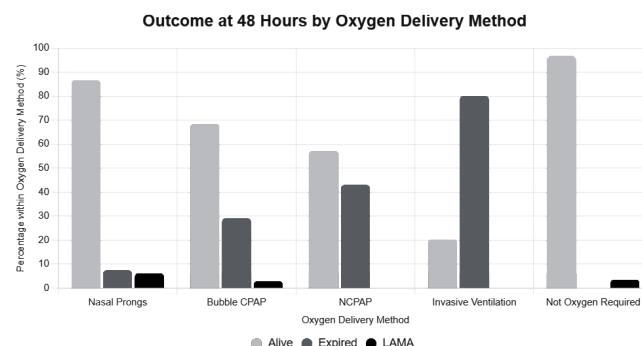


Figure-1. Oxygen delivery method and outcome at 48 Hours. (n=355)

Severity of Hypothermia	Blood Glucose: Normal n(%)	Blood Glucose: Hypoglycemia n(%)	IV Bolus: Yes n(%)	IV Bolus: No n(%)	Oxygen: Yes n(%)	Oxygen: No n(%)	Outcome: Alive n(%)	Outcome: Expired n(%)	Outcome: LAMA n(%)
Normothermic (n=242)	204(83.3)	18(7.4)	28(11.6)	214(88.4)	213(88.0)	29(12.0)	198(81.8)	33(13.6)	11(4.5)
Mild (n=101)	72 (71.3)	21(20.8)	33(32.7)	68(67.3)	97(96.0)	4(4.0)	72(71.3)	26(25.7)	3(3.0)
Severe (n=11)	6(54.5)	2(18.2)	8(72.7)	3(27.3)	11(100.0)	0(0.0)	5(45.5)	6(54.5)	0(0.0)
Hypothermia (n=1)	1(100.0)	0(0.0)	0(0.0)	1(100.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)	1(100.0)
Total (n=355)	282(79.7)	41(11.5)	69(19.4)	286(80.6)	322(90.7)	33(9.3)	275(77.5)	65(18.3)	15(4.2)
p-value	0.029		0.000		0.034		0.000		

Table-I. Association of severity of hypothermia with clinical variables and outcome (n = 355)

IV Fluid Resuscitation Need at Admission (n=355)

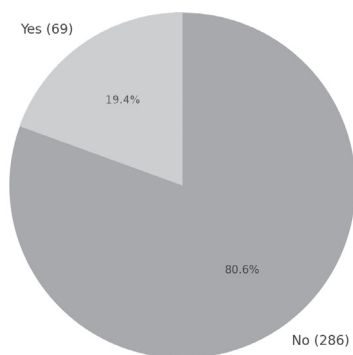


Figure-2. IV Fluid resuscitation need at admission (n=355)

DISCUSSION

The present study demonstrates that nearly one-third of referred neonates presented with hypothermia, and this was strongly associated with mortality. The prevalence (31.5%) is lower than reported in Ethiopian studies (64–70%)^{3,8} and Sri Lanka (63%)⁴, but higher than reported from some Indian urban centers where referral systems are better equipped.⁹ In Pakistan, a study from Karachi reported 45% admission hypothermia among NICU referrals¹⁰, similar to our findings. Regional temperature variation and differences in transport stabilization may account for disparities.

In our cohort, mortality was highest among severely hypothermic infants, aligning with evidence that each 1°C drop in temperature increases mortality by ~30%.¹¹ Comparable outcomes were observed in Nepal and Ethiopia where hypothermic neonates had 2–3 times higher mortality.^{2,3} Hypoglycemia prevalence (11.5%) was consistent with reports from Lahore and Lucknow showing 10–15% incidence among admitted neonates.¹² The coexistence of hypothermia and hypoglycemia compounds mortality risk, as both impair metabolic adaptation and increase oxygen consumption.⁶

Oxygen delivery method and need for IV fluid bolus were also linked to poor outcomes. Infants requiring invasive ventilation or fluid resuscitation had higher mortality, reflecting illness severity,

consistent with data from Addis Ababa⁸ and Chennai.⁹ Inappropriate or excessive fluid boluses during transfer may worsen pulmonary edema and cerebral injury, underscoring the importance of pre-referral stabilization protocols.^{13,14} Local referral systems in Pakistan rarely include thermal control or glucose monitoring during transport, exposing neonates to additional preventable risks.

The study highlights critical deficiencies in neonatal referral care and supports implementation of low-cost thermal interventions such as thermal wraps and Kangaroo Mother Care (KMC) during transfer. Similar interventions reduced mortality by 25% in Indian and Nepalese community trials.^{12,15} Strengths of this study include prospective data collection and outcome linkage. Limitations include single-center design and short-term (48-hour) outcome follow-up. Despite limitations, the findings emphasize the need for structured neonatal referral networks, continuous temperature monitoring during transport, and staff training in stabilization prior to referral. Integration of these practices within Pakistan's national newborn strategy could significantly reduce preventable deaths.

CONCLUSION

Hypothermia, hypoglycemia, oxygen delivery method, and IV bolus administration were significantly associated with neonatal mortality within 48 hours of referral. The study underscores the vulnerability of referred neonates and highlights the urgent need to improve pre-referral stabilization, including thermal care, feeding support, and rational fluid and oxygen management to improve neonatal survival in Pakistan.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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2	Sulman Jawaaid: Study Design.
3	Shabana Nawaz: Data collection, manuscript writing.
4	Rabia Munir: Literature review.
5	Muhammad Tauseef Omer: Statistical analysis, critical revision.
6	Raheela Rafi: Literature review.