

## Original Research Article

# Admission hypothermia in preterm infants seen at a public tertiary hospital, south-western Nigeria

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## ABSTRACT

**Background:** Hypothermia is associated with increased morbidity and mortality in neonates particularly in preterm infants who may need referral to tertiary centres to access care. The study aimed to document the incidence and characteristics of admission hypothermia in preterm infants seen in the neonatal unit of our hospital.

**Methods:** A retrospective study reviewing the 1-year clinical records of admissions into our neonatal unit. Core temperature is routinely taken for all babies at admission with a low-reading digital thermometer. Hypothermia was defined as temperature <36.5°C; and subclassified into mild (36.0-36.4°C), moderate (32.0-36.0°C) and severe (<32°C). Statistical analysis was with Chi square analysis, student's t-test, and Spearman correlation. P was set at 0.05.

**Results:** During the study period, 278 babies were admitted into our neonatal unit of which 87 (31.3%) were preterm and 191 (68.7%) were term. The incidence of admission hypothermia in preterm infants was 35.6% and 15.2% in term babies (p=0.0003). There was a higher incidence of hypothermia in outborn (62%) compared to inborn babies (52%) (p=0.71). A strong positive correlation existed between the degree of hypothermia and both the gestational age and birthweights of the preterm infants; for mild hypothermia, p=0.002 while for moderate hypothermia, p=0.000. There was a higher mortality in preterms with hypothermia compared to those without hypothermia (p=0.22).

**Conclusions:** A high incidence of admission hypothermia in preterm infants is reported in this study. Commencing immediate kangaroo mother care for preterm infants irrespective of the place of birth could help address this problem.

**Keywords:** Admission, Hypothermia, Neonatal, Nigeria, Preterm infant

## INTRODUCTION

Hypothermia in neonates is defined by the World Health Organization (WHO) as a core body temperature <36.5°C, or a skin temperature <36°C.<sup>1</sup> Neonatal hypothermia after birth is a global problem across all climates including in tropical environments. Preterm infants are particularly vulnerable to hypothermia and it is challenging to keep them sufficiently warm after delivery.<sup>2,3</sup> Maintaining a normal body temperature is however a critical function for newborn survival. Newborns achieve thermoregulation through

sophisticated mechanisms of body temperature regulation controlled by the hypothalamus and mediated by endocrine pathways mainly through non-shivering thermogenesis. The dilemma for preterm and low birth weight infants is that optimal temperature ranges are quite narrow and the thermoregulatory mechanisms are easily overwhelmed, leading to metabolic deterioration and death either directly from hypothermia or indirectly from associated morbidities.<sup>4-6</sup> Several authors have pointed out that early intervention during resuscitation and immediately after delivery for preterm infants is therefore a matter of high priority if hypothermia is to be

prevented.<sup>6-8</sup> Cordaro et al pointed out that admission hypothermia in the low-birth-weight preterm infant is not a “complication of prematurity; it is a consequence of healthcare provider inattentiveness”.<sup>9</sup> If neonatal hypothermia after delivery is prolonged, it is associated with morbidity and mortality.<sup>10</sup> A 2013 systematic review of literature regarding admission hypothermia in low- and middle-income countries reported hospital rates ranging from 8% (Guinea-Bissau, Africa) to 85% (Zimbabwe, Africa) a period. The data base from the Vermont Oxford Network (VON) collated from across 28 countries of high- or upper-middle-income status also reported that the highest rates of hypothermia occurred amongst the smallest (22.1% of 501 to 750 g) and amongst the most immature infants (26.2% at <24 weeks’ gestation).<sup>3</sup> Prematurity and decreasing birth weight are thus identified risk factors for hypothermia however, literature and data from Nigeria on this subject are sparse.<sup>3,11</sup> Our clinical experience suggests that admission hypothermia is an ongoing problem for preterm infants at tertiary centres. Preterm births account for a significant number of admissions in most health facilities but despite this burden, there is a gap in literature as to the prevalence and clinical correlates of hypothermia in preterm infants seen in Nigeria. Preterm infants delivered at primary and secondary health care facilities are often transported to tertiary centres to access specialist care without appropriate neonatal transport services. This may contribute to the incidence of hypothermia in low resource settings however, there is the need to document the prevalence and characteristics of the problem as seen in a tertiary centre in Nigeria which typifies a low resource setting. The availability of evidence in this regard can help to advocate for immediate Kangaroo mother care as the means of transporting preterm infants to facilities where they can access care. Soll et al in 2008 re-emphasized the need to address and understand the consequences of hypothermia for the newborn to improve clinical outcomes.<sup>10</sup> It is therefore important to study and understand neonatal hypothermia which is one of the important determinants of clinical outcome in preterm infants.

## METHODS

This was a retrospective study reviewing the 1-year clinical records of admissions into our neonatal unit at the Federal Teaching Hospital, Ido-Ekiti. The hospital is a tertiary health facility that provides specialist care in specialized areas of medicine, surgery, obstetric and pediatric care for communities in Ekiti, Ondo, Osun, and Kwara States of South-West zone of Nigeria. The neonatal ward has a capacity for 36 admissions and receives babies delivered in the labour ward of the hospital (inborns) as well as sick babies referred from outside the hospital (outborns). The neonatal ward generally provides Level IIIa neonatal care and is well equipped with incubators, LED phototherapy units, resuscitaires, invasive and non-invasive ventilation,

syringe pumps, infusion pumps, pulse oximeters and glucometers among others.

The ward is taken care of by 2 pediatricians, 1 senior registrar, 2 junior registrars and 2 interns and 23 nurses with expertise available for exogenous surfactant administration and total parenteral nutrition.

## Subjects and methods

The electronic admissions records for all babies consecutively seen in the neonatal ward for the period June 2021 to June 2022 were reviewed. The babies whose gestational age were less than 37 weeks at delivery formed the subjects for the study. Gestational age was determined by information obtained from the last menstrual period, antenatal ultrasonography and postnatal gestational assessment using the new Ballard score. Patients with GA less than 24 weeks were excluded from the study as well as those with congenital anomalies incompatible with life.

Core temperature was routinely taken for all babies at admission with a low-reading digital thermometer. Hypothermia was defined as core temperature <36.5°C; and sub-classified into mild (36.0-36.4°C), moderate (32.0-36.0°C) and severe (<32°C).

Information required was extracted from the electronic records into an MS-Excel sheet designed for the study. Neonatal data such as gestational age, age at admission, birth weight, weight at admission, place of birth, sex, other co-morbidity at admission and while on admission, temperature on admission and other vital signs on admission, initial diagnosis, other morbidities on admission, treatment received including respiratory support CPAP, phototherapy, exchange blood transfusion, clinical outcome, duration of admission and the postnatal age and post-conceptual age at demise or discharge were recorded.

Other relevant data which were recorded include: mother’s age, mother’s parity, mother’s occupation, maternal level of education, time duration between onset of illness to presentation in facility in hours.

## Data analysis and management

Data that was entered into the MS-Excel spreadsheet was imported to the statistical package SPSS version 23 for analysis. Descriptive statistics included mean, standard deviation, and associated percentages where appropriate. Statistical analysis was with Chi square analysis, student’s t-test, and Spearman correlation. P was set at 0.05.

## RESULTS

There were 278 admissions during the study period of which 87 (31.3%) were preterm babies and 191 (68.7%)

were term. Out of the preterm babies, there were 51 males and 36 females giving a male to female ratio of 1.4:1. The GA of the study subjects ranged from 24 weeks to 36 weeks while the mean (SD) GA was 33 (3.04). The late preterm (34-36 weeks GA) babies formed the largest (50.6%) proportion of the subjects followed by the early preterms (28-31 weeks GA) who formed 24.1% of the babies. The birth weight ranged from 600 grams to 3350 grams while the mean (SD) birthweight was 1764 (596.40) grams. The largest proportion of the subjects were the VLBW infants who formed 52.9% of the preterm infants. This is shown in Table 1. Twenty-six (29.9%) of the babies were outborn admissions while 61 (70.1%) were inborn admissions. The babies that were outborn were delivered in primary health care centres (3.4%) secondary health care centres (4.6%), private hospitals (10.3%) traditional birth attendants (3.4%) and in transit (4.6%).

**Admission temperature and characteristics**

The temperature of the preterm infants ranged from 34.0 to 39.4°C at admission. There was no baby with severe hypothermia. Out of the preterm infants, 31 (35.6%) of them had hypothermia at admission; this was higher than the number of term babies 29 (15.2%) that had admission hypothermia. The difference between the number of preterm babies and the term babies that had hypothermia was statistically significant (p=0.0003) (Table 2). The mean admitting temperature for the preterm infants was 36.5°C while the mean admission temperature for the

term babies on the other hand was 36.9°C. The difference between the mean admission temperature for preterm babies and that of term babies was statistically significant (p=0.000). The majority (63.2%) of the babies presented after 6 hours of life as seen in Table 3 and more babies (38.2%) that presented after 6 hours had hypothermia compared to those that presented within 6 hours and had hypothermia (31.3%). There was also a higher incidence of hypothermia in outborn 21 (62%) babies compared to inborn babies 10 (52%) though the difference was not statistically significant (p=0.71). There was a higher mortality (22.6%) in preterm infants with hypothermia compared to those without hypothermia (12.5%) (p=0.22).

**Table 1: Gestational age and birth weight of the subjects.**

Gestational age (weeks)	Frequency	Percentage
<28	5	5.7
28-31	21	24.1
32-33	17	19.5
34-36	44	50.6
Total	87	100.0
<b>Birthweight (g)</b>		
<1000	8	9.2
1000-1499	20	23.0
1500-2499	46	52.9
≥2500	13	14.9
Total	87	100.0

**Table 2: Comparing the admission temperature of preterm and term babies.**

Gestational age	Admission temperature		Total	P value
	Hypothermia N (%)	Non-hypothermia		
Preterm	31 (35.6)	56 (64.4)	87	0.0003
Term	29 (15.2)	162 (84.8)	191	
Total	60 (21.6)	218 (8.4)	278	

**Table 3: Age at admission compared with admission temperature.**

Count	Age at admission	Temperature at admission		Total
		Hypothermia	Normal temperature	
	0-6 hours	10 (31.3)	22 (68.8)	32
	7-23 hours	9 (33.3)	18 (66.7)	27
	24-72 hours	12 (42.9)	16 (57.1)	28
<b>Total</b>		31	56	87

**Comparison between admission temperature, gestational age and birthweight**

The incidence of hypothermia appears distributed along gestational age lines. The highest incidence of hypothermia (60%) was among the babies whose gestational age was less than 28 weeks gestation followed

by the early preterms at 28-31 weeks gestation (38%). With the exception of the 32-33 weeks GA band, the incidence of hypothermia reduced as the gestational age increased. The difference in the numbers of babies that had hypothermia at the different gestational ages was however not statistically significant (p=0.485) as shown in Table 4. The incidence of hypothermia was highest amongst the ELBW group (60%). The results also

showed that the incidence of hypothermia appears to reduce with increasing birthweight except for the VLBW group whose incidence of hypothermia was lower than the LBW group. The lowest incidence of hypothermia (15%) was among the babies who had normal birth

weight above 2500 gm. The difference in the number of babies who had hypothermia and those who did not as compared by birthweight was however not statistically significant (Table 5).

**Table 4: Relationship between gestational age and incidence of hypothermia for preterm babies.**

Gestational age (weeks)	Temperature		Total	P value
	Hypothermia N (%)	Normal temperature N (%)		
<28	3 (60.0)	2 (40)	5	0.485
28-31	8 (38.1)	13 (61.9)	21	
32-33	4 (23.5)	13 (76.5)	17	
34-36	16 (36.4)	28 (63.6)	44	
<b>Total</b>	31 (35.6)	56 (64.4)	87	

**Table 5: Relationship between birth weight and incidence of hypothermia for preterm babies.**

Birth weight	Temperature		Total	P value
	Hypothermia	Non-hypothermia		
<1000	5 (62.5)	3 (37.5)	8	0.147
1000-1499	6 (30.0)	14 (70.0)	20	
1500-2499	18 (39.1)	28 (60.9)	46	
2500 and above	2 (15.4)	11(84.6)	13	
<b>Total</b>	31 (35.6)	56 (64.4)	87	

**Table 6: Relationship of gestational age and birthweight to the degree of hypothermia.**

Degree of hypothermia	Birth weight (gm)	Gestational age			P value	Correlation coefficient (r <sub>s</sub> )	P value
		Preterm	Term	Total			
Moderate hypothermia	<1000	3	0	3	0.000	0.691	0.000
	1000-1499	4	0	4			
	1500-2499	14	5	19			
	≥2500	1	11	12			
	Total	22	16	38			
Mild hypothermia	<1000	2	0	2	0.002	0.816	0.000
	1000-1499	2	0	2			
	1500-2499	4	1	5			
	≥2500	1	12	13			
	Total	9	13	22			
Total	<1000	5	0	5	0.000	0.748	0.000
	1000-1499	6	0	6			
	1500-2499	18	6	24			
	≥2500	2	23	25			
	Total	31	29	60			
<b>Degree of hypothermia</b>		<b>Number of patients</b>		<b>Correlation coefficient (r)</b>		<b>P value</b>	
Mild hypothermia		38		0.691		0.000	
Moderate hypothermia		22		0.816		0.000	
Total		60		0.748		0.000	

**Degree of hypothermia**

Moderate hypothermia occurred in 38 preterm and term infants and constituted (63.3%) of the total number of babies that had hypothermia (Table 6). Moderate

hypothermia was also the more common degree of hypothermia as it occurred in 22(25.3%) of the total number of preterms (87) and in 71% of the preterms that had hypothermia (31). Mild hypothermia on the other hand occurred in a total of 22 (36.7%) preterm and term infants. It was also seen in 9 (10.3%) of the total preterms

and in 29% of the preterms that had hypothermia. On further analysis, when the degree of hypothermia was compared using gestational age, there was a statistically significant difference between preterm and term babies who had mild and moderate hypothermia ( $p=0.000$ ). A statistically significant difference was also found when the birthweight was compared with the degree of hypothermia, i.e. mild or moderate hypothermia ( $p=0.002$ ). When the 2 factors i.e. GA and birthweight, were combined, the differences were still statistically significant ( $p=0.000$ ) as shown in Table 6. A strong positive correlation existed between the degree of hypothermia and both the GA and birthweights of the preterm infants; for moderate hypothermia, ( $r=0.691$ ,  $p=0.000$ ) while for mild hypothermia ( $r=0.816$ ,  $p=0.000$ ).

## DISCUSSION

The principal finding of this study is that hypothermia occurred in 35.6% of preterm infants seen at admission in the hospital. In a recent large systematic review, newborn hypothermia has been shown to be ubiquitous, including tropical environments.<sup>2</sup> Hypothermia in the current study occurred in subjects even though the hospital is located in a tropical region with room temperatures ranging between 24 and 27°C. The finding of admission hypothermia has been reported frequently in studies undertaken in other tropical countries such as Zambia, Tanzania and Zimbabwe.<sup>12-14</sup> The incidence of hypothermia in the current study was not as high as 51% reported from Brazil however the study from Brazil recruited subjects born between 22-23 weeks gestation.<sup>15</sup> It is however noteworthy that in the GA<28 weeks group, the incidence of hypothermia in this study (60%) was close to that reported from Brazil which was 51%. Extremely low birth weight infants have been reported to have an incidence of hypothermia as high as 78%.<sup>16</sup> Although hypothermia occurred in both outborn and inborn babies, the incidence was more in outborn babies. An higher incidence of hypothermia in outborn babies compared to inborn babies was also reported from a similar study setting by Ogunlesi et al.<sup>17</sup> This may be a pointer to the lack of awareness of thermal control in health care providers outside the tertiary centres as many of the outborn babies were born in private facilities, and traditional birth attendants. Primary and secondary health centers. Onalo in his review of neonatal hypothermia in SSA alluded to the fact that home delivery and inadequate knowledge among health workers were part of the risk factors for neonatal hypothermia in Sub-Saharan Africa.<sup>18</sup> Such loss of thermal control is potentially detrimental to the health of the newborn causing both morbidity and mortality and impaired growth and particularly harmful to low birthweight newborns.<sup>12,19</sup> In this current study, a higher mortality was found in preterms with hypothermia than those without. The difference was not statistically significant though it is possible the difference may amount to a statistically significant one with a larger sample size. A systematic review and meta-analysis of 32 studies from the community

and hospitals in resource-limited settings reported that though hypothermia is rarely a direct cause of mortality, it contributes significantly to neonatal morbidity and mortality. It is therefore important to scale up measures for thermal control on such as immediate skin-to-skin care or the use of appropriate devices for neonatal transport.<sup>2</sup>

The results of the incidence of hypothermia by birth weight found in the present study are similar to that found in a review of transitional hypothermia in preterm infants in NICUs in California where incidences ranging between 50 and 89% were demonstrated in ELBWs and incidence of about 36% for VLBWs. The similarity of these results shows that even in developed countries, hypothermia can be challenging for preterm infants. That review thus recommended that the delivery room temperature for the preterm infant should be at or higher than that recommended for the labor-delivery-recovery-postpartum, nursery-room temperatures for babies that are not preterm.<sup>16</sup>

The degree of hypothermia that was seen in the current study was very similar to that reported more than a decade ago by Ogunlesi et al who found that almost 60% of the babies admitted had moderate hypothermia and it was more common than mild hypothermia.<sup>17</sup> This perhaps suggests that optimal attention has yet been paid to this very critical factor for Nigerian newborns. The current study has gone further than the study by Ogunlesi et al in reviewing the subject of hypothermia in the vulnerable group of preterm infants and found that moderate hypothermia occurs in more than 70% of preterms that have hypothermia. This suggests that if optimal clinical outcomes are to be achieved for this vulnerable group of newborns, thermoregulation must be addressed as a matter of urgency. This is all the more important because the present study found that the degree of hypothermia correlated strongly with the gestational age and the birth weight.

## CONCLUSION

Neonatal hypothermia is potentially preventable. The introduction of simple hypothermia prevention messages and interventions like immediate KMC into maternal and newborn care (irrespective of the place of birth) has promising potential to reduce the global burden of neonatal hypothermia and inevitably reduce newborn deaths. It is important for health facilities in Nigeria and other low resource settings to have a standardized approach to the collection and analysis of data on neonatal hypothermia because evidence is needed to inform policy and program planners on optimal thermal protection interventions. Finally, proactive steps should be taken in delivery rooms to prevent hypothermia. Preventing and treating newborn hypothermia in health institutions and communities requires all hands to be on deck because addressing this widespread challenge might



play a substantial role in reaching the sustainable development goal 3, a reduction of child mortality.

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