

Hypothermia in preterm very-low-birthweight infants in a neonatal care unit of a tertiary hospital in Limpopo Province, South Africa

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Background. Despite numerous interventions to prevent neonatal heat loss, preventing hypothermia after delivery continues to be a concern in developing countries.

Objective. To determine the prevalence of hypothermia and its risk factors among preterm very-low-birthweight infants admitted to the neonatal care unit (NCU) of a tertiary hospital in Limpopo Province, South Africa.

Method. A retrospective study (January - July 2015) was undertaken to analyse data from the medical records of infants admitted to the NCU of Mankweng Hospital. Hypothermia at admission was the major outcome and was defined as an axillary body temperature <36.5°C. Maternal data collected were age, parity, use of antenatal corticosteroids, and mode of delivery, while neonatal data included sex, birthweight, gestational age, Apgar score, resuscitation at delivery, admission and discharge dates, length of stay, morbidity, interventions and infant outcomes.

Results. A total of 252 neonate-and-mother pairs were included in the study, with hypothermia on admission being present in 35% of infants. Factors associated with hypothermia on admission include being born in the winter season, resuscitation at delivery, use of synchronised inspiratory positive airway pressure (SiPAP), respiratory distress syndrome and mortality.

Conclusion. In our study, hypothermia on admission occurs relatively frequently, and is associated with resuscitation in the delivery room, respiratory distress syndrome, use of SiPAP, winter season and neonatal mortality. Therefore maintaining infant temperature in the desired range of 36.5°C to 37.5°C after delivery, during transport and on NCU admission might improve neonatal outcomes.

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Hypothermia immediately after birth remains a concern and is associated with increased morbidity and mortality worldwide, particularly in developing countries.^[1,2] The World Health Organization (WHO) defines hypothermia in newborns as axillary temperature <36.5°C, and classifies it as mild (36.0 - 36.4°C), moderate (32.0 - 35.9°C) and severe (<32.0°C).^[3] The WHO also recommends that neonatal body temperature be maintained at 36.5°C to 37.5°C. However, evidence has shown that there are global differences in the case definition of hypothermia and methods used to measure neonatal temperature.^[1] Earlier studies have shown that an increase in heat loss among neonates is mainly due to poor thermoregulation and a large surface area to body mass ratio.^[4-6] The prevalence of hypothermia among hospital-born neonates ranges from 30% to 85%,^[7-10] while in those born outside of hospital it is between 10% and 90%.^[1,11] The risk factors of hypothermia vary markedly within different settings, with preterm birth, very low birthweight (VLBW), transportation (within or between facilities) and seasonality (being born during the winter season) being important factors associated with neonatal hypothermia.^[7,12-14]

There are numerous interventions to prevent heat loss, such as early drying and wrapping, covering the head of the newborn with a cap, skin-to-skin contact, breastfeeding, delayed bathing and weighing, appropriate clothing and bedding, and warm transportation.^[1,11,15-19] Despite all these, preventing hypothermia in neonates continues to be a major challenge, particularly in developing countries.^[8-10,12] In the rural tertiary hospitals of South Africa (SA), particularly in

Limpopo Province (LP), there is a paucity of published research on the prevalence and risk factors associated with hypothermia among neonates admitted to neonatal care units (NCUs). Therefore, this study aimed to determine the prevalence and risk factors of hypothermia on admission among preterm VLBW neonates.

Method

Study design and setting

A retrospective descriptive study based on the review of medical records of VLBW premature neonates admitted to the NCU was undertaken at Mankweng Hospital, the only rural tertiary referral hospital in LP. The data for this study were collected for a period of 7 months from January to July 2015. There is one NCU, which is a 60-bed unit with 18 intensive care and high-care beds, a nursery with 30 beds and 12 kangaroo mother care beds. The unit has a total admission of approximately 2 000 patients per annum. A consecutive sample ($n=252$) of all preterm VLBW infants paired with their mothers was selected for the study.

Data collection

Data were collected using a data collection form designed for the study. The NCU register was used to identify infants admitted during the study period. Then the relevant medical records were retrieved. Using the register and patient files, the following maternal data were collected: age, parity, use of antenatal corticosteroids, HIV status, mode of delivery and maternal morbidity. Infant data

included sex, birthweight, gestational age, Apgar score, resuscitation on delivery, admission date and discharge date, length of stay, morbidity and mechanical ventilation, synchronised inspiratory positive airway pressure (SiPAP), nasal continuous positive airway pressure (nCPAP), the administration of surfactant and infant outcome. In the present study, hypothermia was defined as an axillary body temperature of $<36.5^{\circ}\text{C}$ on NCU admission, while hypoglycaemia was defined as a blood glucose level of <2.6 mmol/L.

Data analysis

Statistical analyses were performed using the statistical programme Stata version 10.0 (StataCorp, USA). Characteristics of the study population were presented as mean and standard deviation (SD) for continuous variables and frequency and percentage for categorical variables. Comparisons between hypothermic and normothermic groups were performed using Student *t*-tests and χ^2 /Fisher exact tests for continuous and categorical data, respectively. A *p*-value ≤ 0.05 was considered statistically significant.

Ethics considerations

Ethics approval to conduct the study was obtained from the University of Limpopo Ethics Committee (ref. no. TREC/84/2016: PG), and permission to conduct the study was also granted by the Limpopo Department of Health. Anonymity and confidentiality of patient personal information were protected.

Results

Demographic characteristics

Two hundred and fifty-two preterm VLBW infants were admitted to the NCU during the study period. Of these, 84% were inborn and 16% were outborn infants. Three-quarters (76%) of outborn babies were from district hospitals, 15% born on arrival and 9% from regional and primary healthcare centres. The mean (SD) gestational age was 31.1(2.5) weeks, while the mean birthweight was 1 180.5 (206.7) g. The mean (SD) age of the mother was 26.4 (6.6) years. Table 1 shows a detailed description of the demographic profile of the study participants.

Prevalence and factors of hypothermia on admission

Hypothermia on admission was present in 89 (35; 95% confidence interval 29.2 - 41.3) of the infants admitted to the NCU. As shown in Table 2, resuscitation in the delivery rooms was performed in 13% ($n=32/252$) of the newborns and was more common among the hypothermic than normothermic group (21% v. 8%, $p<0.05$). The use of SiPAP was significantly higher in the hypothermic group as compared with the normothermic group (29% v. 18%, $p<0.05$). The hypothermic group was significantly more likely to have respiratory distress syndrome (46% v. 28%, $p<0.05$), be born in the winter season (38% v. 25%, $p<0.05$) and had higher neonatal mortality (33% v. 17%, $p<0.05$) than the normothermic group.

Infant factors such as being referred (from another healthcare facility or ward), male sex, gestational age, birthweight, 1-min Apgar score <6 , season (i.e. summer and fall), length of stay in NCU, sepsis, hypoglycaemia, and intraventricular haemorrhage were not significantly associated with hypothermia on admission ($p>0.05$). We also observed that maternal factors, which include age, parity, caesarean section, and antenatal steroids, were not associated with hypothermia on admission.

Discussion

This study reports on the prevalence and factors associated with hypothermia on admission to the NCU among preterm VLBW neonates. Overall, 35% of the neonates arrived in the NCU with a body

Table 1. Characteristics of the preterm VLBW infants, N=252

	n (%)
Inborn infants	213 (84)
Female sex	150 (60)
Gestational age (weeks)	
<28	25 (10)
28 - 32	140 (56)
33 - 36	87 (34)
Birthweight (g)	
<1 000	50 (20)
1 000 – 1 199	28 (11)
1 200 - 1 399	131 (52)
1 400 - 1 499	43 (17)

temperature $<36.5^{\circ}\text{C}$. This rate is lower than the 64.8% in Malaysian NICUs,^[8] 51% in Brazil,^[9] 56.2% in the USA,^[12] 76.8% in Taiwan,^[10] and 46.1% in SA.^[27] A systematic review in developing countries found that the hypothermia prevalence rate in hospital-based studies ranges from 32% to 85%, with the exception of 8% in Guinea Bissau, while in the community-based studies the rates are between 10% and 90%.^[11] The wide range in the rates might be attributable to the case definition and also the differences in the method used to measure temperature.^[1,11] Additionally, it could be related to the quality of care delivered by the centres.

Consistent with previous studies, our study found that hypothermia may increase mortality in preterm VLBW neonates.^[9,10,12,20,21] In addition, similarly to previous studies,^[1,11] our findings revealed that a significantly greater proportion of hypothermia on admission occurred in the winter season. A warm delivery room, early drying and wrapping, skin-to-skin contact, breastfeeding, postponing bathing and weighing, appropriate clothing and bedding, and warm transportation could reduce the high prevalence of hypothermia.^[1,11,15-19]

The WHO has recommended that delivery or resuscitation room temperatures should be kept in the range of 25°C to 28°C to prevent heat loss.^[3] Although the temperature of the room to which each infant was exposed at birth was not recorded in this study, our findings showed that a higher proportion of hypothermic neonates were delivered by caesarean section and resuscitated after birth compared with their normothermic counterparts. The implementation of the standard practices based on the Neonatal Resuscitation Program guidelines on temperature control^[22] has been shown to reduce the number of neonates with a low temperature at birth.^[23]

Hypothermia is known to be more prevalent in preterm and low birthweight infants,^[24,25] and the incidence is higher in infants with birthweight <1 500 g and at <28 weeks' gestation.^[7,10] However, in our study, preterm and VLBW did not significantly affect admission hypothermia. A possible reason may be the small sample size. The transfer of neonates between different health facilities,^[26] or between wards within hospitals, increases the risk of cold exposure and adverse events.^[11] In our study, referred neonates were more likely to have a low admission temperature than inborn neonates; however, the results were not statistically significant.

Limitations of the study

Causality could not be established as this is a retrospective study. Moreover, as with retrospective studies, missing data from patient files affected the reliability of the data. Another limitation is that the study is based on the results from one referral centre, conducted over a short period, with a small sample size, and it is therefore not possible to generalise the results. Lastly, it was not possible to assess the severity

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Table 2. Maternal and neonatal factors associated with hypothermia on admission

	<i>n</i> (%) [*]	Hypothermic, N=89 <i>n</i> (%) [*]	Normothermic, N=163 <i>n</i> (%) [*]	<i>p</i> -value
Maternal				
Age (years), mean (SD)	26.4 (7)	26.8 (7)	26.2 (7)	0.485
Parity, mean (SD)	1.1 (1)	0.68 (1)	0.63 (1)	0.560
Caesarean section	139 (55)	56 (63)	83 (51)	0.067
Antenatal steroids [†]	103 (87)	35 (81)	68 (90)	0.215
Infant				
Referred	39 (15)	16 (18)	23 (14)	0.417
Male sex	102 (41)	39 (44)	63 (39)	0.424
Gestational age (weeks)				
<28	25 (10)	11 (44)	14 (56)	0.632
28 - 32	140 (56)	48 (34)	92 (66)	
33 - 36	87 (35)	30 (34)	57 (66)	
Birthweight (g)				
<1 000	50 (20)	21 (42)	29 (58)	0.564
1 000 - 1 199	28 (11)	8 (29)	20 (71)	
1 200 - 1 399	131 (52)	47 (36)	84 (64)	
1 400 - 1 499	43 (17)	13 (30)	30 (70)	
1-min Apgar score <6	50 (20)	23 (26)	27 (17)	0.091
Season				
Jan - Mar	115 (45)	39 (44)	76 (47)	0.693
Apr - May	62 (25)	16 (18)	46 (28)	0.092
Jun - Jul	75 (30)	34 (38)	41 (25)	0.043
Resuscitation in the delivery room	32 (13)	19 (21)	13 (8)	0.003
Length of stay in NCU (days), mean (SD)	17.4 (16)	16.3 (16)	18.0 (17)	0.430
Intervention				
nCPAP	13 (5)	5 (6)	8 (5)	0.775
SiPAP	55 (22)	26 (29)	29 (18)	0.039
Ventilation	51 (20)	23 (26)	28 (17)	0.139
Surfactant	53 (21)	24 (27)	29 (18)	0.106
Infant morbidity				
Sepsis	118 (47)	42 (47)	76 (47)	0.932
Respiratory distress syndrome	86 (34)	41 (46)	45 (28)	0.003
Hypoglycaemia	37 (15)	15 (17)	22 (14)	0.472
Intraventricular haemorrhage	4 (2)	3 (2)	1 (1)	0.128 [‡]
Demised	57 (23)	29 (33)	28 (17)	0.005

SD = standard deviation; NCU = neonatal care unit; nCPAP = nasal continuous positive airway pressure; SiPAP = synchronised inspiratory positive airway pressure.

^{*} Unless otherwise indicated.

[†] Information available for 113 patients only.

[‡] Fisher exact.

of hypothermia, as the results on the infants' medical records were classified as categorical data (i.e. above or below 36.5°C).

Conclusion

Based on the results of this study, more than one-third (35%) of the infants were hypothermic on NCU admission, which indicates a need to closely monitor the NCU admission temperatures of preterm infants. We also observed that hypothermia on admission was associated with resuscitation in the delivery room, use of SiPAP, respiratory distress syndrome, winter season and neonatal mortality. As a result, maintaining infant temperature in the desired range of 36.5°C to 37.5°C after delivery, during transport and on NCU admission might improve neonatal outcomes, because hypothermic neonates were found to have high mortality. Further population-based investigations are also needed to look into infant transport systems, processes, and clinical care. In addition, organising helping

babies breathe (HBB) workshops may assist in improving neonatal resuscitation skills, as well as training healthcare workers on measures to prevent hypothermia.

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