Original Article
doi: https://doi.org/10.1590/1983-1447.2023.20220042.en

Hypothermia among premature newborns on admission to a neonatal intensive care unit

Revista Gaúcha de Enfermagem

Hipotermia entre recém-nascidos prematuros na admissão em uma unidade de terapia intensiva neonatal

Hipotermia entre los recién nacidos prematuros que ingresan en una unidad de cuidados intensivos neonatales

Janaina Otoni de Carvalho[a]
Luana Vieira Toledo[b]
Luciene Muniz Braga[b]
Paula Krempser[a]
Zuleyce Maria Lessa Pacheco[a]
Herica Silva Dutra[a]

How to cite this article:
Carvalho JO, Toledo LV, Braga LM, Krempser P, Pacheco ZML, Dutra HS. Hypothermia among premature newborns on admission to a neonatal intensive care unit. Rev Gaúcha Enferm. 2023;44:e20220042. doi: https://doi.org/10.1590/1983-1447.2023.20220042.en

ABSTRACT

Objective: To assess prevalence and factors associated with hypothermia in preterm infants admitted to a neonatal intensive care unit.

Methods: It is a cross-sectional retrospective study, with 154 premature newborns admitted between 2017 and 2019 in a neonatal intensive care unit. Logistic regression was used to evaluate the association to hypothermia.

Results: There was a predominance of males (55.8%), coming from the operating room (55.8%), gestational age > 32 weeks (71.4%), weight > 1500g (59.1%), Apgar in the 1st minute of life less than seven (51.9%) and in the 5th minute of life greater than or equal to seven (94.2%). The prevalence of hypothermia at admission was 68.2%. It was found that the lower the weight, the greater the chances of hypothermia, being three times higher in low weight (OR 3.480), five times higher in very low weight (OR5.845) and up to 47 times higher in extremely low weight (OR47.211).

Conclusion: Hypothermia was 68.2% and it was associated with lower birth weight.

Keywords: Intensive care units, neonatal. Hypothermia. Infant, premature. Nursing.

RESUMO

Objetivo: Avaliar prevalência de hipotermia e fatores associados entre recém-nascidos prematuros admitidos em uma unidade de terapia intensiva neonatal.

Métodos: Estudo transversal retrospectivo, com 154 recém-nascidos prematuros admitidos entre 2017 e 2019 em uma unidade de terapia intensiva neonatal. Utilizou-se regressão logística para avaliar associação à hipotermia.

Resultados: Houve predomínio do sexo masculino (55,8%), procedência de centro cirúrgico (55,8%), idade gestacional > 32 semanas (71,4%), peso > 1.500g (59,1%), Apgar no 1º minuto de vida menor que sete (51,9%) e no 5º maior ou igual a sete (94,2%). A prevalência de hipotermia à admissão foi de 68,2%. Verificou-se que quanto menor o peso, maiores as chances de hipotermia, sendo três vezes maior no baixo peso (O.R.3,480), cinco vezes maior no muito baixo peso (O.R.5,845) e 47 vezes maior no extremo baixo peso (O.R.47,211).

Conclusão: A hipotermia foi de 68,2% e esteve associada ao menor peso ao nascer.

Palavras-chave: Unidade de terapia intensiva neonatal. Hipotermia. Recém-nascido prematuro. Enfermagem.

RESUMEN

Objetivo: Evaluar prevalencia y factores asociados a la hipotermia entre los recién nacidos prematuros ingresados en una unidad de cuidados intensivos neonatales.

Métodos: Estudio transversal retrospectivo, con 154 recién nacidos prematuros ingresados entre 2017 y 2019 en una unidad de cuidados intensivos neonatales. Se utilizó la regresión logística para evaluar la asociación a la hipotermia.

Resultados: Hubo un predominio de varones (55,8%), procedentes del centro quirúrgico (55,8%), edad gestacional > 32 semanas (71,4%), peso > 1500g (59,1%), puntuación de Apgar en el primer minuto de vida inferior a siete (51,9%) y en el quinto minuto superior o igual a siete (94,2%). La prevalencia de hipotermia al ingreso fue del 68,2%. Se comprobó que cuanto menor es el peso, mayores son las posibilidades de hipotermia, tres veces más para el peso bajo (R.O.3,480), cinco veces más para el peso muy bajo (R.O.5,845) y hasta 47 veces más para el peso extremadamente bajo (R.O.47,211).

Conclusión: La hipotermia fue del 68,2% y se asoció a un menor peso al nacer.

Palabras clave: Unidades de cuidado intensivo neonatal. Hipotermia. Recien nacido prematuro. Enfermería.

[a] Universidade Federal de Juiz de Fora (UFJF), Faculdade de Enfermagem, Programa de Pós-Graduação em Enfermagem. Juiz de Fora, Minas Gerais, Brasil.

[b] Universidade Federal de Viçosa (UFV), Departamento de Medicina e Enfermagem. Viçosa, Minas Gerais, Brasil.

INTRODUCTION

Preterm birth is characterized as any birth before 37 completed weeks of gestation. Preterm newborns (PTNBs) are classified according to gestational age (GA), as follows: extremely preterm are those under 28 weeks; very preterm, those between 28 and 31 weeks and 6 days; moderate, those between 32 and 33 weeks and 6 days, and late preterm babies those born between 34 and 36 weeks and 6 days[1]. Due to prematurity, this group of newborns is physiologically immature, which makes the control of body temperature difficult, increasing the risk of hypothermia at birth[2].

Hypothermia in PTNB is considered a worldwide problem associated with increased morbidity and mortality[3–4]. PTNBs are at greater risk of hypothermia due to rapid heat loss after birth, which can reduce their body temperature by 1°C to 3°C in the first 30 minutes after delivery[5–7]. The normal range of temperature levels in newborns is between 36.5°C and 37.5°C. Hypothermia is considered mild when the axillary temperature ranges from 36.0ºC to 36.4ºC, moderate, from 32.0ºC to 35.9ºC, and severe when axillary temperature is lower than 32.0ºC[3,8].

Heat loss in PTNBs with lower birth weight is more accelerated than that of full-term newborns because they have a high ratio of body surface area to weight, integumentary immaturity, deficiency of subcutaneous brown adipose tissue acting as an insulator, increased evaporative water loss via the skin, immature central nervous system, and low energy reserve[5,7,9,10–11].

Several physiological disorders in PTNBs can cause hypothermia, such as increased oxygen consumption and peripheral vascular resistance, impaired surfactant production, decreased cardiac output and hypoglycemia, which may evolve with neonatal sepsis, respiratory distress syndrome, acute renal failure, necrotizing enterocolitis, pulmonary and peri-intraventricular hemorrhage and, in severe cases, can lead to death[4,7–13].

Hypothermia in PTNBs is considered a predictor of morbidity and mortality and an indicator of quality in the care provided in the delivery room and admission to the neonatal intensive care unit (NICU)[5–7]. Because it is directly involved in PTNB care at birth and in the NICU, nursing is responsible for controlling the temperature of the environment. Such care should be started after birth and maintained during transport to the NICU and admission to this sector[13].

To assist in the prevention and thermal control of PTNBs, the nursing team is supposed to monitor the room temperature in the delivery room, use of a crib with a radiant heat source and heated incubator, heated cot mattress, mesh or cotton cap, polyethylene body plastic bag and transport of the newborn in a heated incubator. Despite all the precautions taken, hypothermia is still a problem related to the assistance given to PTNB[3–9,12,14].

Therefore, nurses must have skills, abilities and knowledge based on scientific evidence, which, added to their professional experience, make them able to develop a care plan referred to the nursing team in the care of the PTNB[15].

In view of the aforementioned, it is necessary to identify the relationship between hypothermia and the factors associated with personal and health care characteristics of PTNB. Thus, the following guiding question was elaborated for the present study: what is the prevalence of hypothermia in PTNBs upon admission to the NICU? The research object of the present investigation is hypothermia in PTNB in the NICU and the objective of the study was to evaluate the prevalence of hypothermia and associated factors among premature newborns admitted to a neonatal intensive care unit.

METHOD

Cross-sectional retrospective study based on the analysis of computerized medical records of PTNBs admitted to the NICU of a medium-sized general hospital that provides exclusive care for patients of the Unified Health System (SUS), located in the Zona da Mata of the state of Minas Gerais (MG). The hospital has 290 beds, of which ten are in the NICU. Births of PTNBs in this health facility occur in the birth center, in case of vaginal delivery, or in the operating room, in case of Caesarean section.

All 159 PTNBs admitted to the NICU between 2017 and 2019 were included, regardless of gender, place and type of delivery. In this study, all the computerized medical records of PTNBs admitted to the NICU for medical care or surgical treatment, with one bed occupied, and whose axillary temperature was measured upon admission, were analyzed. This measurement was performed up to 30 minutes after the PTNB was sent to the NICU. Patients with a stay of less than 48 hours and who did not have their axillary temperature measured on admission were excluded, totaling five patients. The convenience sample consisted of 154 PTNBs who met the eligibility criteria.

Data were collected in the nursing service coordination room, between July and November 2020, by the main researcher, through consultation of computerized medical

records. The collected data were recorded with the aid of the KoboToolbox that allows for data collection using Android mobile services and sends the data to a cloud server.

A structured instrument was used with the following independent variables to characterize premature newborns: vital signs on admission (heart rate, respiratory rate, axillary temperature, length of stay in the NICU, in days), gender (male/female), gestational age (weeks of life), birth weight (grams), Apgar at the 1st and 5th minute of life (0-10 points), origin (operating room, birth center and neonatal intermediate care unit), care procedures performed in the first 24 hours of life (surfactant administration, ventilatory support, bladder catheter, central peripheral inserted catheter, oro/nasogastric tube, umbilical catheter, orotracheal intubation, peripheral venous access, collection of arterial or peripheral blood sample) and outcome for patients (discharge/death). The monitoring of PTNBs in this study comprised the first 24 hours of life.

To characterize the type of hypothermia in PTNBs, the following classification was used for PTNBs' axillary temperature: normothermia (36.5ºC – 37.5ºC), mild hypothermia (36ºC – 36.4ºC), moderate hypothermia (32ºC – 35.9ºC) and severe hypothermia (less than 32ºC)[14].

Data were analyzed using the statistical package Statistical Package for the Social Sciences (SPSS version 23). Descriptive statistics were performed, showing frequencies (relative and absolute), measures of central tendency (mean/median) and dispersion (standard deviation [SD]/quartile 1 – quartile 3 [Q1-Q3]), considering the result of the normality test of quantitative variables. In inferential statistics, Pearson's and Mann Whitney's chi-square tests were used to compare the characteristics of PTNBs who had or did not have hypothermia. To assess the association of the independent variables with the dependent variable "dichotomized" hypothermia (yes/no), logistic regression was performed. The Backward conditional method was used, and the Hosmer & Lemeshow test was considered (X2=0.046; p=0.997) as a statistical test for goodness of fit for the final logistic regression model.

The study met the ethical recommendations for research involving human beings, being submitted to the prior appreciation of the Research Ethics Committees of the responsible institutions and approved under opinions no 4,120,334 on 06/29/2020 and no 4,141,834 on July, 8th, 2020.

RESULTS

As for the personal characteristics of the PTNBs admitted to the NICU, there was a predominance of males (55.8%), coming from the operating room (55.8%), gestational age > 32 weeks (71.4%), weight > 1,500g (59.1%), Apgar in the 1st minute of life less than seven (51.9%) and in the 5th minute of life greater than or equal to seven (94.2%) according to (Table 1).

In this study, hypothermia on admission to the NICU was prevalent in 68.2% of PTNBs. Regarding the characteristics of PTNBs who did or did not have hypothermia, univariate analysis showed higher rates of hypothermia in those with lower gestational age, lower birth weight, lower Apgar score in the 1st minute of life and in those transferred to the NICU from the Operating Room (Table 2).

An association was found between hypothermia in PTNBs at the NICU and factors related to health care, with lower temperatures (< 36.5°C) for those who were given surfactant, ventilatory support, peripherally inserted catheter, umbilical catheter, orotracheal intubation and peripheral venous access (Table 3).

Logistic regression analysis was performed for evaluation of the variables associated with the occurrence of hypothermia in combination with the variables of personal and health care characteristics of PTNBs. In multivariate analysis, the variables with p< 0.020 in the univariate analysis were included, but only weight showed an association with hypothermia on admission to the NICU. Thus, birth weight was associated with the risk of hypothermia, i.e. the lower the birth weight, the greater the chance of PTNBs developing hypothermia. Therefore, the lower the birth weight, the greater the chance of hypothermia, which is three times higher in low birth weight, five times higher in very low birth weight and up to 47 times higher in extremely low birth weight (Table 4).

Table 1 – Characterization of PTNBs admitted to the NICU (n = 154). Juiz de Fora, Minas Gerais, Brazil, 2021.

Variables	median (Q_1-Q_3)	
Vital Signs on admission		
Axillary Temperature	36.2 (35.9 – 36.6)	
Heart Rate	149.0 (137.0 – 161.0)	
Respiratory Rate	46.0 (40.0 – 52.0)	
Length of Stay in the NICU	11 (7 – 26)	
Gender	**n**	**%**
Female	68	44.2
Male	86	55.8
Gestational Age		
Extremely preterm (< 28 weeks)	16	10.4
Very preterm (28 to 31 weeks)	28	18.2
Moderate preterm (32 to 33 weeks)	40	26.0
Late preterm (34 to 36 weeks)	70	45.4
Birth Weight		
Extremely low weight < 999g	28	18.2
Very low weight 1,000g to 1,499g	35	22.7
Low weight 1,500g to 2,500g	73	47.4
Adequate weight >2,500g	18	11.7
Apgar 1st minute		
0 to 6	80	51.9
7 to 10	74	48.1
Apgar 5th minute		
0 to 6	9	5.8
7 to 10	145	94.2
Origin		
Operating Room	86	55.8
Birth Center	40	26.0
Neonatal Intermediate Care Unit	28	18.2
Outcome for Patients		
Discharge	130	84.4
Death	24	15.6

Source: Research data, 2021.

Table 2 – Association between PTNB characterization variables and hypothermia on admission to the NICU (n = 154). Juiz de Fora, Minas Gerais, Brazil, 2021.

Variables	Hypothermia				*p*-value
	No		Yes		
Vital Signs on admission	**median (Q_1-Q_3)**				
Heart Rate	155.0 (138.0-167.0)		148.0 (136.0160.0)		0.251[2]
Respiratory Rate	46.0 (41.0-56.0)		45.0(40.0-52.0)		0.937[2]
Length of Stay in the NICU	10 (7–15.0)		12 (8.0–32.0)		0.203[2]
Gender	**n**	**%**	**n**	**%**	
Female	22	44.9	46	43.8	0.899[1]
Male	27	55.1	59	56.2	
Gestational Age					
Extremely preterm (< 28 weeks)	2	4.1	14	13.3	0.007[1*]
Very preterm (28 to 31 weeks)	6	12.2	22	21.0	
Moderate preterm (32 to 33 weeks)	9	18.4	31	29.5	
Late preterm (34 to 36 weeks)	32	65.3	38	36.2	
Birth Weight					
Extremely low weight < 999g	1	2.0	27	25.7	<0.001[1*]
Very low weight 1,000g to 1,499g	9	18.4	26	24.8	
Low weight 1,500g to 2,500g	27	55.1	46	43.8	
Adequate weight >2,500g	12	24.5	6	5.7	
Apgar 1st minute					
0 to 6	18	36.7	62	59	0.010[1*]
7 to 10	31	63.3	43	41	
Apgar 5th minute					
0 to 6	1	2.0	8	7.6	0.273[1]
7 to 10	48	98.0	97	92.4	
Origin					
Operating Room	25	51.0	61	58.1	0.018[1*]
Birth Center	9	18.4	31	29.5	
Neonatal Intermediate Care Unit	15	30.6	13	12.4	
Outcome for Patients					
Discharge	47	95.9	83	79.0	0.008[1*]
Death	2	4.1	22	21.0	

Source: Research data, 2021.
Note: [1] Pearson's chi-square test or Fisher's exact test, in cases where the values were less than 5; [2] Mann-Whitney test.
*Statistically significant p<0.05.

Table 3 – Association between variables related to health care for PTNBs and hypothermia in the NICU (n = 154). Juiz de Fora, Minas Gerais, Brazil, 2021.

Variable	Hypothermia				*p*-value
Surfactant administration	**n**	**%**	**n**	**%**	
No	43	87.8	63	60.0	0.001[1]*
Yes	6	12.2	42	40.0	
Ventilatory support					
No	16	32.7	17	16.2	0.020[1]*
Yes	33	67.3	88	83.8	
Bladder catheter					
No	49	100	104	99.0	1.000[1]
Yes	-	-	1	1.0	
Central Peripheral Inserted Catheter					
No	48	98.0	90	85.7	0.022[1]*
Yes	1	2.0	15	14.3	
Oro/nasogastric tube					
No	5	10.2	3	2.9	0.111[1]
Yes	44	89.8	102	97.1	
Umbilical catheter					
No	45	91.8	77	73.3	0.010[1]*
Yes	4	8.2	28	26.7	
Orotracheal intubation					
No	40	81.6	62	59.0	0.006[1]*
Yes	9	18.4	43	41.0	
Peripheral venous access					
No	2	4.1	27	25.7	0.001[1]*
Yes	47	95.9	78	74.3	

Table 3 – Cont.

Variable	Hypothermia				*p*-value
Arterial blood sample					
No	1	2.0	4	3.8	0.666[1]
Yes	48	98.0	100	95.2	
Not informed	-	-	1	1.0	
Peripheral blood test					
No	25	51.0	60	57.1	0.720[1]
Yes	15	30.6	28	24.8	
Not informed	9	18.4	19	18.1	

Source: Research data, 2021.
Note: [1]Pearson's chi-square test or Fisher's exact test, in cases where the values were less than 5. [2]Mann-Whitney test
* Statistically significant p<0.05.

Table 4 – Variables associated to the occurrence of hypothermia in PTNBs on admission to the NICU (n = 154). Juiz de Fora, Minas Gerais, Brazil, 2021.

Variables	*B*	*Wald*	*OddsRatio*	*CI- 95%*	*p-value*
Adequate weight	-	14.191	-	-	-
Low weight	1.247	4.835	3.480	1.145-10.574	0.028*
Very low weight	1.766	7.532	5.845	1.656-20.626	0.006*
Extremely low weight	3.855	11.381	47.211	5.029-443.229	0.001*
Constant	-0.799	2.420	0.450	-	0.120

Source: Research data, 2021.
*Statistically significant p<0.05

DISCUSSION

Despite all technological developments in neonatology, hypothermia is still present among PTNBs due to their physiological immaturity. In the present study, there was a prevalence of high hypothermia among PTNBs. Similar data were found in a study carried out in Northeast Brazil and in public hospitals in Addis Ababa, Ethiopia, where the hypothermia rate was 93.3% and 76.7%, respectively[2,16].

This may be related to several factors peculiar to each study, such as incubators opened for performing procedures, leading to increased cold stress; lack of a room thermometer in the delivery room and NICU for adjusting the room temperature, which is only adjusted by air conditioning; the need to review and implement care protocols related to thermal control of preterm newborns at birth, and in transport and admission[2]; absence of a heated incubator; lack of early skin-to-skin contact with their mothers; transport of newborn

without the necessary measures to ensure thermal control and lack of training of the health team in the care needed to maintain thermal stability during transportation[16].

To ensure that the levels of care needed by PTNBs after birth are provided, these infants must be referred to a neonatal unit with advanced technology where trained healthcare professionals are capable of giving adequate and safe care to them[17].

Regarding the profile of PTNBs, there was a predominance of males and low birth weight in the present study. Such data is consistent with the findings of other studies. Males were prevalent in this research, with 55.8%, which was also observed in two other Brazilian studies that reported percentages of 55.6% and 53.1% respectively[2,18], and in a study conducted on the African continent (57.3%)[16]. In the latter, there was a predominance of PTNBs weighing between 1,500g and 2,500g (47.4%) and, in other studies, they made up approximately one third of the sample[2,16,18]. Of the PTNBs investigated in this study, 71.4% were classified as moderately premature, a percentage higher than that verified by two other studies (49.2% and 58.2%)[16,18].

The Apgar score is used to assess the clinical status and vitality of neonates, through postpartum parameters. They can be categorized into severe (0 to 3), moderate (4 to 6) and good (7 to 10) [18]. In the present study, lower values of the Apgar score were obtained in the 1st minute of life compared to the 5th minute of life after the application of immediate interventions, which was also reported in another study carried out in a NICU[18]. Physiological instability after birth can contribute to hypothermia among PTNBs with scores lower than seven in the 1st minute of life[4].

With regard to origin, in this study most PTNBs referred to the NICU came from the Operating Room. This can be explained by the need for advanced and specific care due to complications after birth, such as infections, respiratory distress and lung immaturity, cardiovascular and circulatory changes, malformation and others related to prematurity itself, in addition to maternal and obstetric factors[2,14].

As for the invasive procedures performed on admission of PTNBs, there was an association between hypothermia on admission and administration of surfactant, ventilatory support, central peripheral inserted catheter, umbilical catheter, orotracheal intubation and peripheral venous access. In another study, PTNBs were submitted to ventilatory care, orotracheal intubation, peripheral catheter insertion and central peripheral inserted catheter[19]. It can be seen that despite the use of care protocols to minimize excessive handling of PTNBs in the first 24 hours, these individuals are subject to numerous procedures due to their severe condition, which may increase the risk of heat loss through evaporation mechanisms, induction, radiation and conduction, thus increasing the risk of hypothermia[2,10,14].

Hypothermia was associated with lower GA, corroborating data found in the literature[9], its occurrence being justified by the fact that extreme and severe PTNBs have a very reduced chemical thermogenesis, which makes their thermal control difficult[14]; and death, a fact reaffirmed in an investigation with low-weight PTNBs[20], which demonstrates that hypothermia is an important predictor of death among PTNBs[4,7,13].

This study found that the lower the birth weight, the greater the chance of PTNBs developing hypothermia. This relationship was observed in a study carried out in Southern Brazil with PTNBs weighing ≤ 1,500g and in another study in Ethiopia[16,20]. The pathophysiological process of heat loss in PTNBs with lower birth weight is more accelerated than that of full-term newborns because they have a high ratio of body surface area to weight, increased evaporative heat loss due to skin immaturity, deficiency of subcutaneous brown adipose tissue acting as an insulator and low basal metabolic rates, thus reflecting on their thermal instability[14].

There is evidence that offering the necessary training and qualification of the health team so that it can provide care aimed at minimizing heat loss, reducing deficiencies in applied care procedures, implementing and reviewing protocols to improve the current practice and control environment and body temperature may contribute to the reduction of hypothermia among PTNBs[4,18].

Given the severity of hypothermia in PTNBs, care interventions, such as adjusting the temperature in the delivery room at 25°C, use of wool caps and polyethylene bags, as well as the training of the healthcare team, must be implemented. The effectiveness of such measures in the thermal control of RNTPs aims to reduce cases of hypothermia[3].

CONCLUSION

Hypothermia on admission to the NICU was prevalent in 68.2% of admitted PTNBs, in the present study. According to the multivariate model, it was observed that the lower the birth weight, the greater the chances of PTNBs to have hypothermia. The data shown here can contribute to a critical reflection on the importance of nursing care to prevent hypothermia in the delivery room, during transport and admission to the NICU.

For proper management and organization of the services rendered by the nursing and multidisciplinary teams, we stress the need for training, planning of the care provided, updating and implementation of care protocols for measures aimed to prevent thermal instability, and the availability of materials and equipment necessary for the provision of safe and first-rate care. The research reinforces the understanding that hypothermia is still an important event among PTNBs, with greater impact on those born with low birth weight, which can lead to complications and even death.

A limitation of this study is the retrospective cross-sectional design with data collection performed only through medical records, because of the possible issues related to failures or inconsistencies in the recording of information. It is suggested the development of new prospective and intervention studies aimed to highlight other risk factors for hypothermia and evaluate the implementation of preventive measures recommended in guidelines and in the scientific literature on thermal control among PTNBs.

REFERENCES

1. Martinelli KG, Dias BAS, Leal ML, Belotti L, Garcia EM, Santos Neto ET. Prematuridade no Brasil entre 2012 e 2019: dados do sistema de informações sobre nascidos vivos. R Bras Est Pop. 2021;38:e0173. doi: https://doi.org/10.20947/S0102-3098a0173
2. Aquino ARG, Silva BCO, Barreto VP, Aquino ARG, Trigueiro EV, Feijão AR. Profile of risky newborns related to thermoregulation in a Neonatal Intensive Care Unit. Enferm Glob. 2021;20(61):59-97. doi: https://doi.org/10.6018/eglobal.414201
3. Yip WY, Quek BH, Fong MCW, Thilagamangai, Ong SSG, Lim BL, et al. A quality improvement project to reduce hypothermia in preterm infants on admission to the neonatal intensive care unit. Int J Qual Heal Care. 2017;29(7):922-8. doi: https://doi.org/10.1093/intqhc/mzx131
4. Wilson E, Maier RF, Norman M, Misselwitz B, Howell EA, Zeitlin J, et al. Admission hypothermia in very preterm infants and neonatal mortality and morbidity. J Pediatr. 2016;175:61-7.e4. doi: https://doi.org/10.1016/j.jpeds.2016.04.016
5. Lahana A, Delanaud S, Erbani R, Glusko-Charlet A, Durand E, Haraux E, et al. Warming the premature infant in the delivery room: quantification of the risk of hyperthermia. Med Eng Phys. 2018;59:70-4. doi: https://doi.org/10.1016/j.medengphy.2018.06.002
6. McCall EM, Alderdice F, Halliday HL, Vohra S, Johnston L. Interventions to prevent hypothermia at birth in preterm and/or low birth weight infants. Cochrane Database Syst Rev. 2018;2(2):CD004210. doi: https://doi.org/10.1002/14651858.CD004210.pub5
7. Sharma D. Golden hour of neonatal life: need of the hour. Matern Health Neonatol Perinatol. 2017;3:16. doi: https://doi.org/10.1186/s40748-017-0057-x
8. Ministério da Saúde (BR). Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Atenção humanizada ao recém-nascido: Método Canguru: manual técnico [Internet]. 3. ed. Brasília: Ministério da Saúde; 2017 [cited 2022 Feb 21]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/atencao_humanizada_metodo_canguru_manual_3ed.pdf
9. Pinheiro JMB. Prevenção de hipotermia em recém-nascidos prematuros – princípios simples para uma tarefa complicada. J Pediatr. 2018;94(4):337-9. doi: http://doi.org/10.1016/j.jpedp.2017.11.005
10. Choi HS, Lee SM, Eun H, Park M, Park KI, Namgung R. The impact of a quality improvement effort in reducing admission hypothermia in preterm infants following delivery. Korean J Pediatr. 2018;61(8):239-44. doi: https://doi.org/10.3345/kjp.2018.61.8.239
11. Caldas JPS, Millen FC, Camargo JF, Castro PAC, Camilo ALF, Marba STM. Effectiveness of a measure program to prevent admission hypothermia in very low-birth weight preterm infants. J Pediatr. 2018;94(4):368-73. doi: http://doi.org/10.1016/j.jped.2017.06.016
12. Tay VY, Bolisetty S, Bajuk B, Lui K, Smyth J; the New South Wales and the Australian Capital Territory Neonatal Intensive Care Units' Data Collection. Admission temperature and hospital outcomes in extremely preterm infants. J Paediatr Child Health. 2019;55(2):216-23. doi: https://doi.org/10.1111/jpc.14187
13. Lima LS, Reis EAF, Silva EM, Moura JPG. Cuidados de enfermagem na termorregulação de recém-nascidos prematuros: revisão integrativa. Cogitare Enferm. 2020;25:e70889. doi: http://doi.org/10.5380/ce.v25i0.70889
14. Ministério da Saúde(BR). Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Atenção à saúde do recém-nascido: guia para os profissionais de saúde. Cuidados com o recém-nascido pré-termo [Internet]. 2. ed. Brasília: Ministério da Saúde; 2014 [cited 2022 Feb 21]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/atencao_saude_recem_nascido_v4.pdf
15. Ribeiro JF, Silva LLC, Santos IL, Luz VLES, Coêlho DMM. The premature newborn in neonatal intensive care unit: the nurse's care. J Nurs UFPE. 2016;10(10):3833-41. doi: https://doi.org/10.5205/1981-8963-v10i10a11450p3833-3841-2016
16. Demissie BW, Abera BB, Chichiabellu TY, Astawesegn FH. Neonatal hypothermia and associated factors among neonates admitted to neonatal intensive care unit of public hospitals in Addis Ababa, Ethiopia. BMC Pediatr. 2018;18(1):263. doi: https://doi.org/10.1186/s12887-018-1238-0
17. Faria TF, Kamada I. Skin injuries in newborns in neonatal intensive care. 2018;17(49):227-34. doi: https://doi.org/10.6018/eglobal.17.1.273671
18. Lima SS, Silva SM, Avila PES, Nicolau MV, Neves PFM. Clinical aspects of newborns admitted in Neonatal Intensive Care Unit of the reference hospital in the northern region from Brazil. ABCS Health Sci. 2015;40(2):62-8. doi: https://doi.org/10.7322/abcshs.v40i2.732
19. Medeiros FVA, Alves VH, Valete COS, Paiva ED, Rodrigues DP, Souza RRB. Invasive care procedures and neonatal sepsis in newborns with very low birth weights: a retrospective descriptive study. Online Braz J Nurs. 2016;15(4):704-12. doi: https://doi.org/10.17665/1676-4285.20165414
20. Soares T, Pedroza GA, Breigeiron MK, Cunha MLC. Prevalence of hypothermia in the first hour of life of premature infants weighing ≤ 1500g. Rev Gaúcha Enferm. 2020;41(esp):e20190094. doi: https://doi.org/10.1590/1983-1447.2020.20190094

Authorship contribution:

Conceptualization: Janaina Otoni de Carvalho; Herica Silva Dutra.
Data curation: Janaina Otoni de Carvalho.
Project management: Herica Silva Dutra.
Formal analysis: Luana Vieira Toledo, Herica Silva Dutra.
Writing – original draft: Janaina Otoni de Carvalho, Luana Vieira Toledo, Herica Silva Dutra.
Writing – review and editing: Luciene Muniz Braga, Paula Krempser, Luana Vieira Toledo, Zuleyce Maria Lessa Pacheco, Herica Silva Dutra
Methodology: Janaina Otoni de Carvalho, Herica Silva Dutra.
Ressources: Janaina Otoni de Carvalho, Herica Silva Dutra.
Supervision: Herica Silva Dutra.

The authors declare that there is no conflict of interest.

Corresponding author:
Herica Silva Dutra
E-mail: herica.dutra@ufjf.br

Associate editor:
Helena Becker Issi

Received: 03.24.2022
Approved: 07.04.2022

Editor-in-chief:
Maria da Graça Oliveira Crossetti