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Prevalence of hypothermia in the first hour of life of premature infants weighing ≤ 1500g

Prevalência da hipotermia na primeira hora de vida de prematuros com peso ≤ 1500g

Prevalencia de hipotermia en la primera hora vida de prematuros con peso ≤ 1500g

Tamara Soares[a,b]
Géssica Almeida Pedroza[c]
Márcia Koja Breigeiron[c]
Maria Luzia Chollopetz da Cunha[a]

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ABSTRACT

Objective: To analyze the prevalence of hypothermia in the first hour of life of preterm infants with birth weight 1,500 g or less.
Method: A cross-sectional study performed in a Neonatal Intensive Care Unit. Data obtained from 359 computerized records of premature infants admitted between 2012 and 2016. Descriptive Statistics and Poisson Regression were used.
Results: Premature infants (66.9%) presented hypothermia in the first hour of life, with axillary temperature of 36.2ºC (35.7-36.6), associated with: diagnosis of preeclampsia (p = 0.001), small for gestational age (p = 0.029), and the need for chest compression in the delivery room (p = 0.001). In cases of peri-intraventricular hemorrhage grade III (75%) and death (78.9%), there was a prevalence of premature infants with hypothermia in the first hour of life.
Conclusion: Hypothermia in the first hour of life was prevalent in preterm infants, being associated with clinical complications. The prevention of hypothermia in the first hour of life is fundamental in the reduction of diseases related to prematurity.
Keywords: Hypothermia. Infant, newborn. Infant, premature. Nursing care. Neonatology.

RESUMO

Objetivo: Analisar a prevalência da hipotermia na primeira hora de vida de prematuros com peso igual ou inferior a 1.500g.
Método: Estudo transversal, realizado em Unidade de Terapia Intensiva Neonatal. Dados obtidos de registros informatizados de 359 prontuários de prematuros admitidos entre 2012 e 2016. Estatística descritiva e Regressão de Poisson foram utilizadas.
Resultados: Prematuros (66,9%) apresentaram hipotermia na primeira hora de vida, com temperatura axilar de 36,2ºC (35,7-36,6), associada a: diagnóstico de pré-eclâmpsia (p=0,001), pequeno para idade gestacional (p=0,029) e necessidade de compressões torácicas em sala de parto (p=0,001). Nos casos de hemorragia peri-intraventricular grau III (75%) e óbito (78,9%), houve prevalência de prematuros com hipotermia na primeira hora de vida.
Conclusão: Hipotermia na primeira hora de vida foi prevalente nos prematuros, estando associada a complicações clínicas. A prevenção da hipotermia na primeira hora de vida é fundamental na redução dos agravos relacionados à prematuridade.
Palavras-chave: Hipotermia. Recém-nascido. Recém-nascido prematuro. Cuidados de enfermagem. Neonatologia.

RESUMEN

Objetivo: Analizar la prevalencia de la hipotermia en la primera hora de vida de prematuros con peso igual o inferior a 1.500g.
Método: Estudio transversal, realizado en Unidad de Terapia Intensiva Neonatal. Datos obtenidos de registros informatizados de 359 prontuarios de prematuros admitidos entre 2012 y 2016. Estadística descriptiva y Regresión de Poisson fueron utilizadas.
Resultados: Prematuros (66,9%) presentaron hipotermia en la primera hora de vida, con temperatura axilar de 36,2ºC (35,7-36,6), asociada a: diagnóstico de preeclampsia (p = 0,001), pequeño para la edad gestacional (p = 0,029) y la necesidad de compresiones torácicas en la sala de parto (p = 0,001). En los casos de hemorragia peri-intraventricular grado III (75%) y óbito (78,9%), hubo prevalencia de prematuros con hipotermia en la primera hora de vida.
Conclusión: Hipotermia en la primera hora de vida fue prevalente en los prematuros, estando asociada a complicaciones clínicas. La prevención de la hipotermia en la primera hora de vida es fundamental en la reducción de los agravios relacionados con la prematuridad.
Palabras clave: Hipotermia. Recién nacido. Recién nacido prematuro. Atención de Enfermería. Neonatología

[a] Universidade Federal do Rio Grande do Sul (UFRGS). Escola de Enfermagem, Curso de Pós-Graduação em Enfermagem. Porto Alegre, Rio Grande do Sul, Brasil.
[b] Hospital de Clínicas de Porto Alegre (HCPA). Porto Alegre, Rio Grande do Sul, Brasil.
[c] Universidade Federal do Rio Grande do Sul (UFRGS). Escola de Enfermagem, Curso de Graduação em Enfermagem. Porto Alegre, Rio Grande do Sul, Brasil.

INTRODUCTION

Current evidences have proved that there is an association between hypothermia and an increase in the mortality of premature newborns. Despite recommendations on how to prevent hypothermia in the delivery room, the risk of preterm (those born after less than 37 weeks of gestation) newborn hypothermia is still present[1]. Therefore, the presence specialized nursing, targeted at preventing hypothermia and monitoring temperature, is necessary.

Neonate infants undergo environmental interferences during their adaptation to the extra-uterine life, due to their systemic immaturity. Endocrine, metabolic, cardiovascular, and pulmonary adaptations start immediately after birth, and are determinant in the regulation of arterial and glycemic pressure, and in the maintenance of body temperature[2-3].

In the process of heat production, the body of the newborn has metabolically active tissues that produce thermal energy. The brain of the newborn, since it is bigger and more metabolically active, is responsible for from 60 to 80% of the heat production when resting. In addition, the newborn is capable of performing thermogenesis, that is, heat production from the metabolism of brown adipose tissue found in the throat, thorax, and abdomen, which is characterized by an abundant blood flow, sympathetic innervation, and mitochondria[2].

The loss of heat in newborns takes place fast. It can decrease from 2 to 3ºC in the first half-hour of life, since heat production is not greater than the heat lost by convection, evaporation, and radiation[3]. In this metabolic environment, premature children are even more susceptible, since they have low body fat deposits when compared to term newborns, meaning they are under a greater risk of hypothermia and require more attention to the control of their body temperature[2-3].

Based on data about Neonatal Intensive Care Units (NICU) from the Neonatal Research Network, a study showed that, from a group of 5277 newborns with extremely low weight (NELW), 14% had lower than 35ºC temperatures as they were admitted in the NICU, 32% had temperatures from 35 to 35.9ºC. 42% had temperatures between 36 and 36.9ºC, and 10% had temperatures < 37ºC[4].

When the body temperature of newborns remains low, their higher clinical vulnerability favors physiological changes related to the increase in the need of oxygen and in peripheral vascular resistance, leading to a diminution in their cardiac output. Therefore, simple interventions to prevent hypothermia, carried out between birth and the first one-to-two hours of life, diminish mortality[3].

Among the evidence-based practices, the attention offered within the delivery room is determinant for the thermal control of premature newborns. Interventions established to prevent hypothermia in the hospitalization of very low-weight premature infants led to a sharp reduction in hypothermia, from 37.2% to 14.2%[5]. These interventions include: using radiant heat cribs constantly at 35-36ºC; maintaining the door closed; using a plastic cap, tubular shaped fabric, and a polyethylene bag around the body after the fontanel region is dried; keeping the reanimation room temperature from 24-27ºC; transferring the newborn into the hospitalization unit in a transport incubator which has been previously heated to 35-37ºC, and keeping the bag closed during the entire time while caring for the premature infant, even during advanced reanimation and anthropometric assessment[5].

The Golden Hour of a neonate is the first post-natal hour in the life of premature and term newborns[6]. This concept includes the practice of evidence-based interventions in the first 60 minutes of post-natal life, to guarantee a better result in the long-term. The implementation of these Golden Hour practices showed positive results in premature newborns with a sharp reduction in hypothermia and, as a consequence, led to a diminution in the incidence of hypoglycemia, intraventricular hemorrhage, bronchopulmonary dysplasia, retinopathy of prematurity, and other comorbidities[6].

Considering the relationship between hypothrmia and the morbimortality of premature infants, the question that guides this study is: what is the prevalence of hypothermia in the first hour of life of premature infants weighing of 1,500g or lower? Therefore, the objective of this study is analyzing the prevalence of hypothermia of premature infants who weigh 1,500g or less in their first hour of life.

METHODS

This is a retrospective and cross-sectional study. Data was obtained from a research in the medical records of premature infants whose weighed 1,500g or less at birth, and were hospitalized in a university hospital in the South of Brazil. The setting of the research is a level III NICU, with 20 beds, that cares for high-complexity patients. The neonatal assistance is carried out

by a multiprofessional team made up of physicians, nurses, nursing technicians, physical therapists, and nutritionists. Data collection took place from January 1st, 2012, to December 31st, 2016, since this study was carried out in 2017. The following were excluded from this research: premature infants with malformations, genetic syndromes, indications of surgical treatment at birth, who died in the delivery room, were born in other hospitals, and infants whose first axillary temperature verification took place after the first hour of life of the premature infant.

Sample size calculation was based on a ratio of 40% premature children with hypothermia in the first hour of life[7], with a standard error of 5% and a confidence level of 95%, with an estimated sample of 369 medical records.

Data collection took place in the Medical Records and Health Information Service of the hospital, from medical records listed using the Query that the service requires. The Query is a way to investigate computerized medical records in the institution and is carried out by filling a research form with the variables of the study, which generates a databank.

To characterize the premature infants, the following variables were included: date, time, and weight at birth; gestational age (GA); sex; whether there was a twin; axillary temperature as well as the time of axillary temperature verification; temperature of the radiant heat crib used in admission; need for endotracheal intubation and chest compression in the delivery room; use of reanimation medications; Apgar in the 1st and 5th minutes of life; presence of the morbidities: necrotizing enterocolitis, bronchopulmonary dysplasia, retinopathy of prematurity, and peri-intraventricular hemorrhage (as confirmed by cerebral ultrasound scans and stratified in grades I, II, III, or IV), and death. The axillary temperature of the premature babies as they were admitted into the NICU was classified as: normothermia (36.5 - 37.5ºC), hypothermia (below 36.5ºC), mild hypothermia (36 - 36.4ºC), moderate hypothermia (32 - 35.9ºC), and severe hypothermia (below 32ºC)[8].

Regarding maternal characteristics, the following variables were collected: age, clinical diagnoses of preeclampsia and/or chorioamnionitis, use of antenatal corticoids and antibiotics (whatever the dosage), type of delivery, length of time in labor and with a broken amniotic sac higher than 18 hours.

For the statistical analysis, data was tabulated and analyzed using the software Statistical Package for the Social Sciences (version 18.0). The nominal variables were described according to absolute and relative frequencies. Continuous variables were expressed by means and standard deviations (SD), medians and quartiles (25-75). To estimate the prevalence ratio of clinical and demographic variables, the Poisson Regression was used, with a significance level equal to or lower than 5%.

The project was approved in the Research Ethics Committee of the responsible institution, which gave it the Certificate of Submission to Ethical Appraisal (CAAE) number 63582816.6.0000.5327. The study was carried out according to ethical standards of research. The Term of Responsibility for Medical Records Data Use was respected, according to the protocol for institutional researches.

RESULTS

Considering the total number of records of premature children admitted in the NICU whose weight was 1,500g or below, and according to the methodological criteria defined earlier, 10 medical records corresponding to neonate death in the delivery room were excluded, as well as cases in which the births took place in other hospitals and those in which the time of first axillary temperature verification was after the first hour of life of the premature newborn, meaning that the final sample contained 359 records.

Among the characteristics of the sample, pregnant women had a mean age of 27.3 (SD=6.77) y/o. 72.4% (260) received antenatal corticoids and 39.6% (142) received antibiotics in the period before delivery. Among these women, 33.1% (119) had a diagnostic of preeclampsia and 17% (61) had their amniotic bag broke for longer than 18 hours. Regarding the premature infants, they had a mean weight at birth of 1,054.3 grams (SD=302.34) and a GA of 29.1 (SD=2.89) weeks. Most were born via cesarean sections (71%; 255). For the other variables relative to the premature newborns, data is presented in table 1.

After birth, the premature children were admitted in an incubator heated at 34.1°C (SD=2.9), so the first vital sign verification could be carried out. The time interval between birth and the first verification of vital signs had a median of 25 (19-33) minutes. Regarding the assessment of the axillary temperature (Ata), the median corresponded to 36.2°C (35.7–36.6), and hypothermia (Ata < 36.5ºC) was the outcome of 66.9% (240) of cases.

For variables relating to hypothermia in the first hour of life, data is described in table 2.

Table 1 - Descriptive statistics of the characteristics of premature newborns weighing 1,500g or less, admitted in the Neonatal Intensive Care Unit. Porto Alegre, RS, Brazil, 2012-2016 (n=359)

Variables	n (%)	Moderate hypothermia (%)	Mild hypothermia (%)	Normothermia (%)
Sex				
Male	169 (47.1)	44.4	27.8	26.0
Female	190 (52.9)	32.1	30.0	35.3
Very low weight	152 (42.3)	44.7	28.9	23.7
Extremely low weight	207 (57.7)	32.9	29.0	36.2
Weight adequation				
Small for gestational age	162 (45.1)	42.0	32.1	24.1
Adequate for gestational age	197 (54.9)	34.5	26.4	36.5
Premature twin	68 (18.9)	26.5	29.4	38.2
Single premature child	291 (81.1)	40.5	28.9	29.2
Apgar in the 1st minute				
0 to 6	230 (64.1)	40.0	29.1	28.7
7 to 10	129 (35.9)	34.1	28.7	34.9
Apgar in the 5th minute				
0 to 6	74 (20.6)	54.1	25.7	17.6
7 to 10	285 (79.4)	33.7	29.8	34.4
Endotracheal intubation	145 (40.4)	45.5	25.5	25.5
Thoracic compression	21 (5.8)	76.2	19.0	0.0
Reanimation medications	14 (3.9)	71.4	14.3	7.1

Source: Research data, 2012-2016.

Table 2 - Ratio of adjusted prevalence of the variables associated with hypothermia in the first hour of life. Porto Alegre, RS, Brazil, 2012-2016 (n=359)

Variables	PR*	CI95%†	‡p-value
Weight at birth (category)			
Extremely low weight	1.116	0.934 – 1.333	0.229
Very low weight	1.00		
Weight adequation of birth			
Small for gestational age	1.183	1.017 – 1.375	0.029
Adequate for gestational age	1.00		
Sex			
Male	1.212	1.052 – 1.397	0.008
Female	1.00		

Variables	PR*	CI95%†	‡p-value
Twin			
Yes	1.070	0.849 – 1.348	0.565
No	1.00		
Preeclampsia			
Yes	1.322	1.137 – 1.538	0.001
No	1.00		
Type of delivery			
Cesarean section	1.025	0.859 – 1.223	0.787
Natural	1.00		
Chest compression in the delivery room			
Yes	1.443	1.179 – 1.768	0.001
No	1.00		
Reanimation medications			
Yes	0.879	0.663 – 1.167	0.373
No	1.00		
Intubation in the delivery room			
Yes	0.982	0.829 – 1.163	0.830
No	1.00		

Source: Research data, 2012-2016.
*PR: prevalence ratio obtained from multiple robust Poisson Regression; †CI 95%: confidence interval; ‡p Wald's Chi-square.

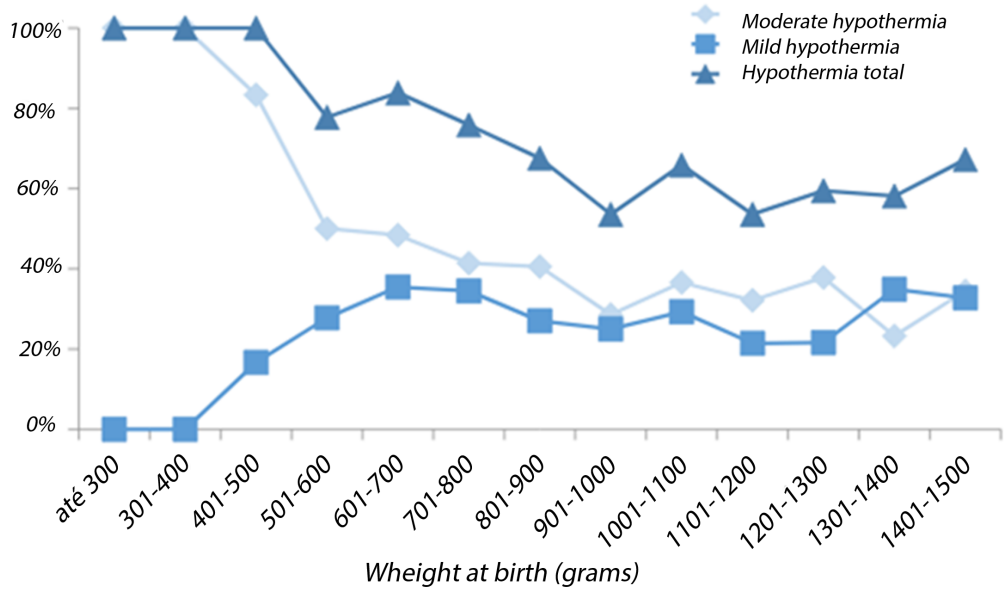
In the admission of the premature child, the mean Ata gradually increased as GA advanced. Premature children who had 22-week GA had an Ata of 35.5°C (SD=1.2). Those with 36 weeks of GA, had an Ata of 36.2°C (SD=0.2).

Regarding the Ata at admission and weight at birth, the mean Ata in the first hour of life was higher in premature infants whose weight was greater at birth. Inferior and superior limits in the weight curve at birth indicate that premature children whose weight is above 300 grams (1) presented Ata of 35.1°C. and those whose weight was between 1,401 and 1,500g (58), had an Ata of 36.1°C (SD=0.5). The mean Ata of premature children was below the range of normothermia both with regards to GA and to weight at birth. Hypothermia levels, classified as moderate or mild, were analyzed according to the levels of weight at birth (Image 1).

Among premature children with hypothermia, 43.3% (104) had mild hypothermia and 56.7% (136) had moderate hypothermia. In addition, the study found that 2.2% (8) premature children had normothermia or hyperthermia (Ata> 37.5%), and there were no records of severe hypothermia.

The prevalent morbidities found during hospitalization, were: necrotizing enterocolitis, bronchopulmonary dysplasia, retinopathy of prematurity, and peri-intraventricular hemorrhage. Records of deaths were found. In the cases of peri-intraventricular hemorrhage grade III and death, there was a prevalence of newborns who presented with hypothermia in their first hour of life (Table 3).

Image 1 - Percentage of hypothermia according to weight at birth



Source: Research data, 2012-2016.

Table 3 - Prevalence of clinical outcomes of premature newborns admitted in the Neonatal Intensive Care Unit. Porto Alegre, RS, Brazil, 2012-2016 (n=359)

Morbidities	n† (%)	Moderate hypothermia (%)	Mild hypothermia (%)	Normothermia (%)
Peri-intraventricular hemorrhage				
Absent	206 (57.2)	35.4	32.5	30.1
Grade I	76 (21.1)	42.1	26.3	27.6
Grade II	14 (3.9)	28.6	28.6	42.9
Grade III	12 (3.3)	33.3	41.7	25.0
Grade IV	22 (6.1)	22.7	22.7	50.0
No exam	29 (8.1)	62.1	10.3	27.6
Retinopathy of prematurity				
Absent	324 (90.2)	39.2	28.7	29.9
ROP‡ I	13 (3.6)	15.4	30.8	46.2
ROP‡ II	14 (3.9)	21.4	50.0	28.6
ROP‡ III	8 (2.2)	50.0	0.0	50.0
Necrotizing enterocolitis	37 (10.3)	40.5	27.0	29.7
Bronchopulmonary dysplasia	70 (19.4)	31.9	30.4	36.2
Death	71 (19.8)	52.1	26.8	21.1

Source: Research data, 2012-2016.
†n: number of cases for the outcome; ‡ROP: Retinopathy of prematurity.

DISCUSSION

Despite advances in intensive neonatal care, hypothermia still takes place. This study found the prevalence of hypothermia in premature infants whose weight at birth is 1,500g or less, indicating that those with the lowest weight and GA had a lower Ata when they were admitted at the NICU. Hypothermia in the first hour of life was associated to newborns who were small for their gestational age (SGA), diagnoses of preeclampsia, and for premature children who received chest compression as a means of reanimation within the delivery room. In addition, in medical records that included peri-intraventricular hemorrhage of the 3rd degree or death, there was a prevalence of premature children who presented with hypothermia in their first hour of life.

Hypothermia is physiologically damaging in neonates, especially for those with very low weight and extremely low weight at birth, and whose GA is extremely low[9]. Hypothermia in premature children, as found in the admission to the NICU, is a risk factor for morbidities and mortality since it favors or increases metabolic disorders, respiratory discomfort, necrotizing enterocolitis and intracranial hemorrhage[5;9]. Therefore, interventions in the Golden Hour give support to the transition of the high-risk neonate into extra-uterine life, impacting positively short- and long-term outcomes, while diminishing the chances for complications using practices targeted at thermoregulation, in the context of a healthcare plan for individualized attention[10].

The results of this study made it clear that, the lower the weight at birth and the GA, the lower the temperature at admission, since most premature children with weight ≤500g and up to 3 weeks of GA had moderate hypothermia.

The risk factors for hypothermia in premature infants are associated to the surface of the body being lengthier as it relates to their weight, to skin immaturity, and to poor thermoregulation[11]. When considering premature infants, there is also the fact that they have a low amount of brown adipose tissue, which is the substance responsible for thermogenesis, and have a very reduced metabolic activity before 32 weeks of GA, making it even more difficult to maintain body temperature[12]. The lower the weight at birth and the GA, the stronger the physiopathological process of heat loss[11].

The Ata found in the first hour of life, with a median of 36.2% (35.7–36.6), was classified as mild hypothermia. Corroborating that data, a temperature of 36.4ºC (35.9º-36.8º) at admission in the NICU shows cases of hypothermia in premature infants[9]. In a cohort study that evaluated the distribution of temperature in the admission to the NICU of infants who were moderately premature (29-33 weeks) and extremely premature (<29 weeks), the thermal lability at admission increased as the GA decreased[13].

This study found a relation between hypothermia, GA, and weight at birth. Similar data was found in a retrospective research that analyzed the occurrence of hypothermia (<36.5°C) in premature children with a GA<32 in the first three hours of admission[14]. The authors found that, the lower the weight at birth and the GA, the more frequent and longer-lasting the hypothermia ($p<0.01$), considering that premature infants take more time to reach normothermia when they are admitted with hypothermia[14]. In addition, moderate hypothermia was found in the admission of very low weight premature infants, being associated to short and long-term consequences[15]. Hypothermia in the admission at the NICU was associated to an increase in the Respiratory Discomfort Syndrome and in mortality rates. It may also play an important role among the multi-factorial causes that compromise the neurological development of premature infants[15].

The data collected showed an association between hypothermia in the first hour of life and certain characteristics of the premature infants, such as being children of mothers with preeclampsia, being SGA, and requiring reanimation through chest compression at birth.

Preeclampsia affects from 5 to 10% of gestations in the world. It is one of the main causes of premature labor, being also associated with the restriction of intrauterine growth, which makes it one of the main causes of premature births, since its final treatment is labor and the delivery of the placenta[16]. A diagnostic of preeclampsia, SGA, and Apgar scores <7 at the fifth minute of life were associated to hypothermia in the first hour of life of premature infants[9].

In the assistance offered to the premature infants in the delivery room, professionals must be prepared to use reanimation maneuvers. These maneuvers start immediately after umbilical cord clamping, while maintaining the body temperature of the neonate using radiant heat, in addition to the fact that the temperature in the environment should be between 23 and 26°C[6]. Neonates whose GA is below 34 weeks and weight is below 1,500 grams must be involved in a transparent plastic bag, except for their heads, which must be involved with a plastic bag and a cap made of fabric. All procedures must be carried out with the neonate within the plastic bag, including aspiration of air passages, ventilation, thoracic compression, and medicine administration[17]. The need for reanimating the newborn in the delivery room is associated to hypothermia at admission[7], corroborating the association found in this study. Thoracic

compression is an advanced reanimation maneuver that is associated to hypothermia in the first hour of life[5].

In the first hour of life, hypothermia may lead to physiological repercussions, such as diminution in the production of surfactants, increased oxygen consumption, metabolic acidosis, hypoglycemia, cardiac output reduction, and increased peripheral vascular resistance[2]. Therefore, the premature infant is susceptible to a negative prognostic regarding specific prematurity-related pathologies[8;18].

Hypothermia is associated to severe neurological lesions (peri-intraventricular hemorrhage grade 3 and 4) [7,19], severe retinopathy of prematurity[18], bronchopulmonary dysplasia[6], and death[9]. Consequently, when investigating the most prevalent morbidities diagnosed during hospitalization, it can be noted that most premature infants with a diagnostic of peri-intraventricular hemorrhage grade 3, or those who did not survive, had hypothermia in the first hour of their lives. Corroborating the findings of this study, another investigation found an association between hypothermia at the admission to an NICU and clinically unfavorable outcomes, such as severe neurological lesions in premature children with less than 33 weeks GA[19].

Low temperatures are a strong predictor of neonate mortality[6;12-20]. Neonates exposed to low temperatures at admission (35-35.4°C) are under a 70% higher risk of mortality when compared to normothermic neonates (36.5-37.5°C)[9]. On the other hand, an 1°C increase at admission diminishes the mortality rate in 15%[9]. Even with changes in the distribution of temperature in the admission to the NICU, there is still a reverse association between temperature and mortality risk[13].

CONCLUSION

This study showed that hypothermia in the first hour of life was prevalent in 66.9% of cases for premature children whose weight was 1,500g or lower. It was found that the median of Ata in the admission of premature children was classified as mild hypothermia. There was also an association between hypothermia in the first hour of life and certain variables (mother with a diagnosis of preeclampsia, SGA, and having received chest compression in the delivery room). In addition, the presence of hypothermia in most morbidity cases was more evident as it related to peri-intraventricular hemorrhage grade 3 and to death.

The relevance of methods to prevent hypothermia stand out, whether they are applied in the delivery room, transportation, or during NICU hospitalization, so that the health problems of the premature child can be overcome. The nursing team is an essential part in the prevention mechanism, since it is responsible for preparing the environments in which the neonate stays. During all stages of care for the premature infant, the team must use its knowledge about thermal control to offer quality and safe assistance.

A potential limitation of this study is its retrospective design, in which the subject of the study is not observed in real time. That is because the study depended on records created before data collection, being limited to these documents.

Future studies that seek to identify risk factors for hypothermia and the best healthcare practices to prevent it are necessary for the benefits of reducing or eradicating hypothermia at the first hour of life to stand out. This study recommends the elaboration of an intervention bundle to better manage the thermal control of premature infants and the use of body temperature as an indicative of the quality of the attention offered.

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Corresponding author:
Tamara Soares
E-mail: tsoares@hcpa.edu.br

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