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The Association between Hypothermia during Emergency Room Admission and Newborn Mortality at Dr. Moewardi Hospital

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ABSTRACT

Background: Hypothermia in newborns continues to be a significant issue and a leading cause of morbidity and mortality. The incidence of hypothermia in referral newborns is still high during hospital admission.
Subjects and Method: This is a prospective cohort study conducted at Dr. Moewardi Hospital. Data collection was carried out on January 1, 2015, until March 31, 2015, for referred newborns. The dependent variable was mortality and the independent variables included gestational age, birth weight, sepsis, severe respiratory distress, and temperature at the time of admission at the ER. The chi-square test and logistic regression were used to analyze the data, with a cut-off value of $p<0.05$ cut off and a confidence interval of 95%.
Results: There were 56 newborn referrals, with 60.7% incidence of hypothermia and 19.6% incidence with mortality. From the chi-square analysis, the variable of gestational age and weight did not meet the requirements of multivariate analysis ($p> 0.25$). The multivariate logistic regression analysis revealed a non-significant association between severe respiratory distress and mortality in referred newborns (OR= 5.25; 95% CI= 0.89 to 30.82; p= 0.066). After performing multivariate logistic regression analysis to obtain controlled ORs, there was a significant relationship between newborn referrals mortality and temperature at the time of ER admission (OR= 8.75; 95% CI= 1.07 to 3.26; p= 0.047) and sepsis (OR= 6.25; 95% CI= 150 to 28.69; p= 0.012) with mortality of referred newborns.
Conclusion: The incidence of hypothermic referred newborns is high. Hypothermia during admission at the ER and sepsis are both associated with increased mortality in referred newborns.

Keywords: newborns, hypothermia, mortality.

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BACKGROUND

Hypothermia in newborns continues to be a significant issue and becomes a cause of morbidity, particularly in developing countries

(WHO, 1997). The incidence of hypothermia in newborn referrals, when they arrived in the hospital, is high. In Zambia, 44% of newborns were reported to have hypothermia upon admission to the hospital (Christensson et al., 1995). At Dr. Moewardi Hospital, hypothermia is still a problem; 29.9% of referred newborns had hypothermia in 2011 (Virgiansari, 2011).

The temperature on admission by the time at the hospital is one of the risk factors for the mortality of the newborns that must be noticed during transportation.(Ferrara and Atakent, 1986). Preventing hypothermia is one of the effective strategies for lowering the incidence of hypothermia in newborns (Darmstadt et al., 2005). The prevention and management of hypothermia in facilities with limited resources should emphasize simple and effective interventions in conjunction with behavior modification and training (Kumar et al., 2009).

The Indonesian Ministry of Health, in collaboration with the Neonatology Division of Child Health Department at the Faculty of Medicine of the University of Indonesia/ Cipto Mangunkusumo Central Hospital (RSCM), conducted training activities on newborn resuscitation, stabilization, and transportation using the Structured, Clinical, Objective-Referenced, Problem-Oriented, Integrated Organized (SCORPIO) method, which aims to increase health workers' competence to reduce infant mortality rates (Ministry of Health RI, 2015). The training was then conducted throughout all provinces, including Central Java, in June 2014 for the Surakarta residency area and in September 2014 for the remaining residency areas.

It is necessary to collect data as an input following training. The purpose of this study is to determine the prevalence of hypothermia, its characteristics, risk factors of mortality, and the association between hypothermia at the time of ER admission and mortality in newborn patients referred to Dr. Moewardi hospital.

SUBJECTS AND METHOD

1. Study Design

This is a prospective cohort study of newborns referred and treated at Dr. Moewardi hospital. The research was conducted between January 1 until March 31, 2015, in the emergency room and Neonatal Intensive Care Unit (NICU) of Dr. Moewardi hospital. This study included all referred newborn patients treated at Dr. Moewardi hospital.

2. Population and Sample

The study's sample size was determined using the rule of thumb method (Madiyono B, et all, 2002). The study's inclusion criteria were newborn patients who had been referred and whose parents had agreed to participate. Patients with significant surgical abnormalities (hydrocephalus, gastroschisis, or omphalocele) were excluded, as were those who died on arrival or were referred to other health care facilities.

3. Study Variables

The dependent variable was the mortality of newborn patients referred for evaluation, which was classified as alive or dead. Gestational age, birth weight, sepsis, severe respiratory distress, and temperature of admission were all independent variables.

4. Operational Definition of Variables

Gestational age was classified into two categories: preterm infants who were born before 37 weeks and term infants who were born after 37 weeks.

10 Birth weight was classified as Normal Birth Weight (NBW) if the baby weighs more than 2,500 grams at birth and as Low Birth Weight (LBW) if the baby weighs less than 2,500 grams at birth.

Sepsis and severe respiratory distress were determined based on the examining physician's admission diagnosis in the ER,

which was divided into two categories: no sepsis and sepsis and no severe respiratory distress (Downe score ≤ 6) and severe respiratory distress (Downe score ≥ 6).

The temperature at the time of admission at the ER was classified as hypothermia if it is less than 36.5°C or as not hypothermia if it is greater than 36.5°C.

5. Study Instruments

Data were collected through the completion of questionnaires.

6. Data Analysis

The chi-square test and logistic regression with a p-value of <0.05 and 95% confidence interval were used to analyze the data. The ethical clearance for this research was obtained from the Standing Committee for Medical/ Health Research Ethics, Faculty of Medicine, Sebelas Maret University before the research began.

7. Research Ethic

The study was approved by Medical Research Ethics Committees of Dr. Moewardi General Hospital, Surakarta. All procedures were performed according to the Declaration of Helsinki and written informed consents were obtained from all parents/ guardians.

RESULTS

1. Sample Characteristics

A total of 56 research subjects were obtained through data collection at the emergency room. There were no subjects excluded. The baseline characteristics of the samples are as follows: Details of the characteristics were described in Table 1.

According to the baseline characteristic, 60,7% of the subjects had hypothermia. The average temperature for referral newborn patients entering the ER is 36.1°C, with a minimum temperature of 32.7°C and a maximum temperature of 38.7°C.

Table 1. Clinical Characteristics of Study Participants

Characteristics	Frequency (n)	Percentage (%)
Gender		
Boy	34	60.7
Girl	22	39.3
Gestational Age		
Term	38	67.9
Preterm	18	32.1
Birthweight		
NBW	31	55.4
LBW	25	44.6
Patient Origin		
Surakarta	8	14.3
Outside Surakarta	48	85.7
Referrer		
Family	6	10.7
Doctor/ Nurse/ Midwife	50	89.3
Referral Letter		
Yes	50	89.3
No	6	10.7
Incubator transpor		
Yes	0	0
No	56	100
Kangaroo method		
Yes	0	0

Characteristics	Frequency (n)	Percentage (%)
No	56	100
Temperature on admission		
No hypothermia	22	39.3
Hypothermia	34	60.7
Mortality		
Alive	45	80.3
Dead	11	19.6

2. Distribution of Newbon Patients

Tabel 2 showed that the frequency of temperature distribution at the time of admission at the ER and the mortality of newborn patients referred at Dr. Moewardi Hospital.

According to the level of hypothermia, 14 (25%) referred newborns had mild hypothermia, 20 (35.7%) had moderate hypothermia, and none had severe hypothermia. The mortality rate of referred newborn patients was 19.6 %, with the majority of deaths occurring in the moderate hypothermia group, accounting for 9 (16%) of the total patients who died. The mortality rate was 4.5 % for no hypothermia, 7.1 % for mild hypothermia, and 45 % for moderate hypothermia.

As shown in Table 4, it is known that the variables of sepsis, severe respiratory distress, and temperature admission have p values less than 0.25, whereas the variables gestational age and birth weight have p values greater than 0.25 and thus do not meet the requirements for multivariate analysis.

The multivariate logistic regression analysis of risk factors for mortality indicated that temperature of admission (OR= 8.75; 95% CI= 1.07 to 3.26) and sepsis (OR= 6.56; 95% CI= 1.50 to 28.69) were statistically significant risk factors for mortality in newborn referred patients. Meanwhile, severe respiratory distress was not statistically significant (OR= 5,25; 95% CI= 0.89 to 30.82).

Tabel 2. The frequency of temperature distribution at the time of admission at the ER and the mortality of newborn patients referred at Dr. Moewardi Hospital

Temperature admission at the ER (°C)	Dead		Alive		Total	
	N	%	N	%	N	%
≥36.5 (no hypothermia)	1	4.5	21	95.5	22	100
36-36.4 (mild hypothermia)	1	7.1	13	92.9	14	100
32-35.9(moderate hypothermia)	9	45	11	55	29	100
<32 (severe hypothermia)	0	0	0	0	0	0

Table 3. The frequency of distribution of complications and mortality of newborn patients referred at Dr. Moewardi Hospital

Temperature admission at the ER (°C)	Dead		Alive		Total	
	N	%	N	%	N	%
Sepsis						
Yes	8	38.1	13	61	21	100
No	3	8.6	32	91.4	35	100
Severe respiratory distress						
Yes	3	50	3	50	100	100
No	8	16	42	84	100	100

Table 4. Summarizes the findings from the bivariate analysis of each risk factor

Variable	Mortality				Total		OR	P
	Dead		Alive					
	N	%	N	%	N	%		
Gestational Age								
Preterm	5	8.9	13	23.2	18	32.1	2.05	0.305
Full term	6	10.7	32	57.1	38	67.9	(0.53 to 7.92)	
Birth weight								
LBW	6	10.7	19	33.9	25	44.6	1.64	0.514
NBW	5	8.9	26	46.4	31	55.4	(0.44 to 6.18)	
Sepsis								
Yes	8	14.29	13	23.21	21	37.5		0.013
No	3	5.36	32	57.14	35	62.5		
Severe respiratory distress								
Yes	3	5.36	3	5.36	6	10.72	6.56	0.083
No	8	14.28	42	75	50	89.28	(1.50 to 28.70)	
Temperature on admission								
Hypothermia	10	17.8	24	42.9	34	55.4	52.64	0.036
No hypothermia	1	1.8	21	37.5	22	39.3	(6.67 to 140.80)	

Table 5. Multivariate logistic regression analysis between risk factors and mortality of newborn patients referred at Dr. Moewardi Hospital

Variable	OR	95% CI		p
		Upper limit	Lower limit	
Sepsis	6.56	1.50	28.69	0.012
Severe respiratory distress	5.25	0.89	30.82	0.066
Temperature on admission	8.75	1.07	3.26	0.047

DISCUSSION

The research was conducted at Dr. Moewardi hospital which is a referral hospital for Central Java Province and types A teaching hospital for Sebelas Maret University. According to the patients' origins, the majority (85.7%) were from outside Surakarta, were delivered by health care workers (89.3%), and brought a letter of referrals (89.3%). There were no patients referred with transport incubators. This is because the majority of health care facilities in Surakarta have a lack of facilities and limited infrastructure so they could not provide transport incubators. The way of referral with Kangaroo Mother Care has also been inadequately well done.

Hypothermia was more prevalent in this study than in other previous studies (Virgiansari, 2011). According to a study carried out in Brazil, only one-third of referral newborns undergone hypothermia11, while a study conducted in Zambia discovered that nearly half of infants were hypothermia upon admission to the emergency department.

Although there were more full-term and NBW births in this study, the proportion of preterm (32.1%) and LBW (44.6%) births were nearly identical. Preterm and LBW infants lose heat more rapidly than full-term and NBW infants, owing to a greater body surface area ratio1 and a greater rate of trans epidermal fluid loss (HAMMARLUND and SEDIN, 2008). Hypothermia occurred in 44% of newborn referrals in Zambia, with a higher incidence in younger infants (0–24-hour period)(Christensson et al., 1995).

Hypothermia occurs in all climates and

is most severe in the first few minutes to hours after birth (Mullany LC, et all, 2010). The data collection period for this study was January 2015 to March 2015, during the rainy season. In a previous study carried out in India15, during January till March was the highest incidence of hypothermia. In a study conducted in northern India, hypothermia occurred in 19.1% of home-born babies during the winter but only 3.1% during the summer (Kumar and Aggarwal, 1998).

Appropriate transportation and health care workers are required to prevent hypothermia. Although almost all patients (89.3%) were delivered by health care workers in this study, adequate transportation procedures were not followed. According to the data, numerous preterm and LBW patients were referred, but none of them were referred using an incubator or with the kangaroo mother care method. Untrained health care professionals contribute to the deterioration of teamwork (Silvieraet al., 2003).

As shown in Table 2, it is known that the more severe level of hypothermia resulted in a higher mortality rate of 81.8%. This is consistent with the established theory that hypothermia is a direct or indirect cause of death (Lunze et al., 2003). While this study did not identify patients with severe hypothermia, mortality was quite high in patients with moderate hypothermia. Therefore, it is critical for health care workers to pay close attention to hypothermia management to prevent hypothermia-related complications, including mortality.

Hypothermia was identified as a risk factor for mortality in referral newborn patients using multivariate logistic regression analysis. The pathophysiology of hypothermia's mortality-inducing effect has been extensively described. A total 21,822 otherwise population-based data about the prevalence and consequences of hypothermia in preterm infants are still lacking (Kumar et al., 2009).

According to this study, referral newborn patients who had undergone hypothermia had an 11 times higher risk of mortality compared to newborn patients who did not have hypothermia. These findings support previous researches in developing countries (Daga A-S,et all, 1991). Similarly, in developed countries, there is a relation between hypothermia upon arrival at the emergency department in patients transported between hospitals and newborn mortality (Fagerli, J Holt, 1999).

Although this study obtained a relationship between hypothermia and mortality, it could not establish a causal relationship between whether newborns become ill as a result of hypothermia or as a result of the illness. Hypothermia on the first day of life is frequently associated with infection, as demonstrated by previous researches (Yunanto, 2014). There was no analysis based on newborn age in this study.

Sepsis was also identified as a risk factor for mortality in this study. Sepsis continues to be the leading cause of morbidity and death in newborns. Sepsis was found to have a strong significant association with mortality in newborns in other previous studies (Niswade et al., 2011).

Severe respiratory distress, preterm births, and low birth weight infants were not associated with increased mortality in newborn referral patients. This is in contrast to previous research (Hidayah and Hafidh, 2014), which found that preterm births and low birth weight infants were risk factors for newborn mortality.

Because a causal relationship could not be established in this study, it is unknown whether the referred newborn patients be-came ill as a result of hypothermia or as a result of their illness. Additionally, this study did not take into account the distance traveled from the referring health care facilities or the

time required for referral, both of which may be associated with risk factors of mortality.

Hypothermia is still a common complication of newborn referrals to Dr. Moewardi Hospital (60.7 %). The majority of referred newborn patients were male, full-term, and normal birth weight infants. Almost all referral patients were delivered from outside of Surakarta by health care workers and directed with referral letters. There was no correlation between gestational age, birth weight, severe respiratory distress, and mortality of newborn referral patients. There is a correlation between the temperature at the time of ER admission and the mortality of newborn referral patients. Referral newborn patients who developed hypothermia had an 11 times higher risk of mortality compared to those who did not develop hypothermia.

AUTHOR CONTRIBUTION

Dwi Hidayah was the main author who conducted the study, processed data analysis, and wrote the manuscript. Rinawati Rohsiswatmo examined the background and discussion of the study. Yulidar Hafidh formulated the framework study.

CONFLICT OF INTEREST

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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