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Neonatal Hypothermia and its Associated Factors among Neonates Admitted to the Neonatal Intensive Care Unit in Western Ethiopia: A cross-sectional study

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Abstract

Background: Globally, neonatal hypothermia has a significant role in the morbidity and mortality of newborns, particularly in low- and middle-income nations. High prevalence of hypothermia has been reported from countries with the highest burden of neonatal mortality. Hypothermia is one of the leading causes of death for over 1.1 million neonates in Sub-Saharan Africa.

Objective: The aim of this study was to determine the prevalence of neonatal hypothermia and assess associated factors among neonates admitted to the Neonatal Intensive Care Unit of Public Hospitals in West Wallaga Zone.

Methods: An institution-based cross-sectional study was conducted from June 20 to August 31, 2024. A systematic random sampling technique was used to recruit the study participants. A total of 396 neonates were included in the study, and the axillary temperature of the newborn was measured by digital thermometer at the point of admission. Data were cleaned manually, coded, and entered into Epi-Data version 4.6 and exported to Statistical Software for Social Sciences (SPSS) 25 software for analysis. Logistic regression analysis determined the association between the outcome variable and associated factors. Adjusted odds ratio (AOR) at a 95% confidence interval (CI) was used to determine the strength of association. Then, the statistical significance of the association was determined at a p-value of <0.05 .

Results: The prevalence of neonatal hypothermia in the study area was 60.1%. Not visiting antenatal care (AOR = 2.570, 95% CI = 1.286 – 5.137), delayed initiation of breastfeeding (AOR = 14.754, 95% CI = 7.518 – 28.952), obstetric complications (AOR = 1.850, 95% CI = 1.014 – 3.285), age of neonate <24 hours (AOR = 5.764, 95% CI = 2.095 – 15.859), <2500 grams weight neonates (AOR = 2.078, 95% CI = 1.157 – 3.733) and neonatal underlying health problems (AOR = 3.858, 95% CI = 2.160 – 6.889) were significantly associated with hypothermia.

Conclusion and recommendation: The prevalence of neonatal hypothermia in the study area was high. Absence of visiting antenatal care, delayed breastfeeding initiation, presence of obstetric complications, being younger than 24 hours, neonatal weight below 2500 grams, and presence of neonatal underlying health problems were significantly associated with neonatal hypothermia. Therefore, attention should be given to health education on antenatal care and early initiation of breastfeeding. In addition, special attention should also be given to mothers with obstetric complications, younger neonates, underweight neonates, and neonates with health problems.

Key words: Hypothermia, neonate, prevalence, associated factors

Introduction

The neonatal phase, which lasts for the first 28 days of an infant's life, is especially vulnerable since it is a time when several dangerous but treatable illnesses are prevalent. The leading causes of morbidity and neonatal fatalities are low birth weight and premature babies, which put them at greater risk (1). In newborn infants, the body temperature decreases on average by 0.5°C during the first 5 minutes after birth. The rapid drop in body temperature may be more noticeable in very preterm newborns (32 weeks of gestation), primarily due to poor thermoregulation and a greater surface area to body mass ratio (2). The newborn period's daily mortality rates are thirty times greater than those of later infancy. An infant's risk of death is highest right after birth; between 25% to 45% of newborn deaths occur in the first 24 hours, and 75% of deaths occur in the first week of life (3).

Neonatal hypothermia is common worldwide, with prevalence rates ranging from 8.5% to 52%. According to a global survey, 32% to 85% of newborns delivered in hospitals in developing nations suffer from hypothermia (4). The prevalence of hypothermia among hospitalized infants is estimated to be as high as 85%, with the majority of cases occurring in low- and middle-income countries (LMICs). About 2.5 million newborns die every year in the first four weeks of life. Most neonatal deaths (99%) occur in low and middle-income countries (LMICs), and about half of the deaths occur at home. The most frequent reason why newborns die is prematurity. The estimated global preterm birth rate was 11.1%, with South Asia and Sub-Saharan Africa accounting for over 60% of preterm births globally (5).

The prevalence of neonatal hypothermia varies among countries. Study findings from France, Italy, Pakistan, Nepal, Pakistan, Iran, Rwanda and Nigeria revealed neonatal hypothermia accounting for 54% (6), 48.4% (7), 49.5% (8), 43% (9), 84.5% (10), 27% (11) and 24.2% (12), respectively. Neonatal hypothermia is also common in Ethiopia as reported by studies from Dessie 66.8% (13), Harar 66.3% (14), Gondar 61.5% (15) and Addis Ababa 83.2% (16).

In Sub-Saharan Africa (SSA), conditions triggering mortality like prematurity, labor complications, infections, and respiratory distress syndrome, are frequently worsened by hypothermia which is believed to scale up the risk of death. In SSA, newborns are at particularly high risk of hypothermia due to a combination of physiological features (low birth weight, prematurity), cultural beliefs (delayed breastfeeding/skin to skin contact, late hospital admission,

bathing after birth), and socioeconomic factors (home deliveries, absence of skilled care at delivery) (17). Countries with high neonatal mortality have high rates of neonatal hypothermia. Hypothermia mainly contributes to mortality by worsening outcomes of severe neonatal infections, preterm birth, and birth asphyxia. It is estimated that 20% of deaths due to prematurity and 10% of deaths in term babies could be prevented by improved thermal care. In addition, neonatal hypothermia results in reduced growth and development (18).

Several studies were undertaken to determine the prevalence of neonatal hypothermia and its risk factors in Ethiopia. The studies had determined the prevalence of neonatal hypothermia and assessed associated factors, and hence, the findings were one of the sources for this particular study. However, previous studies focused on a single institution. The information on the prevalence and associated factors of neonatal hypothermia is not available in the study area. Unlike previous studies, this study included all hospitals having NICUs in the zone. Identifying different factors that are associated with neonatal hypothermia is valuable to design an appropriate intervention strategy to decrease neonatal hypothermia. Therefore, this study aimed to determine the prevalence of neonatal hypothermia and its associated factors among neonates admitted to the neonatal intensive care unit (NICU) of West Wallaga Public Hospitals.

Methods and materials

Study area, period, and design

This study was conducted at West Wallaga Zone public hospitals from June 20 to August 31, 2024. West Wollega Zone is one of the Oromia Zones located in the western part of the region. It is 440 kilometers from Addis Ababa. The estimated area of this zone is 10,883.19 square kilometers, with a total population of 2,054,076. There are 6 government hospitals, all of which have their own NICUs, and this study was conducted at these hospitals.

The hospitals in the zone include Nejo General Hospital, Gimbi General Hospital, Bube Primary Hospital, Genji Primary Hospital, Mendi Primary Hospital, and Begi Primary Hospital. This study was conducted from June 20 to August 31, 2024. An institutional-based cross-sectional study was conducted.

Population and eligibility criteria

All neonates who were admitted to the NICU of public hospitals in the study area were the source population, whereas randomly selected neonates admitted to the NICU were the study population. All neonates whose mothers were willing to participate were included in the study. However, neonates whose mothers were not present at all during the study period were excluded.

Sample size determination and sampling procedure

Sample size was determined using the single population proportion formula by taking into account the assumption of a 95% CI, 5% margin of error, and the proportion of neonatal hypothermia (61.5%) from a previous study conducted at Gondar (15).

Therefore, the final sample size will be

$$N = \frac{(Z_{\alpha/2})^2 \times P(1-P)}{d^2} = \frac{(1.96)^2 \times 0.615 (1-0.615)}{(0.05)^2} = \frac{3.8416 \times 0.615 \times 0.385}{0.0025} = 364$$

By adding a 10% non-response rate

$$364 + (364 \times 10\%) = 364 + 36 = 400$$

Sampling technique and procedure

After proportional allocation based on monthly neonatal admissions, study participants were selected by a systematic random sampling technique. The interval for selection was determined by dividing the total admission for the calculated sample size ($691/400 = 2$). Therefore, every 2 admissions were taken starting from the 2nd admission. Finally, 107, 71, 54, 101, 49, and 18

neonates were taken from Nejo General Hospital, Gimbi General Hospital, Begi Primary Hospital, Mendi Primary Hospital, Bube Primary Hospital and Genji Primary Hospital, respectively making total sample size of 400.

Data collection tools and procedures

Data collection tools

Data were collected using a structured questionnaire. The questionnaire has five main parts, namely sociodemographic characteristics, behavioral factors, obstetric factors, neonatal factors, and environmental factors. The data collection tool was obtained after searching for relevant literature (15,19,20).

Data collection procedure

Data collectors (6 neonatal nurses) and 6 supervisors were recruited, trained, and informed on how to collect data from study participants. Data collectors measured the axillary temperature of neonates using a digital thermometer with which they were working. To avoid cross-contamination, the thermometers were cleaned with 70% alcohol while measuring temperature in between the neonates. Data regarding medical diagnosis and cardiopulmonary resuscitation (CPR) history were taken from charts. Sociodemographic characteristics and obstetric history were taken from mothers of the neonates after appropriate consent was provided by the data collectors.

Study variables

The dependent variable was neonatal hypothermia. Sociodemographic factors, obstetric factors, behavioral factors, neonatal factors, and environmental factors were independent variables.

Operational definitions

Hypothermia - Includes mild (36.0 to 36.4°C), moderate (32.0 to 35.9°C) and sever hypothermia (<32°C)

No hypothermia – Includes normothermia (36.5 to 37.5°C) and hyperthermia (>37.5°C)

Admission temperature - The first temperature obtained from neonates at admission to the NICU

Inborn: a newborn that was delivered from the study Hospital

Outborn: a newborn that was delivered other than the study Hospital

Delayed initiation of breastfeeding: when a mother not starting breastfeeding within one hour of her baby's birth

Data quality assurance

Training was given to both data collectors and supervisors on the objectives and methodology of the study and data collection approach. The questionnaire was translated to Afaan Oromoo and retranslated back into English to check for consistency. Pretesting was done on 5% of the total sample size at Nekemte Comprehensive Specialized Hospital. After pretesting, the reliability of the tool was assessed. The data collection instrument was assessed for completeness, consistency, and applicability. Confidentiality of study participants was ensured by making the participation voluntary. In addition, code was used to avoid the disclosure of the collected data.

Data processing and analysis

The collected data were coded, cleaned, and entered into EpiData version 4.6 software. From this software, the data were exported to SPSS version 25 for analysis. Descriptive statistics was calculated to describe relevant variables. Data were presented on words, figures, and tables. A binary logistic regression analysis was used to select candidate variables for multivariable logistic regression analysis. Data assumptions for binary logistic were checked. Variables with p-value < 0.25 were candidates for multivariate analysis. Model fitness was checked by Hosmer-Lemeshow goodness-of-fit. The logistic model was taken as good fit for the data if p-value > 0.05. The adjusted odds ratio (AOR) at 95% CI was used to determine the strength of association. A p-value of < 0.05 was considered statistically significant.

Ethical consideration

Ethical approval was obtained from Salale University Institutional Research Ethics Review Committee (S/U-IRERC-243/2016). Then permission was taken from each hospital to conduct this study. Since it was conducted on human data, this study adhered to Declaration of Helsinki (<http://www.wma.net/en/30publications/10policies/b3/index.html>). Written informed consent was obtained from study participants (mothers) after explaining the purpose and objective of the study, the benefits and risks (if any) associated with the study and their right when taking part in the study. Only after they provide informed written consent that they were recruited for the study. Inclusion of study participants was on voluntary basis. Information obtained from them were kept confidential and used only for research purposes.

Results

Sociodemographic characteristics among study participants

Of the total 400, 396 neonates with their mothers were included, making a response rate of 99%. The mean maternal age was 31.01 with a standard deviation of 5.82. More than half of the mothers, 203 (51.3%), were in the age group between 30–39 years of age. The mothers were composed mostly of Oromo and Amhara, which accounted for 221 (55.8%) and 104 (26.3%), respectively (Table 1).

Table 1: Sociodemographic characteristics of mothers of newborns admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024.

Characteristics		Frequency	Percent (%)
Maternal age	<20	17	4.3
	20 – 29	144	36.4
	30 – 39	203	51.3
	≥40	32	8.1
Ethnicity	Oromo	221	55.8
	Amhara	104	26.3
	Tigre	27	6.8
	Others*	44	11.1
Religion	Protestant	164	41.4
	Orthodox	129	32.6
	Muslim	63	15.9
	Others**	40	10.1
Residence	Urban	190	48.0
	Rural	206	52.0
Educational level	No formal education	63	15.9
	Primary school	99	25.0
	Secondary school	141	35.6
	Diploma and above	93	23.5
Occupation	Housewife	90	22.7
	Government employee	59	14.9
	Private employee	45	11.4
	Student	25	6.3
	Farmer	100	25.3
	Merchant	77	19.4
Income (ETB)	<2500	92	23.2
	2500 – 3500	163	41.2

>3500	141	35.6
*Gumuz, Gurage	**Catholic and Adventist	

Behavioral factors of neonatal hypothermia

Eighty-six (21.7%) of the mothers had no antenatal visits during pregnancy. About three out of five neonates, 233 (58.8%), had no skin-to-skin contact with their mother immediately after birth, and 245 (61.9%) of the neonates had early initiation of breastfeeding within 1 hour of birth (Table 2).

Table 2: Behavioral factors of neonatal hypothermia among neonates admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024

Characteristics		Frequency	Percent (%)
ANC follow up	Yes	310	78.3
	No	86	21.7
Skin to skin contact with mother	Yes	163	41.2
	No	233	58.8
Initiation of breastfeeding	Yes	245	61.9
	No	151	38.1
Application of oil massage	Yes	113	28.5
	No	283	71.5
Provision of bathing	Yes	99	25.0
	No	297	75.0

Obstetric factors of neonatal hypothermia

The majority of the mothers, 332 (83.8%) were multiparous. According to this study, most of the pregnancies, 377 (95.2%), were single, and the mode of labor onset was found to be spontaneous among 266 (67.2%) of the mothers. Two hundred twenty-eight (57.6%) of the neonates were delivered spontaneously, while only 56 (14.1%) of them were delivered by cesarean section (Table 3).

Table 3: Obstetric factors of neonatal hypothermia among neonates admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024.

Characteristics		Frequency	Percent (%)
Parity	Primiparous	64	16.2
	Multiparous	332	83.8
Pregnancy type	Single	377	95.2
	Above one	19	4.8
	Spontaneous	266	67.2
Mode of labor onset	Induced	130	32.8
	Spontaneous	228	57.6
Mode of delivery	Assisted	112	28.3
	Cesarean section	56	14.1
Obstetric complication	Yes	151	38.1
	No	245	61.9
Type of obstetric complications	Preeclampsia/Eclampsia	24	6.1
	Sepsis/PROM	21	5.3
	Antepartum hemorrhage (APH)	30	7.6
	Obstructed/prolonged labor	39	9.8
	Postpartum hemorrhage (PPH)	37	9.3

Neonatal factors of hypothermia

The findings of this study revealed that most of the neonates, 253 (63.9%), were males. Most of the neonates, 364 (91.9%), were in the age group of below 24 hours, with the median age of 14 hours. The median gestation age was 38.0, with 196 (49.5%) of the neonates having gestational age ≥ 37 weeks, while about 200 (50.5%) were preterm. The majority of the neonates, 269 (67.9%) were found to have a birth weight ≥ 2500 grams with a median weight of 2700 grams. Moreover, more than one-fourth 106 (26.8%) of them had a history of CPR (Table 4).

Table 4: Neonatal factors of hypothermia among neonates admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024.

Characteristics	Frequency	Percent (%)
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Sex	Male	253	63.9
	Female	143	36.1
Neonatal age in hours	<24	364	91.9
	≥24	32	8.1
Gestational age in weeks	<37	200	50.5
	≥37	196	49.5
Birth weight in grams	<2500	127	32.1
	≥2500	269	67.9
History of CPR	Yes	106	26.8
	No	290	73.2
Neonates have health problems	Yes	129	32.6
	No	267	67.4
Medical diagnosis	Sepsis	6	1.5
	Jaundice	20	5.1
	Meconium aspiration syndrome	12	3.0
	Congenital anomalies	14	3.5
	Respiratory distress syndrome	36	9.1
	Hypoglycemia	22	5.6
	Asphyxia	19	4.8

Environmental factors of neonatal hypothermia

The majority of the neonates, 223 (56.3%), were delivered during nighttime time and about 142 (35.9%) were outborn. Of the outborn neonates, 29 (7.3%) were delivered at home (Table 5).

Table 5: Environmental factors of neonatal hypothermia among neonates admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024.

Characteristics	Frequency	Percentage (%)
Delivery time	Daytime	43.7
	Night time	56.3
Place of delivery	Inborn	64.1
	Out born	35.9
Out born	Other hospitals	10.1
	Health center	9.1
	Traditional birth attendant	9.8
	Home	7.3

Prevalence of neonatal hypothermia

As revealed by this study, the prevalence of hypothermia among newborns admitted to the NICU of public hospitals in West Wollega was 238 (60.1%) (95% CI (55.2 – 64.8). Mild, moderate, and severe hypothermia accounted for 74 (18.7%), 153 (38.6%), and 11 (2.7%), respectively, yielding the overall prevalence of hypothermia to be 238 (60.1%) (Figures 2 and 3).

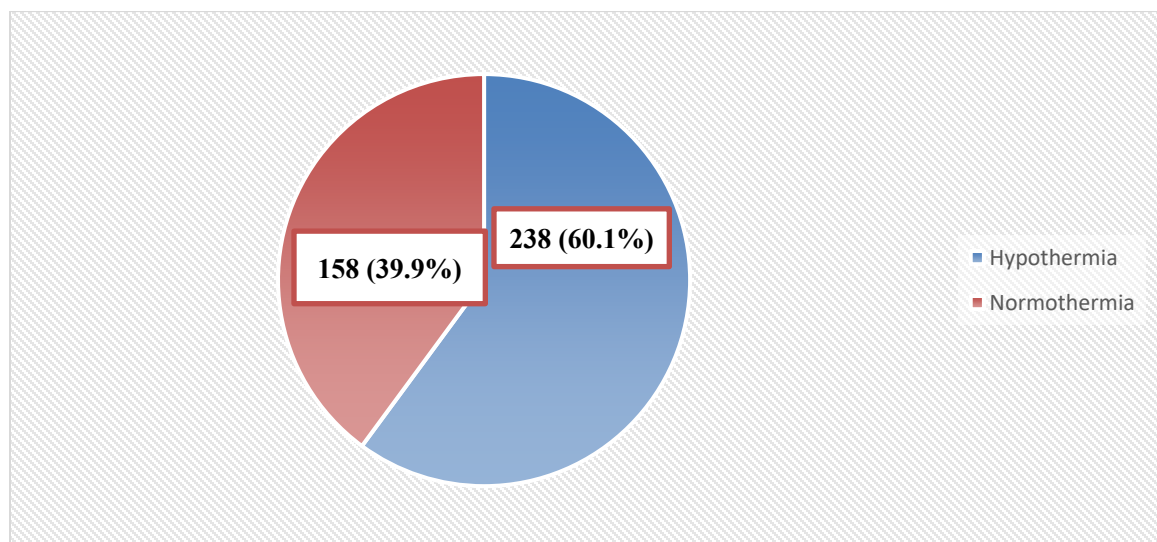


Figure 2: Temperature classification among neonates admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024

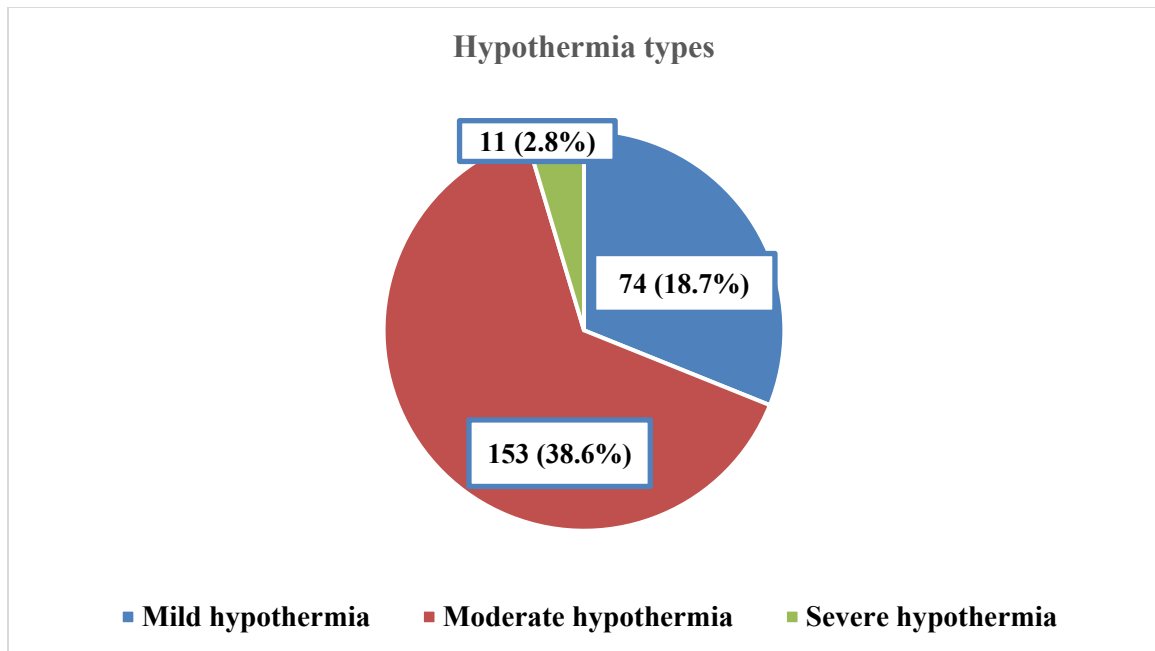


Figure 3: Level of hypothermia among neonates admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024

Predictors of neonatal hypothermia

Bivariate analysis was done to find candidate variables for multivariate analysis. Candidate variables were selected based on the Wald test from logistic regression and a p-value cut-off point of 0.25. Variables with a p-value <0.25 were candidates for multivariate analysis. According to this analysis, the candidate variables were educational level, ANC visit, skin to skin contact, breastfeeding, bathing, mode of labor onset, delivery mode, presence of obstetric complications, age of neonate, gestational age, birth weight of neonate, CPR, presence of neonatal health problem, time of delivery and delivery setting.

Multivariate analysis was done for the candidate variables marked. In this analysis, the significance level was determined at a p-value below 0.05, and the strength of the association was evaluated using adjusted odds ratios. The result of the multivariate analysis revealed that ANC visit, initiation of breastfeeding after delivery, presence of obstetric complications, age of the neonates, birth weight and presence of neonatal health problem were significantly associated with neonatal hypothermia.

It was observed that neonates born from mothers who had no ANC follow up were about two times more likely to develop neonatal hypothermia compared to those neonates born from mothers who had followed ANC [AOR = 2.570 (95% CI: 1.286 – 5.137); p-value = 0.008]. Neonates who did not started breastfeeding immediately after birth were 14 times more likely to develop neonatal hypothermia than those who started breastfeeding [AOR = 14.754 (95 CI: 7.518 – 28.952); p-value = 0.000].

In this study, obstetric complication was also one of the risk factors for neonatal hypothermia. Neonates of mothers who had history of obstetric complication were found to be at risk of hypothermia [AOR = 1.850 (95% CI: 1.041 – 3.285); p-value = 0.036]. On the other hand, neonates below 24 hours old were 5 times more likely to have neonatal hypothermia than those who were more than 24 hours old [AOR = 5.764 (95% CI: 2.095 – 15.859); p-value = 0.001]. Neonates who weighed below 2500 grams were found to be at higher risk of developing neonatal hypothermia than who weighed above 2500 grams [AOR = 2.078 (1.157 – 3.733); p-value = 0.014]. Furthermore, neonates with underlying health problems are about 3 times more likely to have hypothermia [AOR = 3.858 (95% CI: 2.160 – 6.889); p-value = 0.000] (Table 6).

Table 6: Multivariate analysis to identify risk factors among neonates admitted to Neonatal Intensive Care Units of West Wallaga Public Hospitals (n = 396), Ethiopia, 2024

Variables	Category	Hypothermic		COR (95% CI)	AOR (95% CI)	P-value
		Yes	No			
Educational level	No formal education	44	19	1.335 (0.674 – 2.644)	0.878 (0.349 – 2.209)	0.781
	Primary education	58	41	0.815 (0.456 – 1.458)	0.720 (0.328 – 1.580)	0.412
	Secondary education	77	64	0.693 (0.405 – 1.186)	0.781 (0.381 – 1.559)	0.499
	Diploma and above	59	34	1	1	
ANC visit	Yes	171	139	1	1	
	No	67	19	2.866 (1.643 – 5.000)	2.570 (1.286 – 5.137)	0.008*
Skin-to-skin contact	Yes	87	76	1	1	
	No	151	82	1.609 (1.069 – 2.421)	1.311 (0.758 – 2.267)	0.333
Breastfeeding	Yes	102	143	1	1	
	No	136	15	12.711 (7.042 – 22.946)	14.754 (7.518 – 28.952)	0.000*
Bathing	Yes	68	31	1.639 (1.011 – 2.656)	1.049 (0.561 – 1.964)	0.881
	No	170	127	1	1	
Mode of labor onset	Spontaneous	137	129	1	1	
	Induced	101	29	3.279 (2.034 – 5.288)	1.784 (0.978 – 3.254)	0.059
Delivery mode	Spontaneous	119	109	1	1	
	Assisted	80	32	2.290 (1.409 – 3.721)	0.750 (0.340 – 1.652)	0.475
	Cesarean section	39	17	2.101 (1.124 – 3.930)	0.826 (0.351 – 1.945)	0.662
Obstetric complication	Yes	117	34	3.526 (2.234 – 5.568)	1.850 (1.041 – 3.285)	0.036*
	No	121	124	1	1	
Neonate age	<24 hours	222	142	1.562 (0.758 – 3.226)	5.764 (2.095 – 15.859)	0.001*
	≥24 hours	16	16	1	1	
Gestational age	<37 weeks	132	68	1.648 (1.099 – 2.473)	1.445 (0.850 – 2.455)	0.174
	≥37 weeks	106	90	1	1	

Birth weight	<2500 grams	98	29	3.114 (1.930 – 5.024)	2.078 (1.157 – 3.733)	0.014*
	≥2500 grams	140	129	1	1	
Received CPR	Yes	74	32	1.777 (1.105 – 2.858)	1.546 (0.856 – 2.791)	0.149
	No	164	126	1	1	
Neonatal health problems	Yes	96	33	2.561 (1.612 – 4.068)	3.858 (2.160 – 6.889)	0.000*
	No	142	125	1	1	
Delivery time	Day	97	76	1	1	
	Night	141	82	1.374 (0.898 – 2.020)	0.760 (0.444 – 1.301)	0.317
Delivery place	Inborn	135	119	1	1	
	Out born	103	39	2.328 (1.494 – 3.627)	1.519 (0.860 – 2.685)	0.150

***Risk factors for neonatal hypothermia**

Discussion

This study was undertaken among neonates admitted to the NICU at West Wallaga Public Hospital. It has been revealed that 60.1% of the neonates studied were hypothermic. Not following ANC, delayed initiation of breastfeeding, presence of obstetric complications, neonatal age <24 hours, neonatal weight of <2500 grams, and presence of neonatal health problems were significantly associated with neonatal hypothermia.

In this study, the magnitude of neonatal hypothermia was 60.1% [95% CI (55.2 – 64.8)]. This finding is consistent with study findings from Gondar, Ethiopia, 61.5% (15) and Nigeria 62.0% (23). These similarities might be due to study settings, design and population under study. However, it was found that this prevalence is lower than studies done in Addis Ababa, Ethiopia, 83.2% (16), Dessie, Ethiopia 66.8% (13), Korea 74.1% (24) and China 87.9% (25). These higher prevalences are attributed to the involvement of a greater number of NICUs and the selection of health facilities with high patient load.

This study revealed that ANC follow-up has a significant effect on the development of hypothermia. It was found that those neonates whose mothers had no ANC follow-up were two times more likely to be hypothermic as compared to those neonates who were born to mothers who followed ANC during pregnancy. This might be because ANC follow-up provides mothers with birth preparedness, including thermal protective measures. This finding is similar to a study done in Nepal, in which ANC follow-up and hypothermia were significantly associated (9).

Delayed breastfeeding initiation was found to be a significant contributor to neonatal hypothermia. It was revealed that neonates for whom breastfeeding was not initiated immediately after birth were about fourteen times more likely to be hypothermic. Other studies from Tigray (26), Addis Ababa, Ethiopia (19) and Nepal (20) showed that delayed breastfeeding had a significant role on the development of neonatal hypothermia. An early and adequate supply of breast milk is essential to provide the newborn with calories so that it can generate body heat. Breastfeeding prevents susceptibility to infections, hypoglycemia, and provides calories to produce heat for thermoregulation, subsequently preventing hypothermia in neonates.

The presence of obstetric complications during pregnancy and/or labor was also significantly associated with neonatal hypothermia. It was observed that neonates born from women with

obstetric complications were 1.8 times more likely to be hypothermic than those neonates whose mothers had no obstetric complications. Study findings from Arba Minch (27), Harar (14), and Brazil (28) supported current findings showing that the presence of obstetric complications was a determinant factor for neonatal hypothermia. Women who developed obstetrical complications were more likely to need special management like cesarean section or instrumental deliveries like forceps delivery or the mother might be too sick to be with their neonates in close contact during the time of delivery (skin-to-skin contact with the neonates is less likely to be practiced in such cases). Some obstetrical complications, like premature rupture of membranes, might have resulted in neonatal sepsis, where a fall in body temperature is one of its clinical features.

Another determinant for neonatal hypothermia in this study was being younger than 24 hours. Neonates below 24 hours of age were about five times more likely to have hypothermia than neonates older than 24 hours. Other study findings from Addis Ababa (19), Gondar, Ethiopia (15), and Bangladesh (29). These study findings support the fact that younger neonates do not have adequate adipose and brown tissues and have no shivering thermogenesis, limiting their capacity for thermoregulation. Hypothermia on the other hand leads to increased oxygen consumption, which leads to hypoxemia, pulmonary vasoconstriction, the reduced release of pulmonary surfactant, and eventual death (16).

Hypothermia was found to be significantly prevalent among neonates weighed <2500 grams. Those neonates who weighed <2500 grams had about two-fold risk of developing hypothermia as compared to neonates whose weight was ≥ 2500 grams. This is because small neonates have higher surface area to weight, decreased subcutaneous fat with its isolative capacity, less developed stores of brown adipose tissue, immature hypothalamic thermal control, and immature and thin skin. Other study findings from West Shewa, Ethiopia (30), Uganda (18), Kenya (31) and the United States (US) (32) supported the findings of the current study.

The last determinant for neonatal hypothermia in this study was the presence of neonatal health problems. Neonates who had health problems were about three times more likely to have hypothermia as compared to those neonates with no health problems. A study that involved five hospitals (St Paul Millennium College Hospital, Tikur Anbessa Hospital, Gandhi Memorial Hospital, Gondar, Gondar University Hospital, Jimma University Hospital) (5) revealed neonatal

health problems as one of the determinant factors for neonatal hypothermia. Underlying health problems in neonates exacerbate heat loss and lead to neonatal hypothermia.

Strengths and limitations of the study

The study covered all public hospitals in the zone and is therefore generalizable. The study did not incorporate qualitative methods to address cultural and behavioral factors that will affect neonatal hypothermia. In addition, the effect of seasonal variations was not included due to short data collection period.

Conclusion

The prevalence of neonatal hypothermia in West Wallaga Public Hospitals was high. Moreover, the study revealed that ANC visit, delayed breast feeding, presence of underlying obstetric complications, being <24 hours old, birth weight <2500 grams, and neonatal health problem were significantly associated with neonatal hypothermia. Strengthening ANC follow up, encouraging early breastfeeding, prevention and management of obstetric complications, focusing on young neonates, management of underweight neonates, and management of neonates with health problem (s) may alleviate the high proportion of neonatal hypothermia.

Recommendations

Based on the study findings, maternity health workers should strengthen health education on the importance of ANC, ensure routine temperature measurement of all newborns in the labor ward, prioritize thermal protection for newborns within the first 24 hours and those with underlying health problems, and promote appropriate ANC follow-up to improve birth preparedness and reduce neonatal complications. Hospitals should establish and routinely monitor thermal protection guidelines, ensure adequate postnatal care, and promote early initiation of breastfeeding within one hour of delivery through appropriate support and education. Future researchers should conduct longitudinal studies to assess seasonal variations in neonatal hypothermia and incorporate qualitative approaches to explore cultural and behavioral factors influencing its occurrence.

Abbreviations/acronyms

ANC – Antenatal Care

AOR – Adjusted Odds Ratio

APH – Antepartum Hemorrhage

CI – Confidence Interval

CPR – Cardiopulmonary Resuscitation

LMICs – Low and Middle-Income Countries

NICU – Neonatal Intensive Care Unit

PPH – Postpartum Hemorrhage

PROM – Premature Rupture of Membrane

SPSS – Statistical Package for Social Sciences

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Consent to publication

Not applicable

Author contribution

GB and ET worked on designing the study, training and supervising the data collectors, analyzing, interpreting the results, and preparing the manuscript. The authors, namely MM and AT, played their role in revising the analysis and manuscript. All authors were involved in reading and approving the final manuscript.

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Data availability

All relevant data are within this paper.

Ethical consideration

Ethical approval was obtained from Salale University Institutional Research Ethics Review Committee (S/U-IRERC-243/2016). This study was conducted in agreement with the Declaration of Helsinki, Ethical principles for medical research involving human subjects (<http://www.wma.net/en/30publications/10policies/b3/index.html>). Then permission was taken from each hospital to conduct this study. Written informed consent was obtained from study participants (mothers) after explaining the purpose and objective of the study, the benefits and risks (if any) associated with the study and their right when taking part in the study. Only after they provide informed written consent that they were recruited for the study. Inclusion of study participants was on voluntary basis. Information obtained from them were kept confidential and used only for research purposes.

Competing interests

The authors declare no competing interests.

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