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Research Article

A community-based cross-sectional study of neonatal hypothermia and its associated factors among neonates in Shebadino woreda, Sidama region, South Ethiopia

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Abstract

Introduction: Hypothermia is one of the major causes of newborn death, particularly in low-income nations. This was due to poor thermal care in most of the rural communities. The actual prevalence of neonatal hypothermia is unknown. Therefore, this study aimed to assess the prevalence and factors associated with neonatal hypothermia in the Shebadino woreda Sidama region, Ethiopia.

Method: A community-based cross-sectional study design was employed on 583 neonates in Shebadino Woreda, Sidama Region South Ethiopia 2022. A multistage sampling technique was employed. The data was collected door-to-door using pretested and structured questionnaires, through face-to-face interviews. The collected data were cleaned manually, coded, entered into EpiData version 4.6, and exported to SPSS version 26 software for analysis. Bi-variable analysis was conducted to assess the association of independent variables with the outcome variable. Variables with a p-value <0.25 in bi-variable logistic regression were further analyzed using multivariable logistic regression. The odds ratio (OR) with 95% CI was used as a measure of association, and variables that had a p-value less than 0.05 in the multivariable logistic regression were considered as significantly associated variables.

Result: The prevalence of neonatal hypothermia in Shebadino woreda is 56% (95% CI 51.6 to 59.9). Medical Problems during pregnancy (AOR = 3.48, 95% CI: 1.27, 9.55), placing a cold object near babies' head (AOR =3.26, 95% CI: 1.71, 11.24), night time delivery (AOR =2.05, CI: 1.10-3.82), not covered head with cap (AOR =2.71, 95%, 1.44-5.10) and room temperature <20°C 2.66(1.34-5.27) were significantly associated with neonatal hypothermia.

Conclusion: The prevalence of neonatal hypothermia in the study area was relatively high. Therefore, attention is needed for strict adherence to cost-effective thermal care such as warming the room, teaching not to put cold objects near babies, giving special care for newborns for those delivered from women with medical problems, skin-to-skin contact, counseling for birth preparedness for a neonate covering material and giving priority for those delivered at night.

Keywords: Community-based study, Hypothermic, Neonates, Non-hypothermic, Sidama, Ethiopia

Abbreviations: AOR: Adjusted Odd Ratio; CI: Confidence Interval; CBNC: Community-Based Neonatal Care; CFR: Case Fatality Rate; COR: Crude Odd Ratio; EDHS: Ethiopia Demographic Health Survey; EMDHS: Ethiopia Mini Demographic Health Survey; ENC: Essential Newborn Care; IRB: Institutional Review Board; KMC: Kangaroo Mother Care; MDG: Millennium Development Goals; WHO: World Health Organization

Background

The necessity of a warm environment for the care of low-birth-weight newborns was first recognized in the early 1900s [1]. In 1992, the World Health Organization (WHO) developed the guideline for the prevention and management of hypothermia. It is defined as a drop in a newborn's body temperature below 36.5°C (97.7°F) before the age of 28 days. It is mild if the axillary temperature is 36.0°C to <36.5°C, moderate if the temperature is 32.0°C to <36.0°C, and severe hypothermia if the temperature is <32.0°C. Because of their systemic immaturity, newborns are subjected to external interferences, as they adjust to life outside the womb [1]. As an infant's body temperature drops from 2°C to 3°C in the first half-hour of life, heat production does not exceed heat loss [1,2]. The heat can be lost through evaporation (due to the evaporation of amniotic fluid from the skin surface), conduction by coming into contact with cold objects-cloth, etc.), convection (by air currents in which cold air replaces warm air around baby-open windows), and radiation [2].

WHO set ten interlinked warm chain preventive mechanisms; warm delivery room, immediate drying, skin-to-skin contact, breastfeeding, postponing weighing and bathing, appropriate clothing and bedding, keeping mother and baby together, warm transportation, warm resuscitation, training, and awareness-raising [1]. This was set to decrease, and even prevent neonatal hypothermia across the world. On the contrary, the problem of hypothermia is still highly prevalent in developing nations, mostly in sub-Sahara Africa [3]. The risk factors for neonatal hypothermia in the region include poverty, home delivery, low birth weight, early bathing of babies, delayed initiation of breastfeeding, and inadequate knowledge among health workers [4].

Hypothermia plays a significant role in neonatal deaths, with global case fatality rates (CFR) ranging from 8.5% to 52% [5]. Mortality increased by approximately 80%, for every degree Celsius decrease in the first observed axillary temperature. The relative risk of death ranged from 2 to 30 times within the current WHO classification for moderate hypothermia, increasing with greater severity of hypothermia [6]. Around 20% of deaths are caused by prematurity, however, better thermal care could avoid 10% of mortality in term newborns [7]. Respiratory distress syndrome (RDS) and neonatal tachypnea were the two most prevalent comorbidities with 38 and 23 percent respectively [8]. Its presence in most morbidity cases is more evident, as it is related to peri-intraventricular hemorrhage grade 3 and death [8]. According to recent studies, the death rate increases by five times when the temperature of newborns drops by one degree Celsius, and every one-degree drop in body temperature raises mortality by 80 percent [3]. It is particularly common at home in low-income countries with weak health systems, where even health professionals have a poor understanding of hypothermia as a risk to the newborn [5]

In Sub-Saharan Africa, many births and deaths occur at home, which lacks vital records as a result, the actual incidence of newborn hypothermia in the region is unknown [10,11]. Due to this fact, the neonatal mortality caused by hypothermia may exceed the estimated based on complete data [6]. In countries like Ethiopia, where high neonatal mortality exists, the community-based design is essential as there is poor thermal care at-home delivery, then institutional delivery [12]. The recent research conducted in South Ethiopia found that the burden of neonatal hypothermia in the region is high in institutions and recommended for further study to be done, in a community setting [13]. Additionally, the home delivery rate is high [12], and there was cultural malpractice applied to newborns in Shebadino Woreda, South Ethiopia according to recent research [14]. This implies additional research should be done using a better design and methodological sound of community-based studies to understand the problem. These are the entry points for further study requirements. The purpose of this study is to determine the prevalence of neonatal hypothermia and the factors associated with it in the Shebadino woreda, Sidama region of southern Ethiopia.

Materials and Methods

Study settings and design

The study took place from Jun 7/2022 to July 21/2022 in Shebadino Woreda, which is located in the Sidama National Regional State, which is approximately 27 kilometers from Hawassa, the state seat, and 310 kilometers from Addis Ababa, Ethiopia's capital. It is located at an elevation of 1750-3000 meters above sea level. Shebadino woreda has an average annual rainfall of 1200 mm, with a maximum of 1600 mm and a minimum of 800 mm. The average annual temperature is 28.5°C, with a hot day in February and March, which is a maximum of 31°C, and Cold in July and August, which is 21°C and 22°C respectively according to the Regional and woreda metrology report. It has 14 percent highland, 86 percent midland, and nearly no lowland climate zones.

Shebedino woreda has a population of 241,388 people. There was one primary hospital with a Neonatal intensive care unit service, six health centers, and 23 health posts in the woreda. There were two gynecologists on staff, 2 integrated emergency surgery officers, 31 health officers, as well as 50 midwives (20 BSC and 30 Diploma), and 59 health extension workers. The institution-to-population ratio for a health center is 1:32060, whereas the population of a health post is 1:7398. According to the Shebadino District Health office population profile, there were around 6,960 neonates delivered in the woreda last year [16]. The common health problem of the woreda is pneumonia according to studies [12].

Population

The study population was neonates with their mothers in selected kebeles of Shebadino woreda, during the actual data collection period, whereas, neonate's mothers who stayed less than six months in the woreda were excluded from the study.

Sample size and sampling procedure

A separate sample size was calculated for each specific objective (to determine the prevalence of neonatal hypothermia and to identify the factors associated with neonatal hypothermia) using single and double population proportion formulas. The sample size for the first objective (to determine the prevalence of neonatal hypothermia) was calculated using the single population proportion formula. Then the greater sample size between the two results was accepted with the following assumptions: n= minimum sample size required for the study, (Z α/2)2= standard normal distribution with 95% CI, and d= a tolerable margin of error (d=0.05). p = prevalence of neonatal hypothermia; 51% from a previous study conducted in the Lira district in Northern Uganda [17]. The sample size for the second objective was calculated by double population proportion by Epi Info V.7 Stat Cal using different factors from different studies at the hospital (**Table 1).**

Table 1. Sample size determination by using significant factors for neonatal hypothermia and associated factors among neonates in Shebadino woreda.

Factors	Proportion among non-exposed	Ratio	AOR	CI	Sample size	References
Birth weight	58.9	1:1	3.43	1.18, 9.97	127	(18)
Baby breastfed within 1 hour	63.5	1:1	2.43	1.45,4.02	230	(13)
Skin-to-skin contact	78.8	1:1	2.8	1.3,	288	(19)

Note: Those were taken after different research variables were checked in the same way.

Sample sizes for the second objective were all less than that of the first objective. Knowing this, we had taken the first objective. Then 1.5 for design effects multiplied by, 384.006 x 1.5 =576. The final sample size was derived by adding a non-response rate of 5%, which takes the total sample size to 605.

Multi-stage sampling technique was used to select study subjects. There are 30 kebeles in the district, (Twenty-five kebeles from rural, and five kebeles from urban). A simple random sampling technique was employed to select 40% (12) of the total kebeles (the smallest administrative units in a given district in Ethiopia). In selected 12 kebeles, there were 1,284 neonates born in two and half months. The calculated sample size was allocated proportionally to the size of the populations in each selected kebeles. Then participants were selected by using a systematic random sampling technique in order of birth registration from health extension workers, that is, every two birth reports until the required sample size was obtained (K = 2.12, approximately every 2 neonate birth reports were taken). Households of the women who gave birth were identified and reached with the help of the health extension worker and the health development army of selected kebeles.

Operational definitions

Non-hypothermic: an axillary neonatal temperature measurement of ≥ 36.5°C at the time the data collector is arriving home [1].

Hypothermic: an axillary neonatal temperature measurement of <36.5°C at the time the data collector is arriving home.

Mild hypothermia (cold stress): an axillary temperature ranges from 36.0°C to 36.4°C.

Moderate hypothermia: an axillary temperature ranges from 32.0°C to 35.9°C.

Severe hypothermia: an axillary temperature of <32.0°C.

Optimal room temperature for baby; A room temperature at home where a neonate slept which is ≥ 20°C [20].

Data collection tools and procedures

Two MSc for supervision and six B.Sc. midwives participated in data collection and measurements conducted as soon as possible. All data collectors and supervisors are selected based on their previous experience. The data collector reached each household, with the help of health extension worker, and the health development army in each sub kebeles. For those mothers who gave birth at health institutions, data was taken after discharged to home. A structured, interviewer-administered questionnaire, adapted and modified from the study conducted in Addis Ababa and Arbminch General Hospital was used [13,21]. The interview questionnaire was prepared in English, then translated into the local language, Sidamo affo, and then translated back to English by a third person for language consistency.

Data collectors were trained on measuring neonatal temperature, the weight of the baby, room temperature, and calculating gestational age 6 and supervised by a team assigned as supervisors. The temperature was taken during the study visit by a digital thermometer at the site of the axilla until an automatic audible beep was heard. We used these because they are inexpensive, locally available, and easy to use by community workers. Additionally, we used axillary measurements because they were easier to do, safer, and socially more acceptable than rectal measurements [22].

The axillary temperature of the newborn was measured, as soon as arrival, by a digital thermometer (model- MT-101) that has a measurement accuracy of ± 0.1°C for the temperature range from 35.5°C–42.0°C, and ± 0.2°C for the temperature range of 32.0°C–35.5°C or above 42.0°C [21,23]. The room temperature was also measured by a Gera Mercury thermometer with a measurement range of (– 37°C to 356°C) and measurement accuracy of ±3 °C.

The mercury thermometer was placed at the center of the room as soon as home arrived, placed more than 2 feet above the ground, and waited at least 15 minutes for the temperature reading. The baby's temperature measurements were conducted before taking the baby's weight, and a trained data collector was done with emphasis placed on minimizing the time the babies may exposed to the cold. Two measurement readings in degrees Celsius were taken repeatedly at the same time to have good reliability, and the average of these two was taken. The weight was measured by using a weighing scale model of RGZ 20 which had a precision to the nearest 50 grams [24] whereas, gestational age was estimated from the woman's report of last menstrual period and early Ultrasound. A pulse oximeter was used to measure pulse rate and oxygen saturation.

Data quality assurance

The pretest of the data collection was carried out on 5% of the sample size in Arbegona Woredas, on 30 neonates, which have a similar setup to our study area. The purpose of this pretest was to check for the accuracy of responses, language clarity, and appropriateness of the data collection tool, as well as to estimate the time required. Intensive training was given to data collectors for two days on information about the research objective, eligible study subjects, data collection tools and procedures, and interview methods. All the collected data were checked for completeness by data collectors and supervisors every day as well as the principal investigator before data entry. Beyond this, the incomplete questionnaires that were missed

greater than 10% of the total response were excluded and counted as non-respondents. The thermometers and weighing balance were calibrated' (the measurement was crosschecked with the reference every week to avoid any false readings due to possible damages during data collection.

Data processing and analysis

Maintaining the confidentiality of the participants throughout the whole process of data collection was discussed during the training. The completeness and consistency of questionnaires were checked with close supervision of the whole process. The data was entered into EpiData version 4.6 and then exported to SPSS (Statistical Package for Social Sciences, version 26) for data analysis. Descriptive statistics like frequencies, proportion, and summary statistics (mean and standard deviation) were used to describe the study population related to relevant variables and presented in tables, and graphs.

Assumptions such as dichotomous, multi-co linearity issue, Chi-square test, and mutual exclusiveness were first checked, and then bi-variable analysis was carried out to identify candidate variables ($p < 0.25$) for multivariate analysis. Variables found to have a p-value <0.25 in the bi-variable analysis were further analyzed using multivariable logistic regression to control the confounder. The odds ratio (OR) with 95% CI was used as a measure of association, and variables that had a p-value less than 0.05 in the multivariable logistic regression were considered as significantly associated variables. Hosmer and Lemeshow test were used to test the goodness of fit. Data normality was checked by using a histogram and Q-Q plot test.

Result

Socio-demographic characteristics of respondents

A total of 583 mothers with neonates were included in this study with a 96.4% response rate. The majority of the participants, 400 (68.6%) were in the age group of 20-30 years with a mean of 26. 532 (91.3%) of participants were married, whereas 406 (69.7%) were Protestant religious followers. Regarding mothers' occupation, 344 (59%) were housewives. About 489 (83.8%) were from a rural area, whereas 347 (61.2%) respondents had a monthly income less than 2000 ETB (**Table 2**).

Table 2. Socio-demographic characteristics of neonates' mothers in Shebadino woreda, Sidama, Ethiopia 2022 (n =583).

Variables		Frequency	Percent
Mother's Age	<20	120	20.6
	20-30	400	68.6
	>30	63	10.8
Marital Status	Married	532	91.3
	Divorced	22	3.7
	Single	29	5
Religion	Protestant	406	69.7
	Orthodox	118	20.2
	Muslim	59	10.1
Occupation	Housewife	344	59
	Governmental employee	41	7
	Private business	62	10.6
	Farmer	95	16.3
	Other (Student)	41	7.1
Husband's Occupation (n=532)	Farmer	256	48.1
	Private business	181	34.1
	Governmental employee	80	15
	Other	15	2.8
Educational status	Unable to read & write	111	19
	Read & write	141	24.2
	Elementary school	147	25.2
	High school/preparatory	138	23.7
	Above grade12	46	7.9

Husband's educational status (n=532)	Unable to read & write	152	28.6
	Read & Write	80	15
	Elementary school	108	20.3
	Highschool/preparatory	110	20.7
	Above grade12	82	15.4
Mother has her income	Yes	151	25.9
	No	432	74.1
Family monthly income in ETB (n=560)	<2000	347	62
	2000-4000	83	14.8
	>4000	130	23.2
Residence	Urban area	94	16.2
	Rural area	489	83.8
Distance to the Health facility	<10km	433	74.3
	>10km	150	25.7

Obstetric characteristics of the mothers

Four hundred eighty-one (82.5%) of the mothers had visited health facilities for antenatal care (ANC) during the recent pregnancy at least one time. Fifty-one (10.4%) of the mothers reported that they had obstetric problems during their most recent pregnancy, with hypertension being the most reported problem (41.2%). The majority, 397 (68.1%), of the mothers were delivered at a health facility whereas, 564 (96.4) of the mothers' labor was initiated spontaneously. Two hundred five (73%) were delivered at ≥ 37 completed weeks. About 96.4% of the neonates were delivered single (**Table 3**).

Behavioral and neonatal factors

Three hundred eight (52.8%) of the neonates were females. A majority, 534 (91.6%) of the neonates had birth weight ≥ 2500 g. The mean and median of the baby's weight were 3,376 g (SD ± 473.4 g) and 3,400 g respectively. Of the total participants, 301 (51.6%) of the neonates were greater than 7 days of age with a mean age of 9.01. One hundred sixteen (19.9%) of the neonates manifested different symptoms like a decrease in neonatal movement and red umbilicus which accounted for 11.5% and 7.9%, respectively. One hundred sixty (44.6%%) of the neonates were given the traditional medication "Amessa".

Table 3. Obstetric characteristics of the neonates' mothers in Shebadino woreda, Sidama region, Ethiopia 2022 (n=583).

Variable	Category	Frequency	Percent
ANC follow-up during the last pregnancy	Yes	481	82.5
	No	102	17.5
Number of ANC visits (n =481)	<4	351	73
	≥ 4	130	27
Obstetric problem during the last pregnancy/ labor(n=488)	Yes	51	10.4
	No	437	90.3
Type of the obstetrical problem(n=51)	Bleeding	11	21.6
	Hypertension	21	41.2
	PROM	16	31.4
	DM	3	5.9
Onset of labor	Spontaneous	517	88.7
	Induced	53	9.1
	Cesarean section	13	2.2
Place of birth	Health Facility	397	68.1
	Home	186	31.9

Birth attendant	Family	87	14.9
	Health professional	397	68.1
	Traditional birth attendant	95	16.2
	No one (By self)	4	0.7
Parity	1-3	509	87.3
	4-6	62	10.6
	>6	12	2.1
Labor duration (n=573)	<12	253	44.2
	12-24	316	55.1
	>24	4	0.7
Type of delivery	Cesarean birth	13	2.2
	Spontaneous Vaginal birth	564	96.8
	Instrumental	6	1
Gestational age in weeks (n=281)	<37 weeks	76	27
	≥ 37 weeks	205	73
Number of the child delivered	Single	562	96.4
	Twin	21	3.6

The majority, 411 (71.6%) had practiced skin to skin contact immediately after delivery (**Table 4**).

Environmental factors

The majority, 317 (54.4%) of the total neonates are delivered at night. About 252 (43.2%) of the neonates' families placed cold objects or metal nearby the bed of the baby whereas, 394 (67.6%) of the neonates' mothers are non-hypothermic. The majority of the neonates, 350 (60 %) slept in a room temperature ≥ 20 degrees Celsius (**Table 5**).

Prevalence of neonatal hypothermia

The prevalence of neonatal hypothermia in this study is 324 (55.6%) (95% CI: 51.6%-59.9%) (**Figure 1**). The mean axillary temperature was 36.14°C (SD ±1.04). The minimum temperature recorded in this study is 32.5°C whereas the maximum axillary temperature recorded is 38.3°C).

Overall, 142 /583 (24.4%: 95% CI 20.9 to 29.4) have mild hypothermia (temperature 36.0°C to <36.5°C), whereas 181/583 (31% 95% CI 27.7 to 34.4) have moderate hypothermia (temperature 32.0°C to <36.0°C). No neonate was recorded as severe hypothermia (temperature less than 32.0°C) (**Figure 1**).

Factors associated with neonatal hypothermia

Factors that were found to be significantly associated with neonatal hypothermia in the bivariable analysis were; the mother's body temperature, no skin-to skin contact after delivery, cold object (metal) near the baby bed, delivery during night time, bathing within the first 24 hr, those who were given Amessa (Traditional medicine), previous difficult breathing history, neonates who were in the house where humans and animals house was not separated, room temperature less than 20 degree Celsius, uncovered head with Cap, neonates who have faced difficult breathing after delivery, not warmed room before and after delivery, and neonates who have not initiated breastfeeding within an hour.

Table 4. Behavioral and neonatal factors among neonates in Shebadino woreda, Sidama, South Ethiopia 2022 (n=605).

Variables		Frequency	Percent
Baby bathed within 24 hours Water	Yes	219	36.5
	No	386	63.8
Water used to bath the baby (n=219)	Warm water	51	23.4
	Cold water	167	76.6
Baby breastfed within one hour	Yes	560	92.6
	No	45	7.4

where the baby is placed after delivery (Skin to skin contact)	On mother's abdomen	380	62.8
	Covered with Cloth	182	30.1
	I Don't Know	43	7.1
Head covered with a cap	Yes	377	62.3
	No	228	37.7
Baby wrapped with dry clothing after bathing (n=222)	Yes	186	83.6
	No	36	16.2
Baby kept apart from mother (n=462)	Yes	54	11.7
	No	408	88.3
Baby needed resuscitation to breathe	Yes	67	15.9
	No	354	84.1
Any traditional practice done	Yes	274	45.3
	No	331	54.7
Baby took food by mouth	Yes	269	44.5
	No	336	55.5
Food is taken by mouth (n=269)	Water	14	5.2
	Amessa	235	87.4
	Milk	20	7.4
Age of the neonate during admission	<7 day	295	48.8
	≥ 7 day	310	51.2
Additional symptom	Yes	122	20.2
	No	483	79.8
Clinical manifestation raised	Apnea	55	46.2
	Fast breathing	45	37.8
	Abdominal distension	46	39.7
	Not moving well	70	60.3
	Fever	18	15.5
	Vomiting	54	44.3
Oxygen Saturation	<95	186	40.2
	≥ 95	362	59.8
Pulse rate	<120	93	15.4
	120-160	474	93.7
	>160	38	6.3
Sex of the neonate	Male	288	47.6
	Female	317	52.6
Birth weight	≥ 2500 gm	556	91.9
	≤ 2500 gm	49	8.1

Table 5. Environmental conditions assessed during the time of data collection from neonates in Shebadino woreda, Sidama region, South Ethiopia (n= 605).

Variable		Frequency	Percent
Time of delivery	Day	277	45.8
	Night	328	54.2
The room was warmed, before and after the delivery	Yes	230	38
	No	375	62
Cold objects or metal near the bed of the baby	Yes	272	45
	No	333	55
The room has a window	Yes	304	50.2
	No	301	49.8
Human and animal houses separated	Yes	218	43.8
	No	280	56.2
Room temperature	<20	232	38.3
	≥ 20	373	61.7
Mother-body Temperature	<36.5	185	30.6
	≥ 36.5	420	69.4
How baby traveled home from Health facility	Carried by family	138	33.2
	Public Transport	278	66.8

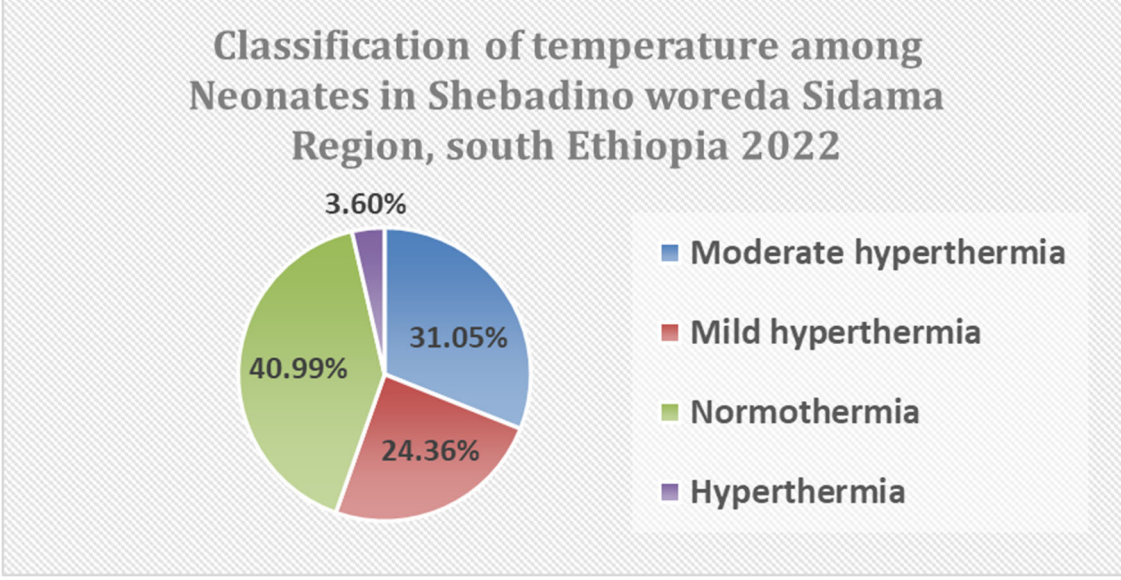

Figure 1. Prevalence of neonatal hypothermia among neonates in Shebedino woreda, Sidama region, South Ethiopia.

In the multivariable logistic regression, placing a cold metal near a baby's head, night time delivery, room temperature <20 degrees Celsius, mother obstetric complications, no skin to skin contact, and uncovered baby head with a cap were significant at a p-value of <0.05 (**Table 6**).

Discussion

The prevalence of hypothermia in this study was 324 (55.6%: 95% CI 51.6 to 59.9). Among them, 31.2% developed mild hypothermia whereas 24.8% developed moderate hypothermia. This

Table 6. Bi-variable and multivariable logistic regression model with cross tabulation for factors associated with neonatal hypothermia among neonates in Shebadino woreda, Sidama Region, South Ethiopia 2022 (n=583).

Variable		Hypothermic (324)	Non-Hypothermic (259)	COR (95% CI)	AOR (95% CI)
Placement of Baby immediately after delivery	Covered with cloth	146 (81.5%)	33 (18.5%)	5.6 (3.67-8.59) *	**4.1 (1.49-11.25) *** **
	On mother's abdomen	178 (48.8%)	226 (55.9%)	1	1
Cold object near babies' bed	Yes	192 (71.2%)	60 (23.8%)	4.82 (3.35-6.94) *	**3.26(1.71-6.22) *** **
	No	132 (39.9%)	199 (60.1%)	1	1
Time of Delivery	Day	148 (46.5%)	169 (53.5%)	1	1
	Night	176 (66.2%)	90 (33.8%)	3.03 (1.04-7.01) *	**2.23(1.59-3.12) ** **
Room temperature	<20°C	189 (81.1%)	44 (18.9%)	6.84 (4.6-10.12) *	**2.66(1.34-5.27) *** **
	≥ 20°C	135 (38.6%)	215 (61.5%)	1	1
Baby bathed with 24hr	Yes	154 (75.9%)	49 (19.3%)	3.882 (2.65-5.67) *	1.28(0.49-3.36)
	No	170 (44.7)	210 (55.3%)	1	1
Head covered with a cap	Yes	163 (44.7%)	201 (55.2%)	1	
	No	161 (73.5%)	58 (26.5%)	3.45 (2.44-4.87) *	**2.71(1.44-5.10) *** **
Separated Human & Animals House	Yes	150 (75.4%)	49 (24.6%)	3.54 (2.38-5.26) *	1.59(0.79-3.22)
	No	134 (46.4%)	155 (53.6%)	1	1
Babies with other S/S	Yes	82 (70.7%)	34 (29.3%)	2.24 (1.44-3.47) *	1.61(0.52-4.93)
	No	242 (51.8%)	225 (48%)	1	1
Started taking Amessa	Yes	172 (66.2%)	88 (33.8%)	2.2 (1.56-3.1) *	2.10(0.40-11.1)
	No	152 (47%)	171 (53%)	1	1
Hx. of Px. Problem	Yes	87 (39.1%)	135 (60.8%)	3.04 (1.55-5.97) *	**3.48(1.27-9.55) ** **
	No	237 (65.6%)	124 (34.3%)	1	1
difficult breathing	Yes	34 (70.8%)	14 (29%)	3.36 (1.74-6.49) *	0.51(0.14-1.84)
	No	150 (41.8%)	208 (58.1%)	1	1
The baby started food PO	No	162 (85.7%)	27 (14.3)	1	0.51(0.14-2.79)
	Yes	162 (41.1%)	232 (58.9%)	2.25 (1.6-3.15) *	1
NICU admission Hx	Yes	40 (75.5%)	13 (24.5%)	3.51 (1.82-6.76) *	1.6(0.51-4.96)
	No	184 (46.7%)	210 (57.7%)	1	1
Started BF within 1 hour		33 (76.7%)	10 (23.3%)	8.7 (3.07-24) *	2.86(0.76-10.72)
	No	285 (52.8%)	255 (47.2%)	1	1

Key: P*Candidate for multivariable at p<0.25, P** Significant at P<0.05; P*** Significant at P<0.01; Hx: History; Px: Pregnancy; S/S: Sign and Symptom; PO: Per Os/oral

study finding is in line with the studies conducted in Southern Nepal with a prevalence of 59% [22], The Islamic Republic of Iran at 53% [25], and Northern Uganda at 51% [17]. This similarity may be due to the research study setting at community levels after neonates were discharged home.

However, the prevalence of neonatal hypothermia observed in our study was higher than in another community-based study conducted in India 45% [6]. This variation might be due to seasonal conditions, data collection tools, differences in temperature measurement sites, and economic and cultural differences in those communities. Additionally, our study finding is higher than another study conducted among home-delivered neonates in North India which found the prevalence of newborn hypothermia was 11% [26]. This is due to Hypothermia definition variation as Kumar et al defined neonatal hypothermia as a temperature less than 35.6°C whereas we defined it based on WHO definition recommendation [1].

This study's finding is lower than other studies conducted at the hospital with 77% on admission to the neonatal intensive care unit in a tertiary hospital in Malawi (88, 69.8% in Gonder Teaching and Referral Hospital [27], and 64% in Addis Ababa Hospital [21]). The possible justification for this difference is that neonates who were admitted to NICU were for different indications, which could decrease their ability to adapt to the external environment outside of the womb and easily develop hypothermia. On the other hand, unlike those studies, late neonates were included in our study in which neonates can resist heat loss as their age increases and easily defend against hypothermia [21,28].

Neonates who were not put in mothers' abdomen within one hour after delivery were 4.1 times more likely to develop hypothermia compared to those who were put in the mother's abdomens (AOR = 4.1, 95% CI: 1.49-11.24). The possible reason for this could be in utero, the body temperature of the fetus is similar to maternal temperature. Because of this, newborns who had skin-to-skin contact with their mothers just after delivery could readily warm up by conduction, which is comparable to how they warmed up in the womb when the baby was exposed to an extrauterine environment. Again, this may be due to the maternal chest and abdominal movement enabling the breathing of newborns which improves heat generation through oxidative phosphorylation [1]. This finding is in line with the study conducted in Rural Zambia [5], and Gonder [27]. The possible justification for this similarity may be due to rural societies' perception that blood, mucus, and amniotic fluid were found to be dirty, polluting, and contaminating which made them deny skin-to-skin contact and end up with hypothermia [29].

Moreover, this study revealed that a newborn whose Head was not covered with a cap after birth was 2.71 times more likely to develop hypothermia compared to those whose head was covered with a cap (AOR = 2.71, 95% CI: 1.44- 5.1). This may be because a baby's large head with open fontanels and sutures contributes about 25% of neonatal heat loss if not covered with a cap [1]. Our study is comparable with the study conducted in Rural Southern Nepal [6] and the Hospital of Eastern Ethiopia [30]. The possible justification for this similarity may be due to failure in birth preparedness and financial problems in buying the necessary material for the neonate in most rural people.

Neonates who were delivered at night were 2 times more likely to develop hypothermia than those delivered during the daytime (AOR =2.05, 95%CI: 1.10-3.82). This may be because of the temperature difference at night and daytime. There is no added warmth during cold nights, and the newborn infant is at risk of becoming hypothermic as they probably lose heat rather than gain it after delivery [1,21]. It may also be due to the work overload during nighttime as the number of staff working in the labor ward during nighttime is not equal to the daytime staff for those who were delivered at the health institution. This finding is in line with another study conducted in Public Hospitals in Addis Ababa [21], Dessie Referral Hospital [30], Western Ethiopia [18], and Northwest Ethiopia. The possible justification for this similarity may be due to the majority, 54.4% of newborns were delivered at night in our study, which is almost the same as the above study. For example, in the Dessie referral hospital 58.4% [30] and in Northwest Ethiopia 60.1% were delivered at night [27].

Neonates who were in a room with a temperature less than 20°C were 2.7 times more likely to develop hypothermia related to their counterparts 2.66 (AOR =2.66, 95%CI: 1.34-5.27). This may be because of less insulation, an infant's thermal control is more limited than that of an adult who can maintain body heat even at temperatures as low as 0°C (32°F) while for the full-term infant, it is between 20°C to 23°C (68-73.4°F) [20]. This finding may be due to seasonality as the cold environment has a higher probability of developing neonatal hypothermia than the hot environment [13]. It may result due to heat loss in the cold environment by radiation from the infant to a cooler environment [1]. This finding is also supported by a study conducted in Sothern Nepal [22] and a study conducted on home-delivered neonates in North India [26]. This similar finding may be due to the same study settings (Community-based studies).

Neonates who were delivered to mothers with obstetric complications were 3.48 times more likely to develop hypothermia as compared to those born to mothers without any obstetric complication (AOR=3.48, 95% CI: 1.27, 9.55). This could be due to newborns that were from mothers with obstetric complications usually facing health problems such as respiratory distress, perinatal asphyxia, and hypoglycemia which may increase the exposure [31]. Additionally, newborns of mothers with obstetric complication often end up with preterm and/or low birth weight which again result in hypothermia [32]. Our finding is almost consistent with the Study conducted in Eastern parts of Ethiopia [23] and Arbaminch General [17]. This similarity may be due to the socioeconomic status of society across the country, which leads to obstetric complications and may result in neonatal hypothermia.

Neonates who slept near cold objects developed hypothermia 3.26 times more likely related to their counterparts (AOR=3.26, 95% CI: 1.71, 6.2). This object was placed at the head of the bed near the baby's head. This metal placement may be due to people's Spiritual beliefs and lack of awareness of environmental thermal care in rural communities. On the Contrary, the neonate lost heat through conduction (neonate body contact with cold objects) and radiation (Loss of heat to the cold metal surface even if not in contact). By this mechanism, the neonate may lose internal heat, which results in hypothermia [1,20]. As no other study was done on it previously, it was difficult to compare our results with the others for discussion.

Limitations and Strengths of the Study

Strength of the study

With our maximum search engine, this is the first purely community-based assessment of neonatal hypothermia in Ethiopia and the Second in sub-Saharan Africa after a study conducted in Northern Uganda in 2021 [17]. Additionally, the obtained finding is generalizable to all neonates in the woreda including home births.

Limitations of the study

Digital thermometers might slightly over, or underestimate temperature readings as compared with mercury thermometers. We have used it as it is easily available and good for field study unlike the mercury thermometer [33]. The measurement of temperature was only based on the measurement record at the same time. The instrument used by the person who took the measurement, the site, and the time of measurement taken might not be similar for all neonates, which may bias the result. Our study was done in one season, and considerations such as seasonal variations were not taken into account. On the other hand, hospital-related characteristics such as the qualifications of healthcare personnel working in delivery rooms and NICUs were not taken into consideration as they may have been related to our dependent variable. The other limitation of our finding was recalling bias. To decrease this possibility, proper definition and articulation of the research questions, and administering the interview properly and consistently were done. The outcome of the neonate was unknown including those referred to health institutions.

Conclusion and Recommendations

Conclusion

The prevalence of neonatal hypothermia in the study area was highly relative to other community-based studies. No skin-to-skin contact, placing a cold object (Metal) near a neonate's bed, not covering a head with cap, maternal obstetric problems during pregnancy, sleeping at room temperature <20°C and nighttime delivery were the factors that had a significant association with neonatal hypothermia.

Recommendations

Based on our study findings, the following public health measures were recommended

For woreda health sector management

It is better to give periodic training for HEW on cost-effective thermal care. This is to end up with good awareness, knowledge, and skills of HEWs to endeavor prevention mechanisms such as room warming, neonatal wrapping (head covering), continuous skin-skin contact, and separating a cold object from a neonate's bed.

For the public health institutions

Proper counseling should be required before discharge to home for those born to mothers with obstetric complications, good thermal care on the way to home as well as at home for those delivered at the health institution. Priority should be given to nighttime delivery room manpower. Additionally, counseling for cost-effective thermal care such as a warm environment where neonates can sleep, and endeavoring pregnant women for hospital delivery for proper thermal care at health institutions is recommended. Counseling on birth preparedness during ANC for neonates covering material should also be mandatory.

NGOs working in this area

NGOs working in this area such as the Saving Little Lives project should alert and run for solutions to prevent hypothermia in the woreda based on our findings and address the gaps.

Future researchers

Researchers should focus on Qualitative and Prospective cohort study designs in different seasons to address some factors like seasonal variation.

What is known about this topic

- Neonatal hypothermia results in a high burden of health services particularly in low-income nations like Sub-Saharan Africa including Ethiopia.
- Neonatal mortality increased by approximately 80%, for every degree Celsius decrease in the first observed axillary temperature.
- The home delivery rate and cultural malpractice applied to newborns in Shebadino woreda are high.

What this study adds

- The prevalence of Neonatal Hypothermia at the community level was determined.
- New variables such as Amessa usage, not separated Human & Animals House, and putting cold object near babies' bed was determined.
- Depending on the new variable identified, recommendation was made for prevention and further study.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the institutional review board (IRB) of Hawassa University College of Medicine and Health Sciences with a reference number of IRB/193/14; Date:21/06/2022. After the letter of permission was obtained, the letter was taken to the head of the Shebadino woreda health office, and consent was obtained from the woreda health officer and then from the head of each health post catchment. At the time of data collection respondents were informed about the purpose of the study and informed written consent was obtained from the study participants. The data for this study was collected following the declaration of Helsinki. We confirm that all methods were performed per the relevant guidelines and regulations by including a statement in the "ethics approval and consent to participate" section under 'Declarations' to this effect.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used/or analyzed during the current study are not publicly available. Because we did not have consent from all participants to publish raw data but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Mr. Gizu Tola Feyisa developed the draft proposal and performed the statistical analysis which resulted in a write-up under the supervision of Dr. Andargachew Kassa, Mr. Belay Amare, Mr. Shambel Negese, Mr. Shimelis Tadese, Mr. Melkamu Getu Wondimu, Miss Beshatu Berkessa, and Mr. Derebe Chekol participated in manuscript preparation. All authors made a significant contribution to the conception and conceptualization of the study. All authors read and approved the final manuscript.

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