

Hypothermia on admission to a neonatal intensive care unit in Oromia, western Ethiopia: a case-control study

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ABSTRACT

Objective Hypothermia is believed to affect more than half of Ethiopian neonates. The goal of this study is to determine risk factors for newborn hypothermia in neonates admitted to public hospitals in the east Wollega zone of western Ethiopia's neonatal intensive care unit.

Design Unmatched case-control study using neonates admitted to the intensive care unit.

Setting Neonatal intensive care units at public hospitals in western Ethiopia.

Patients Neonates admitted to intensive care units.

Main outcomes The cases were all neonates with hypothermia (less than 36.5°C) and the controls were all neonates with a body temperature of greater or equal to 36.5°C when admitted to the neonatal intensive care unit for other reasons.

Results The study involved the participation of 73 cases and 146 controls. The study found that delayed breastfeeding initiation after 1 hour (adjusted OR (AOR)=3.72; 95% CI: 1.39 to 10.00), admission weight less than 2500 g (AOR=3.43; 95% CI: 1.18 to 9.97), cardiopulmonary resuscitation at birth (AOR=3.42; 95% CI: 1.16 to 10.10.08), lack of immediate skin-to-skin contact with their mother (AOR=4.54; 95% CI: 1.75 to 11.81), night-time delivery (AOR=6.63; 95% CI: 2.23 to 19.77) and not wearing a cap (AOR=2.98; 95% CI: 1.09 to 8.15) were all associated with newborn hypothermia.

Conclusions Neonatal hypothermia was associated with obstetric, neonatal and healthcare provider factors. As a result, special consideration should be given to the thermal care of low birthweight neonates and the implementation of warm-chain principles with low-cost thermal protection in Ethiopian public health facilities.

INTRODUCTION

Neonatal hypothermia is the decrease of an axillary body temperature of the newborn below 36.5°C (97.7°F). It is classified as mild (cold stress) with body temperature between 36.0°C and 36.4°C (96.8°F–97.5°F), moderate between 32.0°C and 35.9°C (89.6°F–96.6°F) and below 32°C (<89.6°F) as severe hypothermia.¹

Hypothermia occurs when the body's physiological systems, such as vasoconstriction, shivering, muscle contraction and non-shivering thermogenesis, are no longer able

What is known about the subject?

- ⇒ Within the first 10–20 min of birth, neonates can lose up to 2°C of their body temperature if sufficient thermal care is not provided.
- ⇒ In resource-constrained countries, hypothermia increases newborn mortality by five times during the first 7 days of life.
- ⇒ Neonatal mortality in Ethiopia was disproportionately high, ranging from 22.1 to 62.5 per 1000 live births.

What this study adds?

- ⇒ Neonatal hypothermia is associated with lack of skin-to-skin contact soon after birth or a delay in starting breast feeding.
- ⇒ Low birth weight, not wearing a cap, cardiopulmonary resuscitation, getting delivered at night and being preterm were all associated with newborn hypothermia in the study.

to maintain a normal core temperature. Because of their higher surface area per unit body weight, large head in comparison with body and lack of subcutaneous fat (low birth weight), newborns are more likely to suffer hypothermia.^{1 2}

If adequate heat care is not provided soon after birth, newborns can lose heat by conduction, convection, evaporation and radiation, resulting in a drop in body temperature of up to 2°C within the first 10–20 min.³ Neonates' deep body and skin temperatures can also drop at a pace of 0.1°C and 0.3°C per minute, respectively.^{4 5}

Neonatal mortality is more common in resource-constrained nations, where hypothermia is the leading cause of death.^{6 7} According to a research, every 1°C drop in body temperature increases mortality by 80%.⁸ Hypothermia has been identified as a substantial contributor to the worldwide

burden of newborn fatalities in sub-Saharan African nations, according to the literature.^{9–18}

Between 1990 and 2015, the under-5 mortality rate in African countries fell considerably.^{8, 19} The rate of newborn mortality in Ethiopia has decreased from 37 to 29 fatalities per 1000 live births, according to the Ethiopian Demographic Health Survey (EDHS) 2016 report. This rate varies by area, with Addis Ababa having the lowest rate at 18 fatalities per 1000 live births and Amhara having the highest rate at 47 deaths per 1000 live births.²⁰ However, according to the mini-EDHS 2019, the newborn mortality rate increased marginally from 29 to 30 fatalities per 1000 live births from 2016 to 2019.²¹

Several factors have been linked to the occurrence of hypothermia in newborns, according to research. These factors were correlated to maternal and neonatal features, as well as environmental and healthcare system characteristics.^{7, 11} The results of previous Ethiopian studies on this topic have been equivocal.^{22–27}

Despite the fact that predisposing factors for hypothermia are easily preventable, and several activities and intervention techniques have been devised to reduce the risk of hypothermia, the problem remains unsolved, and it is extremely common in Ethiopia (53%).^{11, 28} As a result, the goal of this study was to determine the risk factors for newborn hypothermia in neonates born in hospitals in the east Wollega zone of western Ethiopia.

PATIENTS AND METHODS

Study area and subjects

The research was conducted at public hospitals in east Wollega zone, Oromia Region, western Ethiopia, which has a population of 1 598 809 people, 795 618 men and 803 191 women, and covers an area of 12 579.77 km².²⁹ Nekemte Specialized Hospital, Wollega University Referral Hospital, Arjo Hospital, Gida Ayana and Sire Hospital are the five public hospitals in the province. The neonatal intensive care unit (NICU) is one of the units in these hospitals where all neonates under the age of 28 days were admitted. It includes newborns referred from the labour ward and other surrounding health facilities.

A hospital-based unmatched case–control study design was conducted from 30 February to 30 April 2020. All neonates and their mothers/caregivers admitted to public hospitals in the east Wollega zone of western Ethiopia served as the study's source population.

Cases were neonates with an axillary body temperature of less than 36.5°C at admission to the NICU during the study period at public hospitals in the east Wollega zone.¹

Controls were neonates admitted to the NICU during the study period who did not have hypothermia or an axillary body temperature of greater or equal to 36.5°C.¹

All neonates admitted to NICUs in public hospitals in east Wollega zone within 28 days of delivery, regardless of where they were born, were included in the study, while newborns with serious congenital malformations were omitted.

Sample size and sampling procedures

Using Epi Info V.7.1.3.10 software, the sample size for an unmatched case–control study was estimated using assumptions of a double population proportion formula. Low birth weight 2500 g, preterm (37 weeks), APGAR score at 5 min and commencement of breast feeding within 1 hour were deemed decisive variables to attain the maximal sample size in earlier studies.²⁵ Finally, the primary exposure variable was the proportion of controls who started breast feeding within 1 hour. As a result, the final sample size was 219 neonates and their mothers/caregivers (73 cases and 146 controls), which was the largest sample size estimated.

The study subjects were chosen using a consecutive selection procedure from five public hospitals during the course of the study period until the predetermined sample size was reached. Cases and controls were chosen from the same health facility on consecutive days. Based on cases received from the NICU registration book in the previous 2 months of the study, the sample was proportionally allocated to each study site. During the study period, we did not encounter a mother with two or more babies for this particular study.

Data collection tools and data collectors

The data collection questionnaire was written in English and subsequently translated into Afaan Oromo, the regional working language. Using structured questionnaires presented by an interviewer, data were obtained from mothers, newborns and charts of neonates admitted to the NICU (online supplemental appendix). Two Bachelor of Science nurses and three midwives who have previous experience of data collection and can fluently speak Afaan Oromo were recruited from maternal and child health department to collect the data. Three supervisors were on hand during the data collection period to provide continuous follow-up and supervision. To distinguish cases from controls, a digital thermometer was used, which measured the surface temperature at the axilla location in accordance with WHO recommendations.

Prior to data collection, a pretest was performed on 5% of neonates admitted to the NICU at Shambu Hospital. The tool's reliability was tested, yielding a Cronbach's alpha of 0.73. Data collectors and supervisors received 2 days of training on how to collect data. The measurement was then double-checked with reference thermometers every day to avoid any misleading readings caused by thermometer deterioration. Following data collection, supervisors and the principal investigator reviewed and checked the questionnaires for completeness on a regular basis. To limit the possibility of data-entering errors, EpiData V.3.1 was employed. Each and every questionnaire was cross-checked with the entered data and all observed errors were corrected.

Variables

Dependent variable: neonatal hypothermia.

Independent variables: maternal sociodemographic/economic determinants, neonatal-related determinants, neonatal caring practices, obstetric determinants.

Statistical analysis and processing

Data were entered into EpiData V.3.1, cleaned and double-checked for completeness and consistency, and exported to SPSS Windows V.25.0 for analysis. A bivariable analysis was performed to identify candidate variables associated with neonatal hypothermia, and variables with *p* values less than 0.25 were transferred for multivariable logistic regression to determine hypothermia risk factors (online supplemental tables 1 and 2). The model's goodness of fit was evaluated using the Hosmer-Lemeshow test, which yielded a *p* value of ≥ 0.05 . Variance inflation factors were used to test the variables' multicollinearity. The analysis was adjusted for mother's age. Crude and adjusted ORs with a 95% CI and a *p* value of < 0.05 were considered statistically significant.

Patient and public involvement

Neither patients nor the public were involved in the design, analysis and interpretation of this study and will not be involved in the dissemination of the results.

RESULTS

Sociodemographic/economic characteristics of mothers

In this study, 73 neonates who had hypothermia with their mothers (cases) and 146 neonates who did not have hypothermia with their mothers (controls) were included. The mean age of the mothers in cases was 24.88 years (SD 4.39), and the age of the mothers in controls was 25.62 years (SD 4.69). Thirty-six (49.3%) of case mothers and 76 (52.1%) of control mothers lived in rural areas (table 1).

Factors associated with neonatal hypothermia

According to this study, the odd of hypothermia was 3.43 times higher in those weighing less than 2500 g compared with those weighing more than 2500 g (adjusted OR (AOR)=3.43; 95% CI: 1.18 to 9.97). Birth resuscitation was also a significant risk factor for neonatal hypothermia. The odds of hypothermia were 3.42 times higher among those who were resuscitated at birth (cardiopulmonary resuscitation (CPR)) compared with those who did not (AOR=3.42; 95% CI: 1.16 to 10.08).

Furthermore, the odd of hypothermia was 3.72 times (AOR=3.72; 95% CI: 1.39 to 10.00) higher among neonates who were initiated breast feeding compared with those who were initiated before 1 hour after birth. Similarly, the odd of hypothermia was more than three times higher in those who do not wear cap than controls (AOR=2.98; 95% CI: 1.09 to 8.15).

Lack of skin-to-skin contact with mothers after delivery was another significant determinant of neonatal hypothermia. Those who do not have skin-to-skin contact with their mother after birth were 4.54 times higher to

develop hypothermia compared with their counterparts (AOR=4.54; 95% CI: 1.75 to 11.81). Also, the odd of developing hypothermia was about seven times higher in those who were born during the night compared with those who were born during the day (AOR=6.63; 95% CI: 2.23 to 19.77) (table 2).

DISCUSSION

One of the risk factors for newborn hypothermia, according to this study, was delayed commencement of breast feeding. This finding is supported by research from Tigray, north Ethiopia, Zambia and southern Nepal.^{25 30 31} The association could be related to the fact that early breast feeding allows babies to have more skin-to-skin contact with their mothers, prevents the newborn from being exposed to the environment and increases mothers' follow-up care for their babies, all of which help to prevent hypothermia.³² Another reason could be that breastfed newborns obtain enough calories from their mother's milk, which produces heat for thermoregulation, so the more they are breast fed, the more glucose they get to meet their energy needs.³³ Lack of skin-to-skin contact with their mother shortly after birth was another significant risk factor for newborn hypothermia in this study, which supports this finding. The findings are also supported by the literature.^{22 31 34} This is because newborns who do not have skin-to-skin contact with their mothers lose more heat through conduction, even when their mother's external body temperature is nearly identical to their womb temperature.³⁵ Furthermore, skin-to-skin contact is more successful than incubator care for rewarming the infant because the maternal chest and abdomen movement promotes the newborn to breathe more deeply, which improves heat generation via oxidative phosphorylation.¹

This finding, however, contradicted other Ethiopian findings.²³ This variance could be related to differences in delivery location, study context and study methodology. According to the study, all mothers delivered at health facilities, although 9.1% of the mothers delivered at home in this study.

Low birth weight at admission was found to be a risk factor for newborn hypothermia in this study. This finding is consistent with research done in Ethiopia's Arba Minch, South Nations and Nationalities, and Gondar, Amhara area.^{24 26} This conclusion was also corroborated by research undertaken in Iran and Pakistan.^{36 37} This could be due to a variety of factors, including radiant heat loss (when bare skin is exposed to a cooler environment), evaporative heat loss (when neonates are wet with amniotic fluid shortly after birth), conductive heat loss (when neonates are placed in contact with a cool surface or object) and convective heat loss (when a flow of cooler ambient air carries heat away from the neonate).²

The timing of delivery was also revealed to be a risk factor for newborn hypothermia in this study. Those whose mothers gave birth at night had a greater chance

Table 1 Sociodemographic and economic characteristics of mothers for neonates admitted at public hospitals of east Wollega zone, western Ethiopia, February–April 2020

Variables	Cases n=73 (%)	Control n=146 (%)	Total n=219 (%)	Crude OR (95% CI)	P value
Age of respondent					
15–19	7 (9.6)	13 (8.9)	20 (9.1)	1.14 (0.38 to 3.37)	0.81
20–29	49 (67.1)	97 (66.4)	146 (66.7)	1.07 (0.55 to 2.09)	0.84
30–39	17 (23.3)	36 (24.7)	53 (24.2)	1	
Residence					
Urban	37 (50.7)	70 (47.9)	107 (48.9)	1	
Rural	36 (49.3)	76 (52.1)	112 (51.1)	0.90 (0.51 to 1.57)	0.7
Ethnic group					
Oromo	54 (74)	114 (78.1)	168 (76.7)	1	
Amhara	14 (19.2)	26 (17.8)	40 (18.3)	1.14 (0.55 to 2.35)	0.73
Other*	5 (6.8)	6 (4.1)	11 (5)	1.76 (0.51 to 6.02)	0.37
Religion					
Orthodox	19 (26)	48 (32.9)	67 (30.6)	1	
Protestant	45 (61.6)	81 (55.5)	126 (57.5)	1.40 (0.74 to 2.67)	0.3
Muslim	9 (12.3)	17 (11.6)	26 (11.9)	1.34 (0.51 to 3.52)	0.56
Educational status					
Can't read and write	18 (24.7)	30 (20.5)	48 (21.9)	2.06 (0.74 to 5.73)	0.17†
Grade 1–8	31 (42.5)	59 (40.4)	90 (41.1)	1.80 (0.70 to 4.65)	0.22†
Grade 9–12	17 (23.3)	33 (22.6)	50 (22.8)	1.77 (0.63 to 4.92)	0.28
College and above	7 (9.6)	24 (16.4)	31 (14.2)	1	
Occupation					
Housewife	29 (39.7)	56 (38.4)	85 (38.8)	1.15 (0.53 to 2.49)	0.73
Private business	18 (24.7)	33 (22.6)	51 (23.3)	1.21 (0.52 to 2.84)	0.66
Government employee	12 (16.4)	26 (17.8)	38 (17.4)	1.02 (0.40 to 2.59)	0.96
Farmer	14 (19.2)	31 (21.2)	45 (20.5)	1	
Family size					
1–3	26 (35.6)	54 (37)	80 (36.5)	1	
4–6	43 (58.9)	78 (53.4)	121 (55.3)	1.69 (0.51 to 5.63)	0.4
>6	4 (5.5)	14 (9.6)	18 (8.2)	1.93 (0.60 to 6.23)	0.27
Distance to reach health facility					
<30 min	23 (31.5)	51 (34.9)	74 (33.8)	1	
30–60 min	33 (45.2)	57 (39)	90 (41.1)	1.01 (0.47 to 2.14)	0.98
>60 min	17 (23.3)	38(26)	55 (25.1)	1.30 (0.63 to 2.65)	0.48
Wealth index status					
Poor	41 (56.2)	34 (23.3)	75 (34.2)	5.15 (2.50 to 10.60)	0.01†
Medium	18 (23.3)	48 (32.9)	65 (29.7)	1.51 (0.66 to 3.33)	0.31
Rich	15 (20.5)	64 (43.8)	79 (36.1)	1	

*Gurage and Tigre.

†Variables that showed significant association during bivariable analysis.

of experiencing hypothermia than those whose mothers gave birth during the day. This is supported by research from Gondar, northwest Ethiopia, Tigray, north Ethiopia and Uganda.^{25 26 38} This could be owing to the fact that

night-time room temperatures are lower than daytime temperatures, or it could be due to temperature differences between night and day.³⁹ Additionally, work overload during the night could be a factor, as the number of staff

Table 2 Factors associated with neonatal hypothermia among neonates admitted at neonatal intensive care units in hospitals of east Wollega zone, Ethiopia; February–April 2020

Variables	Cases n=73 (%)	Controls n=176 (%)	Crude OR (95% CI)	Adjusted OR (95% CI)
Weight of newborn at admission				
<2500 g	30 (41.1)	12 (8.2)	7.79 (3.67 to 16.53)	3.43 (1.18 to 9.97)*
≥2500 g	43 (58.9)	134 (91.8)	1	1
Cardiopulmonary resuscitation done				
Yes	64 (87.7)	70 (47.9)	7.72 (3.58 to 16.67)	3.42 (1.16 to 10.08)*
No	9 (12.3)	76 (52.1)	1	1
Initiation of breast feeding at birth				
Immediately	16 (21.9)	81 (55.5)	1	1
Within 1 hour	10 (13.7)	39 (26.7)	1.30 (0.54 to 3.12)	1.64 (0.57 to 4.68)
After 1 hour	47 (64.4)	26 (17.8)	9.15 (4.46 to 18.78)	3.72 (1.39 to 10.00)*
Head covered with cap at birth				
Yes	43 (58.9)	120 (82.2)	1	1
No	30 (41.1)	26 (17.8)	3.22 (1.72 to 6.05)	2.98 (1.09 to 8.15)*
Skin-to-skin contact present at birth				
Yes	29 (39.7)	128 (87.7)	1	1
No	44 (60.3)	18 (12.3)	10.79 (5.46 to 21.31)	4.54 (1.75 to 11.81)*
Time of delivery				
Day	9 (12.3)	86 (58.9)	1	1
Night	64 (87.7)	60 (41.1)	10.19 (4.71 to 22.05)	6.63 (2.23 to 19.77)*
Gestational age				
<37 weeks	26 (35.6)	18 (12.3)	3.93 (1.98 to 7.83)	2.80 (0.93 to 8.41)
≥37 weeks	47 (64.4)	128 (87.7)	1	1

1: referent category; variables were adjusted for mother's age.
*P value less than 0.05 (significant risk factors of neonatal hypothermia).

working in the labour room at night is not equivalent to the number of staff working during the day.

Furthermore, neonatal hypothermia was associated with children who received CPR at birth. This result is consistent with research from Addis Ababa, Ethiopia, Iran and Bangladesh.^{22 34 40} This is because neonates who require resuscitation have undergone birth asphyxia; there is insufficient oxygen for mitochondrial oxidation in brown adipose tissue, which is required for heat production.² In addition, temperature regulation during resuscitation at birth may not be effectively addressed; in an emergency, resuscitation may be performed without wrapping the newborn and on a cold surface. This result, however, is contradicted by a research conducted in Arba Minch, southwest Ethiopia.²⁴ This discrepancy could be attributable to differences in thermal care during resuscitation, warm resuscitation, resuscitation period and study methodology.

Neonates who did not have their heads covered after delivery had a higher risk of developing hypothermia than those who did. This conclusion was similar to that of a research conducted in Harar, Ethiopia's eastern region.²³ This could be owing to their huge skull, which has open

fontanels and sutures, and contributes to nearly 25% of neonatal heat loss if not covered by a cap.³

Even though the study was conducted in different hospitals, it was only done for a short period or in one season, therefore considerations such as climatic changes or seasonal variations were not taken into account. Another drawback of this study was that hospital-related characteristics like the abilities and qualifications of healthcare personnel working in delivery rooms and NICUs, which may have been linked to hypothermia, were not taken into consideration. There could also be an effect of recall bias.

CONCLUSIONS

The study found that delayed breastfeeding initiation, neonatal weight less than 2500 g on admission, lack of skin-to-skin contact with mothers at birth, cardiopulmonary situations at birth, being born at night and not wearing a cap immediately after birth were all significantly associated with neonatal hypothermia on admission to NICUs.

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Questionnaires: English Language Version**Part I: Maternal Socio demographic and economic status**

S.No	Questions	Codes and Possible responses	Skip pattern
101	How old are you?	_____	
102	Where is your residence?	1. Urban 2. Rural	
103	What is your marital status?	1. Single. 2. Divorced 3. Widowed 4. Married	
104	What is your ethnicity?	1. Oromo 2. Amhara 3. Other(specify)_____	
105	What is your religion?	1. Orthodox 2. Protestant 3. Muslim 4. Other(specify)_____	
106	What is your highest level of education you achieved?	1. Can't read and write 2. Grade 1-8 3. Grade 9-12 4. College and above	
107	What is your occupation?	1. House wife 2. Private business 3. Governmental employee 4. Farmer 5. Other(specify)_____	
108	What is your family size?	Male ____ Female ____ Total ____	
109	Distance from nearest health facility	_____ minutes	

Part II: Clinical information of new born

S.No	Questions	Possible responses	Skip pattern
201	Axillary temperature of the newborn on admission to NICU	_____ °c	
202	Time of admission	1. Day 2. Night	
203	Sex of the new born	1. Male 2. Female	
204	Age of new born at time of admission	_____ hrs OR _____ days	

Supplemental table 1: Neonatal related factors admitted to NICU of public hospitals of East Wollega Zone, western Ethiopia, February-April 2020

Variables	Cases n=73(%)	Controls n=176(%)	Total n=219(%)	Crude OR (95% CI)	p-value
Sex of the new born					
Male	38(52.1)	74(50.7)	112(51.1)	1.06(0.60,1.85)	0.85
Female	36(49.3)	72(49.3)	107(48.9)	1	
Age of the new born					
< 1 day	17(23.3)	22(15.1)	39(17.8)	1.75(0.80,3.80)	0.16*
1-3 day	29(39.7)	63(43.2)	92(42)	1.04(0.55,1.96)	0.90
> 3 day	27(37)	61(41.8)	88(40.2)	1	
Weight of newborn					
<2500 g	30(41.1)	12(8.2)	42(19.2)	7.79(3.67,16.53)	0.01*
≥ 2500 g	43(58.9)	134(91.8)	177(80.8)	1	
Gestational age					
< 37 weeks	26(35.6)	18(12.3)	44(20.1)	3.93(1.98,7.83)	0.01*
≥ 37 weeks	47(64.4)	128(87.7)	175(79.9)	1	
CPR done at birth					
Yes	64(87.7)	70(47.9)	134(61.2)	7.72(3.58,16.67)	0.01*
No	9(12.3)	76(52.1)	85(38.8)	1	
Neonatal medical problem					
Yes	35(47.9)	89(61.0)	124(56.6)	0.59(0.33,1.04)	0.07*
No	38(52.1)	57(39)	95(43.4)	1	
Type of medical problems					
Neonatal sepsis	6(17.1)	18(20.2)	24(19.4)	1	
Birth asphyxia	18(51.4)	40(44.9)	58(46.8)	1.35(0.46,3.97)	0.59
Respiratory disease	11(31.4)	31(34.8)	42(33.9)	1.07(0.34,3.37)	0.92

*Variables that showed significant association during bivariable analysis

Questionnaires: English Language Version**Part I: Maternal Socio demographic and economic status**

S.No	Questions	Codes and Possible responses	Skip pattern
101	How old are you?	_____	
102	Where is your residence?	1.Urban 2. Rural	
103	What is your marital status?	1 .Single. 2.Divorced 3.Widowed 4. Married	
104	What is your ethnicity?	1.Oromo 2.Amhara 3. Other(specify)_____	
105	What is your religion?	1.Orthodox 2.Protestant 3.Muslim 4.Other(specify)_____	
106	What is your highest level of education you achieved?	1.Can't read and write 2.Grade 1-8 3.Grade 9-12 4.College and above	
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108	What is your family size?	Male ____Female ____Total ____	
109	Distance from nearest health facility	_____minutes	

Part II: Clinical information of new born

S.No	Questions	Possible responses	Skip pattern
201	Axillary temperature of the newborn on admission to NICU	_____°c	
202	Time of admission	1.Day 2.Night	
203	Sex of the new born	1. Male 2. Female	
204	Age of new born at time of admission	_____ hrs OR _____ days	

205	weight of new born at admission	_____gram	
206	Gestational age at birth	_____ weeks	
207	Cardio-pulmonary resuscitation given to breath at birth	1.Yes 0.No	
208	Neonatal medical problem	1.Yes 0.No	If 'No' skip to part III.
209	What is the medical problem?	1.Neonatal sepsis 2.Birth asphyxia 3.Respiratory distress 4.Other(specify)_____	

Part III. Neonatal caring practice questionnaires

S.No	Questions	Possible responses	Skip pattern
301	Did baby breast fed after birth?	1.Yes 0.No	If 'No' skip to Q 303
302	When baby Started breastfeeding after birth?	1.Immediately 2.Within 1 Hr 3.After 1 Hr	
303	Was skin to skin contact with mother done?	1.Yes 0.No	
304	Was baby kept apart from mother for > 15 minutes?	1.Yes 0.No	
305	Was the baby body dried immediately at birth?	1.Yes 0.No	
306	Was baby bathed within 24 hr?	1.Yes 0.No	If 'No' skip to Q 308
307	Water used to bath the baby	1.Cold 2.Warm	
308	Was baby head covered with cap?	1.Yes 0.No	
309	Oil massage of the skin immediately after birth?	1.Yes 0.No	
310	Was something given to baby my mouth?	1.Yes 0.No	If 'No' skip to part IV.
311	What was given to baby?	1. Water 2. Milk 3. Butter	

Part IV. Obstetric and maternal related questionnaires

S.No	Questions	Possible responses	Skip pattern
401	Parity	_____	
402	Gravidity	_____	
403	History of abortion	1.Yes 0.No	
404	Had mother followed antenatal care?	1.Yes 0.No	If 'No' skip to Q 407
405	Number of ANC visits	_____	
406	Place of ANC visit	1.Health post 2.Health center 3.Hospital 4.Home	
407	Obstetric complication during pregnancy?	1.Yes 2.No	If 'No' skip to Q 409
408	Type of obstetrical problem during pregnancy?	1.Bleeding 2. Hypertension 3. Premature rupture of membranes 4. Other(specify)_____	
409	Type of pregnancy	1. Single 2.Twin	
410	Place of delivery	1. Hospital 2. Health center 3. Private clinic 4.Home	
411	Onset of labor	1. Spontaneous 2. Induced	
412	Labor duration	_____ hours	
413	Obstetric complication during pregnancy?	1.Yes 2.No	If 'No' skip to Q 415
414	Type of obstetrical problem during pregnancy?	1.Bleeding 2. Hypertension 3 Other(specify)_____	
415	What is Mode of delivery?	1.Spontaneous 2.Instrumental 3.C/S	
416	Birth attendant	1.Family member 2. Health professional 3.Health extension worker 4. Traditional birth attendant	
417	Time of delivery	1.Day 2.Night	

Part V. Wealth index**A. For urban residents only**

No	Questions	Response	Skip pattern
501	Do you belong to the house?	1.Yes 0.No	If 'No' skip to Q 505
502	What is the roof of the main house?	1. Corrugated iron sheet 2. Thatch 3. Other specify -----	
503	What is the wall of the main house?	1.Mud 2.Cement 3.Bricks 4.Other specify -----	
504	What is the floor of the main house?	1. Soil 2. Cement 3. Ceramic 4.Other specify -----	
505	Availability of electricity	1.Yes 0. No	
506	Availability of radio	1.Yes 0. No	
507	Availability of television	1.Yes 0. No	
508	Availability mobile	1.Yes 0. No	
509	Availability of non-mobile telephone	1.Yes 0. No	
510	Availability of refrigerator	1.Yes 0. No	
511	Availability of chair	1.Yes 0. No	
512	Availability of table	1.Yes 0. No	
513	Availability of bed with cotton/sponge/spring matters	1.Yes 0. No	
514	Availability of electric baking stove	1.Yes 0. No	

B. For rural residents only

515	Do you belong to the house?	1.Yes 0. No	Skip pattern
516	Type of the house	1. Corrugated iron sheet 2. Thatch 3.Other specify -----	If 'No' skip to Q 517
517	Availability of radio	1.Yes 0. No	
518	Availability of mobile telephone	1.Yes 0. No	
519	Availability of table	1.Yes 0. No	
520	Availability of chair	1.Yes 0. No	
521	Availability of bed with cotton/ sponge/spring matters	1.Yes 0. No	
522	Availability of electricity	1.Yes 0. No	
523	Availability of kerosene lamp/pressure lamp	1.Yes 0. No	
524	Does the household own any agricultural land?	1.Yes 0. No	
525	What type of agricultural land do you own?	1.Private 2.Rent	
Annual farm product status			
526	Teff	1.Yes 0. No	
527	Barley	1.Yes 0. No	
528	Maize	1.Yes 0. No	
529	Rise	1.Yes 0. No	
530	Wheat	1.Yes 0. No	
531	Sorghum	1.Yes	

		0. No	
532	Bean	1. Yes 0. No	
533	Pea	1. Yes 0. No	
534	Chickpea	1. Yes 0. No	
	Availability of cattle's		
535	Milk cows, oxen or bulls	1. Yes 0. No	
536	Back animals (Horses, donkeys, or mules)	1. Yes 0. No	
537	Goats?	1. Yes 0. No	
538	Sheep?	1. Yes 0. No	
539	Chickens?	1. Yes 0. No	
540	Beehives?	1. Yes 0. No	

Thank you for your cooperation!

WALLAGGAA YUUNIVARSIIITII

INSTITIYUUTII SAAYINSII FAYYAA FI MUMMEE FAYYAA HAWAASAA

Unka Ragaa Odeeffannoo

Akkam bultan/ooltan, бага nagaan dhuftan. Maqaan koo _____n jedhama. Qorannoo mata dureen isaa, “**Sababoota gadi bu’uu ho’insa qaamaa daa’imman umuriin isaanii guyyaa 28 gadi ta’anii kutaa ciisicha yaala addaa Hospitaalota mootummaa Wallagga Bahaa keessatti hordoffii irra jiran murteessan**” jedhu kan barataa digirii lammaaffaa Wallagga Yuunivarsiitii **Biqilaa Girmaatiin**, hojjetamuuf ragaa funaannaadha. Kaayyoo qo’annichaa fi maaliif akka ati filatamte siif ibsuudhaaf yeroo gabaabaa akka naaf kennitu kabajaan isin gaafadha.

Kayyoon qoranichaa Sababoota gadi bu’uu ho’insa qaamaa daa’immanii kanneen guyyaa 28 gadi ta’anii qoratanii gargar baasuun; ogeessota toora Kanaan jiraniifis ta’e daa’imman dhibee kanaaf saaxilamaniif bu’aa mataa isaa qaba. Sababoota kana adda baasuun rakkoolee gadi bu’uu ho’insa qaamaan dhufan ittisuufis ta’e xiqqeessuuf gahee guddaa qabaata. Argannoon qorannoo kana walitti qabamuun argamu kaayyoo baruufi barsiisuu fi murtoo dabalataaf kan fayyaduta’a. Anis gaaffilee daa’imman reefu dhalatan waliin wal qabatan si gaafachuuf daqiiqaa 15-30 barbaada. Qorannicha keessatti hirmaachuu keetiif rakkoon sirra gahu hin jiru; akkasumas yeroo barbaadde kamiyyuu qorannicha addaan kutuufi gaaffilee deebisuuf sitti hin tolle deebisu dhiisuu dandeessa. Haata’u malee deebinkee daa’ima reefu dhalatu/ttuuf; kunuunsa isaaniif barbaachisu fooyyeessuufis ta’e fayyaa isaanii eegsisuuf baay’ee barbaachisaadha. Iccitiin odeeffannookee baay’ee dhokataa fi eegamaa yoota’u, eenyummaankee addatti kan akka maqaafi bilbilaa si hin gaafatu. Ragaan sirraa funaaname erga xiinxalamee xumuramee booda kan dhabamsiifamu ta’a. Qorannoo kana keessatti hirmaachuun guutummaatti fedhaanidha. Gaaffii fi waan siif hin ifne kamiyyuu yoo qabaatte, teessoo armaan gadiin qoraticha gaafachuu dandeessa.

Gaaffii koo isin waliin itti fufuu nii danda’aa? Eyyee _____

Lakkii _____

Maqaa isa gaafatuu _____ Guyyaa _____ Mallattoo _____

Maqaa to’ataa _____ Guyyaa _____ Mallattoo _____

Maqaa: Biqilaa Girmaa

Lak.Bilb:-(+251) 91-743-2848

Iimeeyilii:- bikogirma1@gmail.com

Bargaaffii Afaan Oromoo**Kutaa I: Dhimma Hawaas- dinagdee Haadholii**

Lakk	Gaaffilee	Deebiilee fi kooddii	Ce'umsa
101	Umriin kee meeqa?	_____ (Waggaadhaan)	
102	Yeroo ammaa eessa jiraatta?	1.Magaalaa 2. Baadiyaa	
103	Haala gaa'elaa kee akkami?	1.Hin heerumne 2.Hiikeera 3.Narraa du'e 4.Heerumeera	
104	Qomoon kee maali?	1.Oromoo 2.Amaaraa 3.Kan biro (ibsi)_____	
105	Amantiin kee maali?	1.Ortoodooksii 2. Pirotetaantii 3.Musiliima 4.Kan biro(ibsi)_____	
106	Sadarkaan barnoota kee maali?	1.Dubbisuu fi barreessuu hin danda'u 2.Kutaa 1-8 3.Kutaa 9-12 4.Kollejjii fi isaa ol	
107	Hojiin kee maali?	1.Haadha warraa mana ooltu 2.Hojii dhuunfaa 3.Hojjettuu mootummaa 4.Qonnaan bultuu 5.Kan biroo (ibsi)_____	
108	Baay'inni maatii keetii meeqa?	Dhiira____ ,Dhalaa _____ Ida'ama ____	
109	Mannikee mana yaalaa sitti dhiyoo irraa hagam fagaata?	_____ daqiiqaa	

Kutaa II: Gaafannoo sababoota daa'imman waliin wal qabatan

Lakk	Gaaffilee	Deebilee fi kooddii	Ce'umsa
201	Temperecherri daa'ima reefu dhalatu kutaa ciisichaatti meeqa?	_____ °c	
202	Daa'imni reefu dhalate/tte yoom kutaa ciisichaatti ramadame/tte?	1.Guyyaa 2.Halkan	
203	Saala daa'ima	1.Dhiira 2. Dhalaa	
204	Daa'imni kun erga dhalattee umuriin hangami?	_____sa'atiidhaan yookan _____ guyyaadhaan	
205	Ulfaatina daa'ima reefu dhalattuu kutaa ciisichaatti meeqa?	_____giraamaa	
206	Yeroo ulfaa daa'imni itti dhalate hammami?	_____torbee	
207	Lubbuu daa'ima dhalatee oolchuuf gargaarsi taasifameera ? (resuscitation)	1.Eeyyee 0.Lakki	
208	Daa'imni reefu dhalatu rakkoo fayyaa qabaa?	1.Eeyyee 0.Lakki	Lakki>>> kutaa III.
209	Rakkoon fayyaa kun maali?	1.Rakkoo ho'insa qaamaa olaanaa(Sepsis) 2.Rakkoo yeroo da'umsaa daa'imni qilleensa gahaa dhabuu (asphyxia) 3.Dhukkuba sirna hargansuu 4.Kan biroo(_____ibsi)	

Kutaa III: Gaaffilee dhimma shaakala daa'imman kunuunsuun walqabatan

Lakk	Gaaffilee	Deebilee fi kooddii	Ce'umsa
301	Daa'imni erga dhalatee harma hodheeraa /teetti?	1. Eeyyee 2. Lakki	Lakki>>> 303
302	Daa'imni yeroo kam harma hodhuu jalqabe/de?	1.Yerooma sana 2.Sa'atii tokko keessatti 3.Sa'atii tokkoo booda	
303	Da'imni kun akka dhalatten haatii qama ishee qullaa haamattettii?	1.Eeyyee 0.Lakki	
304	Daa'imni dhalate daqiiqaa 15 oliif haadha irraa adda baafameeraa/teetti?	1.Eeyyee 0.Lakki	
305	Daa'imni akka dhalateen/tteen qaamni qoorfameeraa/teetti?	1.Eeyyee 0.Lakki	Lakki>>>308
306	Daa'imni sa'atii 24 keessatti qaamni dhiqameefiraa?	1.Eeyyee 0.Lakki	
307	Bishaan qaama daa'ima reefu dhalattu dhiquuf fayyadamte waan akkamiiti?	1.Qorraa 2.Ho'aa	
308	Daa'imni mataa isaatti haguuggiin itti uwwifameeraa?	1.Eeyyee 0.Lakki	
309	Daa'imni battala dhalate/tte qaamni dhadhaa dibameeraa/teettii?	1.Eeyyee 0.Lakki	
310	Daa'ima reefu dhalateef/tteef wanti afaaniin kenname jiraa?	1.Eeyyee 0.Lakki	Lakki>>> kutaa IV.
311	Maaltu kennameefi?	1.Bishaan 2.Aannaan 3.Dhadhaa	

Kutaa IV: Gaaffilee sababoota fayyaa haadholee fi ulfa waliin wal qabatan

Lakk	Gaaffilee	Deebilee fi kooddii	Ce'umsa
401	Yeroo meeqaaffaa deesse?	_____	
402	Yeroo meeqaaffaaf ulfa taate?	_____	
403	Ulfi sirraa ba'ee beekaa?	1.Eeyyee 0.Lakki	
404	Kunuunsa da'umsa duraa hordofteettaa?	1.Eeyyee 0.Lakki	Lakki>>>407
405	Si'a meeqa hordofte?	_____	
406	Eessatti hordofaa turte?	1.Keellaa fayyaa 2.Buufata fayyaa 3.Hospitaala 4.Kilinika dhuunfaa	

407	Yeroo ulfaa rakkoon fayyaa si mudate jiraa?	1.Eeyyee 0.Lakki	Lakki>>>409
408	Rakkoo akkamiitu si muudate?	1.Dhangala'uu dhiigaa 2.Dhiibbaan dhiigaa ol ka'uu 3. Bishaan bubbee osoo cininsuun sirritti hin eegalin dhangala'uu 4.Kanbiroo(_____ ibsi)	
409	Ulfikee lakkuudha moo tokkote?	1.Tokko 2.Lakkuu	
410	Eessatti deesse?	1.Hospitaala 2.Buufata fayyaa 3.kilinka dhuunfaa 4.Mana	
411	Cininsuun akkamitti si jalqabe?	1.Ofii isaatiin/Uumamaan 2.Ogeessa fayyaan jalqabsiifame	
412	Cinsinsuun hagam sirra ture?	_____ Sa'atiidhaan	
413	Yeroo da'umsaa rakkoon fayyaa si mudate jiraa?	1. Eeyyee 0.Lakki	
414	Rakkoo akkamiitu si muudate?	1.Dhiigni dhangala'uu 2.Dhiibbaan dhiigaa ol ka'uu 3.Kan biroo(_____ ibsi)	Lakki>>>415
415	Mala kamiin deesse?	1.Gargaarsa meeshaa yaalaa malee 2.meeshaalee yaalaatiin 3.Baqaqsanii yaaluutiin	
416	Kan si deesise eenyu?	1.Miseensa maatii 2.Ogeessa fayyaa 3.Ekteenshinii fayyaa 4.Namoota aadaan deesisan	
417	Yeroo kam deesse?	1.Guyyaa 2.Halkan	

Kutaa VI. Gaaffilee safartuu qabeenyaa

A. Jiraattota Magaalaa qofaaf

Lakk	Gaaffilee	Deebii	Ce'umsa
501	Mana qabda?	1.Eeyyee 0.Lakki	Lakki>>>505
502	Baaxiin mana jireenyaa kee maal irraa hojjetame?	1.Qorqoorroo 2.Citaa 3.Kan biroo (ibsi)_____	
503	Dhaabni mana jireenyaa kee maal	1. Dhoqqee	

	irraa hojjetame?	2. Simmintoo 3. Biriikii 4. Kan biro (ibsi)___	
504	Lafni mana jireenyaa kee maali?	1.Biyyee 2.Simmintoo 3.Seraamikii 4. Kan biro (ibsi)___	
505	Elektirikii qabda?	1.Eeyyee 0.Lakki	
506	Raadiyoo qabda?	1.Eeyyee 0.Lakki	
507	Televiziyinii qabda?	1.Eeyyee 0.Lakki	
508	Bilbila sochooftuu qabda?	1.Eeyyee 0.Lakki	
509	Bilbila dhaabbataa qabda?	1.Eeyyee 0.Lakki	
510	Firiijii qabda?	1.Eeyyee 0.Lakki	
511	Taa'umsa qabda?	1.Eeyyee 0.Lakki	
512	Minjaala qabda?	1.Eeyyee 0.Lakki	
513	Siree ispoonjii qabda?	1.Eeyyee 0.Lakki	
514	Istoovii qabda?	1.Eeyyee 0.Lakki	

B. Jiraatota Baadiyaa qofaaf

Lakk	Gaaffiilee	Deebii	Ce'umsa
515	Mana qabda?	1.Eeyyee 0.Lakki	Lakki>>>517
516	Manichi gosa akkamiti?	1. Qorqoorroo 2. Citaa 3.Kan biroo (ibsi)_____	
517	Raadiyoo qabda?	1.Eeyyee 0.Lakki	
518	Bilbila sochootu qabda?	1.Eeyyee 0.Lakki	
519	Minjaala qabda?	1.Eeyyee 0.Lakki	
520	Teessuma qabda?	1.Eeyyee 0.Lakki	

521	Siree ispoonjii qabda?	1.Eeyyee 0.Lakki	
522	Elektiriikii qabda?	1.Eeyyee 0.Lakki	
523	Ibsaa kurraazii qabda?	1.Eeyyee 0.Lakki	
524	Lafa qonnaa qabda?	1.Eeyyee 0.Lakki	
525	Kan dhuunfaakee moo ni kireefatte?	1.kan dhuunfaa 2.kireeffadhee (qixxee)	
Haala Oomisha waggaa qonnaa			
526	Xaafii	1.Eeyyee 0.Lakki	
527	Garbuu	1.Eeyyee 0.Lakki	
528	Boqqolloo	1.Eeyyee 0.Lakki	
529	Ruuzii	1.Eeyyee 0.Lakki	
530	Qamadii	1.Eeyyee 0.Lakki	
531	Garbuu adii	1.Eeyyee 0.Lakki	
532	Baaqelaa	1.Eeyyee 0.Lakki	
533	Atara	1.Eeyyee 0.Lakki	
534	Boloqqee	1.Eeyyee 0.Lakki	
Haala Loon (horii)			
535	Sa'aa aannanii, qotiyyoo	1.Eeyyee 0.Lakki	
536	Horii dugdaa (Farda, Harree,ykn Gaangee)	1.Eeyyee 0.Lakki	
537	Re'ee	1.Eeyyee 0.Lakki	
538	Hoolaa	1.Eeyyee 0.Lakki	
539	Lukkuu	1.Eeyyee 0.Lakki	
540	Gaagura	1.Eeyyee 0.Lakki	

Galatoomi!

Supplemental table 1: Neonatal related factors admitted to NICU of public hospitals of East Wollega Zone, western Ethiopia, February-April 2020

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Age of the new born					
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1-3 day	29(39.7)	63(43.2)	92(42)	1.04(0.55,1.96)	0.90
> 3 day	27(37)	61(41.8)	88(40.2)	1	
Weight of newborn					
<2500 g	30(41.1)	12(8.2)	42(19.2)	7.79(3.67,16.53)	0.01*
≥ 2500 g	43(58.9)	134(91.8)	177(80.8)	1	
Gestational age					
< 37 weeks	26(35.6)	18(12.3)	44(20.1)	3.93(1.98,7.83)	0.01*
≥ 37 weeks	47(64.4)	128(87.7)	175(79.9)	1	
CPR done at birth					
Yes	64(87.7)	70(47.9)	134(61.2)	7.72(3.58,16.67)	0.01*
No	9(12.3)	76(52.1)	85(38.8)	1	
Neonatal medical problem					
Yes	35(47.9)	89(61.0)	124(56.6)	0.59(0.33,1.04)	0.07*
No	38(52.1)	57(39)	95(43.4)	1	
Type of medical problems					
Neonatal sepsis	6(17.1)	18(20.2)	24(19.4)	1	
Birth asphyxia	18(51.4)	40(44.9)	58(46.8)	1.35(0.46,3.97)	0.59
Respiratory disease	11(31.4)	31(34.8)	42(33.9)	1.07(0.34,3.37)	0.92

*Variables that showed significant association during bivariable analysis

Supplemental table 2: Neonatal caring practice related factors among neonates admitted to NICU of public hospitals of East Wollega Zone, western Ethiopia February-April 2020

Variables	Cases n=73(%)	Controls n=176(%)	Total n=219(%)	Crude OR (95% CI)	p-value
Initiation of breast feeding					
Immediately	16(21.9)	81(55.5)	97(44.3)	1	
Within 1 hour	10(13.7)	39(26.7)	49(22.4)	1.30(0.54,3.12)	0.56
After 1 hour	47(64.4)	26(17.8)	73(33.3)	9.15(4.46,18.78)	0.01*
Skin to skin contact present					
Yes	29(39.7)	128(87.7)	157(71.7)	1	
No	44(60.3)	18(12.3)	62(26.5)	10.79(5.46,21.31)	0.01*
Baby kept apart from mother for > 15 min					
Yes	27(37.0)	32(21.9)	59(26.9)	3.87(2.12,7.07)	0.02*
No	46(63.0)	114(78.1)	160(73.1)	1	
Baby body dried at birth					
Yes	67(91.8)	133(91.1)	200(91.3)	1	
No	6(8.2)	13(8.9)	19(8.7)	1.09(0.39,3.00)	0.87
Baby Bathed within 24 hr					
Yes	14(19.2)	6(4.1)	20(9.1)	5.54(2.03,15.10)	0.001*
No	59(80.8)	140(95.9)	199(90.9)	1	
Head covered with cap					
Yes	43(58.9)	120(82.2)	163(74.4)	1	
No	30(41.1)	26(17.8)	56(25.6)	3.22(1.72,6.05)	0.01*

*Variables that showed significant association during bivariable analysis