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Cross-sectional Study

Magnitude and associated factors of neonatal sepsis among neonates admitted to neonatal intensive care unit of Northern oromia hospitals, Ethiopia: A multicenter cross-sectional study

Kumera Bekele [a], Firomsa Bekele [b,*], Dejene Edosa [c], Mathewos Mekonnen [a], Mengistu Benayew [a]

[a] Department of Nursing, College of Health Science, Selale University, Fiche, Ethiopia
[b] Department of Pharmacy, College of Health Science, Mettu University, Mettu, Ethiopia
[c] Department of Midwifery, College of Health Science, Selale University, Fiche, Ethiopia

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ABSTRACT

Background: Globally sepsis is the most cause of neonatal death. Neonatal sepsis is the major newborn killer in Ethiopia, which accounts for more than one-third of neonatal deaths. Therefore, the study was aimed to assess the prevalence and associated factors of neonatal sepsis.

Methods: An institutional based cross-sectional study was employed on a total of 378 neonates admitted to the NICU of selected four hospitals. It was conducted from January 2021 to March 2021. Multivariate logistic regression analysis was used to determine the prevalence of neonatal sepsis.

Results: Among neonates who enrolled in this study 188(50.1%) of them were females and 283 (75.5%) of them were in the age group of early neonatal period. The overall magnitude of neonatal sepsis in this study was 196 (52.27%). From this 159(81.12%) and 37(18.88%) of neonates developed early onset neonatal sepsis and late onset neonatal sepsis, respectively. Factors such as age of neonates[AOR = 2.351, 95% CI (1.131, 4.888)], birth weight of neonate less than 2.5 kg[AOR = 2.546, 95% CI (1.875, 3.643)], multiple per digital vaginal examination[AOR =0.278, 95% CI (0.148,0.522)], history of urinary tract infection[AOR = 3.709, 95% CI (1.828–7.301)], Meconium stained amniotic fluid (MSAF)[AOR = 0.384, 95% CI (0.152, 0.968)] and intrapartum high fever[AOR = 2.203, 95% CI (1.034, 4.692)] were the independent determinants of neonatal sepsis.

Conclusion: This study indicated that the magnitude of neonatal sepsis was found to be high. In general, this study has found that both maternal and neonatal factors had contributed to the risk of neonatal sepsis. Based on these results we recommend the healthcare providers to focus on the prevention of risk factors rather than treating the disease after it occurs.

1. Background

Neonatal sepsis is the infectious etiology of newborns in the first month of their life that can be categorized as either early or late-onset neonatal sepsis [1,2]. The mortality rate of the children became increased from day to day with about 2.5 million of them were only of newborn ages. Neonatal mortality accounts for two-fifths of all deaths in under-five children with poor resources [3].

Globally the possible risk factors for newborn death were neonatal and maternal related factors [4]. The magnitude of newborn death was more prevalent in low-income countries like sub- Saharan Africa, South Asia, and Latin America [5,6].

Premature rupture of membrane (PROM), maternal infectious etiology, gestational age<37weeks, APGAR score<7, need for artificial ventilation, not crying immediately at birth, delay in care-seeking and inexperienced health care workers are the predictors of neonatal sepsis [7,8].

In Ethiopia, about one-thirds of neonatal death was secondary to neonatal sepsis despite some modification towards the advancement of care [3,9]. The most likely predictors of mortality were preterm birth, infection, and asphyxia [10].

It has been reported that case diagnosis and management of neonatal sepsis is a complex task due to unspecified symptoms and the lack of sufficient human power and facilities in Ethiopia. Therefore identification of the possible cause of neonatal sepsis can decrease the possibility of death and morbidity [11,12]. In low-resource countries like Ethiopia,

* Corresponding author. Department of Pharmacy, College of Health Science, Mettu University, Mettu, Ethiopia.
E-mail address: firomsabekele21@gmail.com (F. Bekele).

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there is a delay in diagnosing and management of neonatal sepsis. However, early diagnosis of sepsis is paramount in identifying the risk factors of the disease and saving the future generations [1,13].

Even though the impact of neonatal sepsis remains a public health problem in resource-limited settings like Ethiopia, there is a scanty finding on the magnitude and predictors of neonatal sepsis and no study in our study area. Therefore, this study aimed to determine the prevalence and associated factors of neonatal sepsis among neonates admitted to the Neonatal Intensive Care Unit (NICU)

2. Patients and methods

2.1. Study area, design, and period

The hospital based cross-sectional study design was employed from January 11, 2021 to March 10, 2021 in selected hospitals of Fiche, Kuyu, Gundo Meskel, Chancho, and Muka Turi Hospitals with established and functional neonatal intensive care units. Fiche Hospital is located in Fiche town the capital town of North-shewa zone on a distance of 112 km from Addis Ababa in the north direction. Kuyu, Gundo meskel, and Muka Turi hospitals are also found in the North shewa zone of the Oromia region. On the other hand, Chancho Hospital is located in Special Zone Surrounding Finfinne about 30 km in the Northern direction. The work has been reported in line with the strengthening of the reporting of cohort studies in surgery (STROCSS) criteria [14].

2.2. Study participants and eligibility criteria

All neonates who were admitted to the neonatal intensive care unit (NICU) during the study period who had complete charts were included in this study whereas neonates who were discharged early before data collection, neonates with incomplete patient chart information, neonates who were admitted without their mothers and mothers who had hearing impairments or unable to talk were excluded.

2.3. Study variables and outcome endpoints

Neonatal sepsis was the primary outcome whereas independent variables includes socio-demographic characteristics of neonates and parents (age sex, religion, ethnicity, marital status of the parents, educational status of mother, family occupation, family monthly income, and place of residence), Maternal factors (parity, place of delivery, mode of delivery, PROM, duration of labor, ANC follow-up, the person assisting delivery, foul-smelling fluid/vaginal discharge, meconium-stained amniotic fluid, frequency of digital per-vaginal examination, history of UTI, maternal fever, history of APH and PIH/Eclampsia and neonatal factors (birth weight, gestational age, birth asphyxia, APGAR score, resuscitation at birth, immediate cry, method of oxygen administration, surgical procedures, umbilical catheterization, urinary catheterization, Naso/oropharynx tube insertion, and endotracheal tube.

2.4. Sample size determination and technique

The sample size for this particular study was determined by using the single population proportion formula and the proportion was taken from the previous literature in Ethiopia. According to a study conducted at Wolaita Sodo hospital, the prevalence of neonatal sepsis was 33.8% [15].

By considering 95% confidence interval (CI) and 5% marginal error, the sample size will be calculated as follows:

$n= (Z\alpha/2)^2 P (1-P)/d^2$

$n= (1.96)^2 (0.338) (0.662)/ (0.05)^2$

$n = 344$

Where n = required sample size.

Z = critical value for normal distribution at 95% confidence level which equals to1.96 (Z value at $\alpha = 0.05$)

P= (Proportion of neonatal sepsis among neonates admitted in the NICU with the prevalence of 33.8% from previous study.

d = 0.05 (5% margin of error); and non-response rate 10%.

✓ The total sample size was (344*10%) +344 = **378**

A systematic random sampling technique was employed to get study subjects from neonates admitted to the neonatal intensive care unit.

2.5. Data collection process and management

A pre-tested interviewer-administered questionnaire and checklists were used to collect the data. The tools were developed by reviewing different works of literature. The tool was prepared in English and translated to the local languages 'Afan Oromo' to ensure the clarity of questions for the respondents. A pretest was conducted in Bishoftu Referral Hospital in the East Shewa zone of the Oromia region by taking 10% of our sample size that was not included in the actual study population before the actual data collection takes place. Correction on the instrument was done accordingly. Data were collected by eight [10] trained experienced B.Sc nurses and the data collection process was supervised by the principal investigators. Before the date of actual data collection, orientation was given to data collectors for two days about the data collection and how to handle the data and the content of the instrument. The information was collected during the admission of the neonate to NICU and by reviewing the registration book records in the labor ward, NICU, and gynecologic ward in each hospital.

2.6. Data processing and analysis

Data was entered into Epidata version 3.1 then it was transported to SPSS 22 version for analysis. The associations between dependent variables and independent factors were examined in logistic regression models. Bivariate analysis between dependent and independent variables was performed using binary logistic regression. To control the effect of confounding variables, multiple logistic regressions were considered. All variables with a P-value < 0.25 were entered into the multivariable logistic regression. A P-value less than 0.05 was considered as significantly associated in this model.

2.7. Ethics approval and consent-to-participate

Ethical clearance was secured from the Ethical review board of Salale University. A permission letter was provided to all hospitals for proceeding data collection. After that participants were well-oriented about the purpose and procedure of data collection, and the confidentiality and privacy were ensured. It is also clear that participation was fully based on the willingness of participants to use written consent; the name and address of the interviewee were not recorded in the questionnaire. The study protocol was performed in accordance with the declaration of Helsinki. The study was registered researchregistry.com with a unique reference number of "researchregistry7723".

2.8. Operational definitions

Neonatal sepsis: Neonates with the presence of infection or sepsis who are diagnosed either clinically or with laboratory results that are suggestive of neonatal sepsis by professionals during admission of the neonate within 0–28 days of life.

Early-onset of sepsis: Is sepsis occurring within 7 days of life after birth.

Late-onset of sepsis: Is sepsis occurring after 7 days of life.

Premature rupture of membranes (PROM): The time from

membranes' rupture to onset of delivery is more than 18 h.

Meconium stained amniotic fluid (MSAF): Was considered if the amniotic fluid was green/brown or mixed with meconium, or appeared meconium-stained on the baby.

3. Results

3.1. Socio-demographic characteristics of respondents

A total of 375 neonates admitted to the neonatal intensive care unit with their index mothers were included in the study, making the response rate 99.2%. Of the total respondents, 202 (53.9%) were from urban and 173 (46.1%) were from rural residences. The majority (60.3%) of the mothers were in the age group of 20–29 years. Most of the mothers had primary 104 (27.7%) as their highest educational attainment, while only 76 (20.3%) of the respondents had completed college and above. Among neonates who enrolled in this study 188(50.1%) of them were females. Concerning the age proportion of neonates, 283 (75.5%) of them were in the age group 0–7 days (early neonatal period) and the rest 92 (24.5%) were from 8 to 28 days (late neonatal period) (Table 1).

3.2. Obstetric characteristics of the mothers

Of the total mothers of the neonates, the majority of 195 (52.0%) of them were primipara and 325 (86.7%) had received antenatal care (ANC) service at least once during the recent pregnancy. The majority of mothers 243 (64.8%) gave birth with spontaneous vaginal delivery while 36 (9.6%) and 96 (25.6%) gave birth with instrument-assisted and cesarean section, respectively.

During labor, 224 (59.7%) mothers had ≥3 digital vaginal examinations (PV) and 135 (36.0%) had foul-smelling amniotic fluid. One hundred eighty-two (48.5%) of mothers had intrapartum fever during their labor. Regarding maternal risk factors, 128 (34.1%), 139 (37.1%), 130 (34.7%), 93 (24.8%), 206 (54.9%), of mothers had a history of pregnancy-induced hypertension, UTI/STI, meconium-stained amniotic fluid, APH, and PROM respectively (Table 2).

Table 1
Socio-demographic characteristics of mothers and neonates admitted in NICU at selected governmental hospitals of Fiche, Kuyu, G/Meskel and Muka Turi, Oromia Region, Ethiopia 2021.

Variables	Category	Frequency	Percent (%)
Residence	Urban	202	53.9
	Rural	173	46.1
Age of mothers (Years)	<20	18	4.8
	20–24	129	34.4
	25–29	97	25.9
	30–34	70	18.7
	≥35	61	16.3
Ethnic group	Oromo	276	73.6
	Amhara	76	20.3
	Tigre	7	1.9
	Others	16	4.9
Religion	Orthodox	217	57.9
	Protestant	100	26.7
	Muslim	30	8.0
	Others	24	6.4
Mother's Educational status	No formal Education	92	24.5
	Primary	104	27.7
	Secondary	103	27.5
	College and above	76	20.3
Mother's Occupation	House wife	169	45.1
	Merchants	58	15.5
	Government employee	50	13.3
	Private Employee	54	14.4
	Others	44	11.7
Age of neonate	≤7 days	283	75.5
	8–28 days	92	24.5
Sex of neonate	Male	187	49.9
	Female	188	50.1

3.3. Descriptive statistics of neonatal health-related characteristics

Among the total neonates 187 (49.9%) neonates had normal birth weight and 164 (43.7%) were of low birth weight. Regarding gestational age, 206 (54.9%) had a term (37–42 weeks), and 126 (33.6%) and 43 (11.5%) had preterm (<37 weeks) and post-term (42 weeks), respectively. The majority of the neonates (60.8%) had an APGAR score of ≤7, and 187 (49.9%) of the neonates cried at birth and 151 (40.3%) of the neonates had resuscitated at birth. One hundred seventy-six (46.9%) of the neonates were administered oxygen immediately after birth and the majority of 118 (67.0%) of them had been taken it through a nasal cannula. Of total neonates, 74 (19.7%), 137 (36.5%), 7 (1.9%), and 45 (12.0%) had endotracheal intubation, gavage feeding, an umbilical catheter inserted, and the urinary catheter inserted after birth (Table 3).

3.4. Prevalence of neonatal sepsis

The overall magnitude of neonatal sepsis in this study was 196 (52.27%). From this 159(81.12%) and 37(18.88%) of neonates developed early-onset neonatal sepsis and late-onset neonatal sepsis, respectively.

3.5. Factors associated with neonatal sepsis

In multiple logistic regressions, Neonates whose age ranged from 0 to 7 days were 2 times more likely to develop neonatal sepsis as compared to those whose age ranged from 8 to 28 days [AOR = 2.351, 95% CI (1.131, 4.888)]. Neonates who had a birth weight of less than 2.5 kg were 1.68 times highly at risk to developed sepsis compared to those

Table 2
Obstetric characteristics of mothers in selected hospitals of Fiche, Kuyu, G/Meskel and Muka Turi, Oromia Region, Ethiopia 2021(n = 375).

Variables	Category	Frequency	Percentage
Maternal parity	Primipara	195	52.0
	Multipara	180	48.0
Maternal ANC follow up	Yes	325	86.7
	No	50	13.3
Number of ANC follow-Up	Once	46	14.2
	2-3 times	141	43.4
	More than 3 times	138	42.5
Place of birth	Hospital	236	62.9
	Health center	115	30.7
	Home	24	6.4
Mode of delivery	SVD	243	64.8
	Instrumental	36	9.6
	Caesarean section	96	25.6
Who attends delivery	Health professional	355	94.7
	HEW	7	1.9
	TBA	13	3.5
History of PROM	Yes	206	54.9
	No	169	45.1
Duration of PROM	<18 h	50	24.3
	≥18 h	156	75.7
Meconium stained amniotic fluid	Yes	130	34.7
	No	245	65.3
Foul smelling amniotic fluid	Yes	135	36.0
	No	240	64.0
Number of pervaginal examination	<3 times	151	40.3
	≥3 times	224	59.7
History of fever during labor	Yes	182	48.5
	No	193	51.5
Pregnancy-induced hypertension	Yes	128	34.1
	No	247	65.9
Bleeding during pregnancy/APH	Yes	93	24.7
	No	282	75.2
History of UTI/STI	Yes	139	37.1
	No	236	62.9

Table 3
Neonatal health related characteristics of neonates in selected hospitals of Fiche, Kuyu, G/Meskel and Muka Turi, Oromia Region, Ethiopia 2021(n = 375).

Variables	Category	Frequency	Percentage
Gestational age	Preterm (<37 weeks)	126	33.6
	Term (37–42 weeks)	206	54.9
	Post-term (>42 weeks)	43	11.5
APGAR score	≥7	147	39.2
	<7	228	60.8
Birth Weight at birth	<2500 gm	164	43.7
	2500-4000 gm	187	49.9
	>4000 gm	24	6.4
Neonate cries immediately after birth	Yes	187	49.9
	No	188	50.1
Neonate resuscitated at birth?	Yes	151	80.3
	No	37	19.7
Oxygen requirement	Yes	176	46.9
	No	199	53.1
Method of oxygen administration	Intranasal catheter	25	14.2
	Mask	33	18.8
	Nasal cannula	118	67.0
Endotracheal intubation?	Yes	74	19.7
	No	301	80.3
Naso gastirc tube insertion	Yes	137	36.5
	No	238	63.5
Umbilical catheter insertion	Yes	7	1.9
	No	368	98.1
Urinary catheter inserted	Yes	45	12.0
	No	330	88.0
Any congenital anomaly	Yes	24	6.4
	No	351	93.6
Any type of surgery done	Yes	11	2.9
	No	364	97.1

who had birth a weight of more than 2.5 kg [AOR = 2.546, 95% CI (1.875, 3.643)]. Neonates born to mothers who had a history of UTI during the index pregnancy were nearly 4 times more likely to develop sepsis than those neonates born to mothers who did not have a history of UTI during the index pregnancy [AOR = 3.709, 95% CI (1.828–7.301)]. Neonates born to mothers who did not have MSAF were less likely to develop neonatal sepsis compared to those neonates born from mothers who had MSAF. [AOR = 0.384, 95% CI (0.152, 0.968)]. Neonates who were born to mothers who had fever during labor had a 2 times the risk of developing sepsis compared to their counterparts [AOR = 2.203, 95% CI (1.034, 4.692)]. Finally, neonates born to mothers who had PV examination <3 were less likely to develop neonatal sepsis compared with neonates born from mothers who had more frequent PV examination [AOR = 0.278, 95% CI (0.148,0.522)](Table 4).

4. Discussion

This study aimed to assess the magnitude and identify determinant factors of neonatal sepsis among neonates admitted into the NICU to contribute to tackling the burden of the disease and its associated problems. This study has attempted to look at the determinant factors of neonatal sepsis by incorporating as many risk factors as possible.

In this study, the overall magnitude of neonatal sepsis was 52.3%. Which was almost similar to the previous study done in Iran (51.8) [16]. The prevalence of neonatal sepsis in this study was lower compared with studies done in Shashemene town, Ethiopia (77.9%) [17] and Arbaminch, Southern Ethiopia (78.3%) [18] and higher compared with the studies done in South-eastern Mexico (24%) [19], Tanzania (31.4%) [7], Uganda (21.8%) [20] and Wolaita Sodo town, southern Ethiopia (33.8%) [15]. The reason for this difference might be due to advances in the health system nowadays that gives infuses on newborn health start from intrauterine life. In addition, the other possible reason might be due to differences in the study setting and health system setup.

The finding of this study showed that both maternal and neonatal factors had a significant effect on the risk of neonatal sepsis, though all factors did not show similar effects as findings of the previous studies.

The finding of this study showed that neonates whose age ranged from 0 to 7 days were 2 times more likely to develop neonatal sepsis as compared to those whose age ranged from 8 to 28 days [AOR = 2.351, 95% CI (1.131, 4.888)]. Similar findings were also observed in earlier studies conducted in different parts of the world, Uganda [20], Shashemene, Ethiopia [17], and Wolaita Sodo [15]. The main reason for this may be most newborns that harbor different infection agents during intrauterine life, intrapartum, and immediately after delivery show signs and symptoms during the early period (0–7 days). Neonates are very sensitive to different infection agents during the early period related to weakened immunity as compared to adults.

According to the finding of this study, neonates who had a birth weight of less than 2.5 kg were 1.68 times highly at risk to developed sepsis compared to those who had a birth weight of more than 2.5 kg [AOR = 2.546, 95% CI (1.875, 3.643)]. This finding was consistent with the studies conducted in India [21], Ghana [22], Gondar, Ethiopia [23], Jinka, Ethiopia [24], and Arbaminch, Southern Ethiopia [18]. This might be since birth weight could affect the immune status of the neonates.

This study revealed that neonates born to mothers who had a history of UTI during the index pregnancy were nearly 4 times more likely to develop sepsis than those neonates born to mothers who did not have a history of UTI during the index pregnancy [AOR = 3.709, 95% CI (1.828–7.301)]. This finding is supported by the study conducted in India [25], Ghana [22], Bishoftu, Ethiopia [26], and Mekelle, Ethiopia [27]. This might be due to late diagnosis and treatment of UTI that could result in an onset of neonatal sepsis by ascending infection of infectious agents of UTI through the vagina.

According to the finding of this study, neonates born from women without MSAF were less likely to develop neonatal sepsis compared to those neonates born from women with meconium-stained amniotic fluid [AOR = 0.384, 95% CI (0.152, 0.968)]. This finding was similar to studies conducted in Mexico [19], India [25], and Ghana [22].

The result of this study revealed that neonates who were born to mothers who had fever during labor had 2 times the risk of developing sepsis compared to their counterparts [AOR = 2.203, 95% CI (1.034, 4.692)]. This finding was consistent with other studies done in India [25], Ghana [22], Gondar, Ethiopia [28], and Mekelle, Ethiopia [27]. This might be explained by the fact that intrapartum fever is indicative of maternal infections that are frequently transmitted to the baby in utero or during passage through the canal which usually causes early-onset sepsis.

The finding of this study also showed that neonates born to mothers who had PV examination <3 were less likely to develop neonatal sepsis compared with neonates born from mothers who had more frequent PV examination [AOR = 0.278, 95% CI (0.148,0.522)]. This was in line with a study done at Wolaita sodo [15].

4.1. Strength and limitations of the study

As a strength, the study was multicenter. The retrospective nature of the study and neonates in the community were not included which may reduce the external validity of the study.

5. Conclusion

This study indicated that the magnitude of neonatal sepsis was found to be high. In general, this study has found that both maternal and neonatal factors had contributed to the risk of neonatal sepsis. Thus, careful monitoring and follow-up as well as rigorous treatment are needed; special follow-up is needed for high-risk neonates. Attention should be given to neonates delivered from women with intrapartum fever, and MSAF to prevent neonatal sepsis. Finally, pregnant women

Table 4
Bivariate and multivariate analyses of factors associated with neonatal sepsis at selected governmental hospitals of Fiche, Kuyu, G/Meskel and Muka Turi, Oromia Region, Ethiopia 2021. (n = 375).

Variables	Category	Neonatal sepsis		COR(95%CI)	AOR(95%CI)	P-Value
		Yes	No			
Ages of neonates	8–28 days	37(18.88)	55(30.73)	1	1	0.022*
	≤7 days	159(81.12)	124(69.27)	1.908 (1.181–3.075)	2.351(1.131–4.888)	
Sex of neonates	Male	105(53.57)	82(45.81)	1	1	0.415
	Female	91(46.43)	97(54.19)	0.733(0.488–1.100)	1.273 (0.713–2.273)	
ANC follow-up	Yes	170(86.73)	155(86.59)	1		
	No	26(13.27)	24(13.41)	1.012(0.558–1.837)		
Parity	Multipara	72(36.73)	108(60.34)	1	1	0.074
	Primipara	124(63.27)	71(39.66)	2.620(1.726–3.976)	1.749 (0.948–3.226)	
Place of delivery	Home	18(9.18(	6(3.35)	1	1	0.442
	Health Institution	178(90.82)	173(96.65)	0.343(0.133–0.884)	0.593 (0.157–2.248)	
PROM	No	56(28.57)	113(63.13)	1	1	0.473
	Yes	140(71.43)	66(36.87)	4.280 (2.774–6.605)	1.292(0.642–2.599)	
Intrapartum fever	No	51(26.02)	142(79.33)	1	1	0.041*
	Yes	145(73.98)	37(20.67)	10.911 (6.736–17.676)	2.203(1.034–4.692)	
No. of PV examination	≥3 times	155(79.08)	69(38.55)	1	1	<0.001*
	<3 times	41(20.92)	110(61.45)	0.166 (0.105–0.262)	0.278 (0.148–0.522)	
MSAF	Yes	84(42.86)	46(25.69)	1	1	0.042*
	No	112(57.14)	133(74.31)	0.461 (0.297–0.715)	0.384 (0.152–0.968)	
Foul smelling amniotic fluid	No	95(48.47)	145(81.01)	1	1	0.387
	Yes	101(51.53)	34(18.99)	4.534 (2.843–7.232)	1.587 (0.557–4.522)	
UTI/STI	No	68(34.69)	168(93.85)	1	1	<0.001*
	Yes	128(65.31)	11(6.15)	4.749 (2.605–8.587)	3.709 (1.828–7.301)	
Birth Weight at birth	NBW	95(48.47)	116(64.80)	1	1	
	LBW	101(51.53)	63(35.20)	1.958 (1.292–2.966)	2.546 (1.875–3.643)	0.001*
Gestational age	Term	96(48.98)	110(61.45)	1		
	Pre term	75(38.27)	51(28.49)	1.059 (0.524–2.138)		
	Post term	25(12.76)	18(10.06)	0.628 (0.323–1.222)		
Apgar score	7–10	59(30.10)	88(49.16)	1	**1**	0.629
	<7	137(69.90)	91(50.84)	2.245 (1.471–3.428)	1.174 (0.613–2.248)	
Neonate cries at birth	No	102(52.04)	86(43.88)	1		
	Yes	94(47.96)	93(56.12)	0.852 (0.568–1.278)		
Endotracheal intubation	No	135(68.88)	166(92.74)	1	1	0.724
	Yes	61(31.12)	13(7.26)	5.770 (3.041–10.946)	1.192 (0.449–3.161)	
Nasogastric tube insertion	Yes	87	50	1	1	0.183
	No	109	129	0.486 (0.315–0.747)	0.629 (0.318–1.245)	

* = P-value <0.05, CI=Confidence Interval.

should be screened for UTIs and those diagnosed with urinary tract infections should be treated with a full course of antibiotics for the prevention of neonatal sepsis. In addition, it should be recommended that the healthcare providers decrease multiple per digital vaginal examination as not indicated should better be promoted.

Ethical approval

Ethical clearance was obtained from the Institutional Review Board (IRB) of Selale University, college of health science.

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This work was funded by Selale University. The funding body did not have any role in study design, data collection, data analysis, interpretation of data or in writing the manuscript.

Authors' contributions

KB, FB, and DE contribute to the preparation of the proposal, methodology, and statistical analysis. MM and MD participated in preparing the first draft of the manuscript and contributed to the methodology and editing of the manuscript. All authors checked and confirmed the final version of the manuscript.

Trial registry number

1. Name of the registry: RESEARCH REGISTRY, https://www.researchregistry.com
2. Unique Identifying number or registration ID: researchregistry7723
3. Hyperlink to the registration (must be publicly accessible): https://www.researchregistry.com/register-now#home/registrationdetails/5d70f2520791fb0011b79e9f/

Guarantor

Firomsa Bekele.

Consent for publication

Not applicable. No individual person's personal details, images, or videos are being used in this study.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

The authors declared that they have no competing interest.

Availability of data and materials

The materials used while conducting this study are obtained from the corresponding author on reasonable request.

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Abbreviations

ANC	Antenatal care
AOR	Adjusted Odds Ratio
APGAR	Activity, Pulse, Grimace, Appearance, and respiration
CI	Confidence Interval
COR	Crude Odds Ratio
CSA	Central Statistical Agency of Ethiopia
C/S	Cesarean Section
EDHS	Ethiopian Demographic and Health Survey
EOS	Early-onset sepsis
LBW	Low birth weight
LOS	Late-onset sepsis
MCH	Maternal and child health
MDG	Millennium development goal
MSAF	Meconium stained amniotic fluid
NGOs	Nongovernmental organizations
NICU	Neonatal Intensive Care Unit
NMR	Neonatal mortality rate
PNC	Postnatal care
PROM	Premature rupture of membrane
OR	Odds Ratio
SDG	Sustainable development goal
SPSS	Statistical package for social sciences
SVD	spontaneous vaginal delivery
UNICEF	United Nations Children's Education Fund
USAID	United States Agency for International Development
UTI	Urinary tract infection
WHO	World Health Organization

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103782.

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