Neonatal Survival and Determinants of Mortality in Aroresa District, Southern Ethiopia: a Prospective cohort study

Desalegn Tsegaw Hibstu (desuethiopia@yahoo.com)
Hawassa University College of Medicine and Health Sciences https://orcid.org/0000-0002-2285-4635

Alaka Adiso Limaso
Hawassa University College of Medicine and Health Sciences

Mesay Hailu Dangisso
Hawassa University College of Medicine and Health Sciences

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Abstract

Background The first day, week and month of life are the most critical period for the survival of children. In Ethiopia, despite a significant reduction in under-five mortality during the last fifteen years, neonatal mortality remains a public health problem accounting for 47% of under-five mortality. Understanding neonatal survival and risk factors for neonatal mortality could help devising tailored interventions. Objective The aim of this study was to determine the neonatal survival and risk factors for neonatal mortality in Aroresa district, Southern Ethiopia. Methods A community based prospective follow up study was conducted among a cohort of term pregnant mothers and neonates delivered from January 1/2018 to March 30/2018. A total of 586 term pregnant mothers were selected with a multistage sampling technique and 584 neonates were followed-up for a total of 28 days, with 12 twin pairs. Data were coded, entered cleaned and analyzed using SPSS version 22. Kaplan–Meier survival curve was used to show pattern of neonatal death in 28 days. Independent and adjusted relationships of different predictors with neonates' survival were assessed with Cox regression model. The risk of mortality was explored and presented with hazard ratio and 95% confidence interval and P-value less than 0.05 were considered as significant. Result The overall neonatal mortality was 41 per 1000 live births. Hazards of neonatal mortality was high for neonates with complications (AHR=3.643; 95% CI, 1.36-9.77), male neonates (AHR=2.71; 95% CI, 1.03-7.09), small sized baby (AHR=3.46; 95% CI, 1.119-10.704), neonates who had initiated EBF after one hour (AHR=3.572; 95% CI, 1.255-10.165) and with mothers who had no postnatal care (AHR=3.07; 95% CI, 1.16-8.12). Conclusion Neonatal mortality in study area was 4.1% which was high and immediate action should be taken towards achieving the Sustainable Development Goals. To improve neonatal survival, high impact interventions such as promotion of maternal service utilization, essential newborn care and early initiation of exclusive breast feeding were recommended.

Background

Neonatal mortality (NNM) is a probability of dying of a baby within the first month of life and is expressed as neonatal deaths per 1000 live births. The first day, week and month of life are the most critical for the survival of children. Estimates made in 2015 indicates that the almost 6 million children who die before their fifth birthday, about one million babies will take their first and final breath on the day they are born. An additional one million will die in the first week, and around 2.8 million will die during their first 28 days of life (the neonatal period). Globally, 2.6 million newborns died in 2016. The neonatal mortality rate fell by 49 % from 37 deaths per 1,000 live births in 1990 to 19 in 2016 [1].

Neonatal mortality has become an important public health issue in many developing countries. Among newborns in sub-Saharan Africa, about 1 child in 36 dies in the first month, while in the world's high-income countries the ratio is 1 in 333 [1]. Africa is one of the two regions that show the smallest reductions in Neonatal Mortality Rate (NMR) of the Millennium period. In Sub-Saharan Africa, neonatal mortality accounts for 35 % of all child deaths [4]. Ethiopia is the third highest neonatal mortality contributor in Africa with 187,000 neonatal deaths in 2015 [3].

According to Ethiopian Demographic Health Survey (EDHS) 2016, the neonatal mortality rate in Ethiopia was 29 deaths per 1,000 live births [5]. Leading causes for neonatal death are pre-term birth, severe infections, and asphyxia. Neonatal factors like birth size, birth rank and birth interval and maternal complication during labour as well as health service seeking behavior are the potential determinants of neonatal mortality [9]. Children who die in the first 28 days of life suffer from diseases and conditions that are associated with quality of care around the time of childbirth and are readily preventable or treatable with proven, cost-effective interventions. Further reductions in neonatal deaths in particular setting depend on building stronger health services, ensuring that every birth is attended by skilled personnel and making hospital care available in an emergency. Cost-effective interventions for newborn health cover the antenatal period, the time around birth and the first week of life, as well as care for small and sick newborns [1].

The Ethiopian government has formulated and implemented a number of policies including Integrated Management of Newborn and Childhood Illness (IMNCI) strategy [10], Kangaroo Mother Care (KMC) [11] and Health Sector Development Plan (HSDP) [12], which aim at continued improvements in childhood survival. Despite these policy and intervention initiatives, currently, Ethiopia has the third highest reported number of newborn deaths in Africa and ranks fifth having the highest number of deaths globally [1]. Therefore, this study was aimed at determining determinants of neonatal survival in Aroresa District, Southern Ethiopia.

Methods

Study Setting and period

The study was conducted in Aroresa district which is one of 23 districts in Sidama Zone, Southern Nation, Nationalities and Peoples Region (SNNPR), Ethiopia. It is located at the distance of 181 km from Hawassa, the capital of SNNPR and 554 km from Addis Ababa. The district has 30 rural and 3 urban *Kebeles* (the smallest administrative unit in Ethiopia) with a total population of 220,332 and of this, females constitute 49.8%. The women of reproductive age group account for 51,337(23.3%) of the total population. According to the district health office report, the total number of estimated deliveries in 2017/18 was 7,623 and proportion of the utilization of first ANC, institutional delivery, PNC services and contraceptive prevalence were 77%, 38%, 69% and 49%, respectively. The district has one primary hospital, 8 health centers, 33 health posts, 3 private clinics and 4 private drug stores [13]. The study was conducted from January 1/2018 to March 30/2018.

Study design and population

A community based prospective cohort study was conducted among a cohort of term pregnant mothers and neonates delivered from January 1/2018 and March 30/2018 in randomly selected kebeles. All term pregnant mothers who live in the study kebeles were included in this study and followed up until they give birth and their neonates were followed-up for a total of 28 days. All term pregnancy and live births

(neonates) in Aroresa district were the source population and the study populations were all term pregnant mothers who live in randomly selected 10 kebeles of Aroresa district.

All term pregnant mothers (≥37 week GA) who live in 10 kebeles, from January, 1/2018 to March, 30/2018 and residents at least for six months were included in this study. All term pregnant mothers (≥37 week GA) who had a known psychiatric disorder, unable to speak and residents for less than six months were excluded from this study.

Sample size and sampling procedure

Sample size was calculated for general objectives using single population proportion with the assumption that the proportion of neonatal mortality 2.9% [5], margin of error 2%, confidence interval of 95%, design effect (DE) of 2 by using the following formula:

$n=Z^2a/2pq/d^2$ Where P = prevalence of neonatal mortality which is 0.029, n=sample size $Z_{\alpha/2}$=1.96, d=margin of error =2%, n= $((1.96)^2$ *0.029*.0.971/ (0.02) (0.02) =270

DE=2 –> n=270×2=540, since the source population is less than 10,000 which is 7623, correction formula was applied as; n_f (final sampe size)=n_i/1+n_i/N, n_f=522

Sample size for 2ndspecific objectives (associated factors) is shown in table 1 using EPI Info version 3.2.1 (**Table 1)**

Sample size determination for significant variable was taken from a study conducted in kersa district, Eastern Ethiopia [14].

Since the sample sizecalculated for the first objective was greater than the sample size calculated for the second objective, n=522 was used. Adding 15% non-response and lost to follow-up rate = 78, the final sample size was 522+78=600.

Multistage sampling was used to identify 600 term pregnant women to be enrolled in the follow up for the study (all term pregnant mothers were recruited consecutively until sample size was reached). First, all the *Kebeles*; in Aroresa district were determined to be 33. Then, 10 *kebele* (9 rural '*Kebele* and 1 urban) were selected from the district by simple random sampling method using openEpi3.03. The calculated sample size was proportionally allocated to each study kebele based on expected number of term pregnant women per '*Kebele*'. Then the calculated sample was selected consecutively from each *kebele*.

Variables

The outcome variable is neonatal survival dichotomized as (alive =1 and died=0) The predictor variables include; *socio-demographic* and *economic factors:* place of residence, marital status, education status of mother and father, occupation status of mother and father, age of mother, *maternal factors*: age at child birth, maternal complication (excessive bleeding, puerperal sepsis and fever, prolonged labour, eclampsia

and preeclampsia malpresentation and malposition, premature rupture of membrane, and obstructed labour), *maternal service utilization factors*: place of delivery, delivery assistance, ANC service, postnatal care, initiation of EBF and *neonatal factors*: birth size, birth order and interval and neonatal complication like asphyxia, infection, hypothermia, and jaundice

Operational definition

Neonatal death: a death of neonate within 28 days of life according to report of mother participated in study. *Neonatal survival* is defined as being alive up to the end of follow-up period (28 days). *Term pregnancy* is a pregnancy between 37 completed weeks up to 42 completed weeks of gestation. *Birth size* is defined as the size of newborn at birth according to the perception of mother. *Stillbirth* is defined as any fetus born without a heartbeat, respiratory effort or movement, or any other signs of life.

Data collection tool and procedure

A structured questionnaire, first prepared in English and translated into Sidamu Afoo (local language), were employed to collect data. All term (>37 week GA) pregnant women at selected kebele were identified by Health Extension Workers (HEW). Trained data collectors were contacted the women to obtain informed consent, to perform interviews and later to conduct postpartum follow-up, home visits, at week 1, and 4. All data collectors were contacted with the supervisor by mobile phone every week and on site supervision. Baseline data collected during recruitment were maternal socio-demographic information, medical history and antenatal use of health services. Pregnancy outcomes, the circumstances of delivery, date of birth, date of death of neonate, feeding patterns and, illness episodes of neonate were collected during follow-up period. The data collection processes were supervised strictly by trained supervisors and the principal investigator.

The quality of data was assured using properly designed questionnaire, proper training of the interviewers and supervisors about the data collection and follow-up procedures, proper categorization and coding of the questionnaire. Questionnaires were pre-tested on 5% of the sample outside the study area. Data were double entered and screened for missing, outlier values and data entry errors using the frequency distribution. Errors were corrected against the raw data and the necessary corrections were made before the analysis.

Statistical Analysis

Data were coded, entered, cleaned and analysed using SPSS version 22. Pregnancy outcome variables were explained by descriptive statistics and neonatal outcome variables were examined against all confounding variables using regression analysis. Kaplan–Meier survival curve was used to show pattern of neonatal death in 28 days. Independent and adjusted relationships of different predictors with neonates' survival were assessed with Cox regression model. The risk of mortality was explored and presented with hazard ratio and 95% confidence interval. P-value less than 0.05 were considered as significant. Multicollinearity between the independent variable was assessed using variance inflation

factors (VIF) and VIF greater than 10 was considered as existence of multicollinearity before interpreting the final output.

Results

A total of 586 term pregnant mothers were identified and enrolled in follow up consecutively for three months period and these pregnancies resulted in 14 (2.4%) stillbirths and 584 live births, including 12 pairs of twins. Then 584 neonates were followed until 28 days to determine their survival status. From a total of 600 neonates planned, 584 neonates were recruited making a response rate of 97.33%. The perinatal mortality (stillbirth and early neonatal deaths) was 49/1000 pregnancies.

The mean age of mothers was 29.08 years [± 4.37 standard deviation (SD)], 523(89.6%) mothers were residing in rural areas at the time of delivery of their last child and 553(94.7%) were married. Regarding educational status, 231(39.6%) of mothers were illiterate and 156(28.2%) of husbands had attended primary school. The median household's monthly income was 550 ETB (IQR=537.5) and 420(72.1%) of mothers were housewives (**Table 2).**

Characteristics of term pregnant mothers and their neonates

Among 584 neonates born in study area, 405(69.3%) born from mothers who had ANC follow up and, of whom 209(35.8%) had 1-2 ANC visits in health facilities. Five hundred and fifty seven (95.4%) of mothers had no history of chronic medical diseases and 500 (85.6%) had no history of previous still births. Majority of neonates, 501 (85.8%) born from mothers who had no complication during delivery. More than half, 318(54.5%) of neonates born in home and 520 (89.0%) had started breast feeding within one hour.

Concerning characteristics of neonates, 300(51.4%) were females, 294(50.5%) were in 3rd and 4th birth order or birth rank and 560 (95.9%) were singleton in birth type. From 584 neonates, 422(72.3%) had no neonatal complication during neonatal period and 52.9% had postnatal care during their neonatal period **(Table 3**).

According to the perception of mothers on size of their neonates, 404(69.18%) reported average size (**Figure 2)** and 258(44.2%) were 24-48 months in birth interval (**Figure 3**).

Neonatal survival

Among 584 neonates followed, there were 24 neonatal deaths making a neonatal mortality rate (NMR) of 41 per 1,000 live births (95% CI: 26-58). Over all the neonatal survival was 95.9% (95% CI: 94.2- 97.4). From 24 neonatal deaths, 15(62.5%) deaths occurred in the first week, 5(20.83 %) occurred at the second week, 3(12.5%) occurred at third week and 1(4.17%) occurred at last week.

The incidence rate of neonatal mortality was 1.51 per 1000 person-days-of observation.

Kaplan-Meir survival analysis

Kaplan-Meier survival function curve shows that the probability of survival of a neonate who had initiated EBF after one hour was lower than a neonate who had initiated EBF within one hour. On day 5, the probability of survival of a neonate who had initiated EBF after one hour was 95.3% and for a neonate who had initiated within one hour was 98.5% (**Figure 4**). Moreover survival graph indicates that the probability of survival of both groups falls rapidly on first week and looks stable after the end of second week.

Cox proportional hazards regression models

Variables with p- value less than 0.25 in crude model were included in the Cox proportional hazards regression model. Maternal educational status, neonatal complication, maternal history of stillbirth, place of child birth, baby's sex, baby's size at birth, birth type, initiation of BF and postnatal care were variables included in Cox regression model. Maternal history of stillbirth, place of child birth and birth type lost their significance after adjusting for confounders.

The risk of neonatal mortality was about 3.6 times higher for neonates who had neonatal complication compared to those who had no complication (AHR=3.64, 95% CI 1.39-9.77). Male neonates had 2.7 times higher risk of neonatal mortality compared with female neonates (AHR 2.71, 95% CI 1.04-7.09). According to mother's perception of baby's size, neonates of small size were 3.46 times more risk of dying compared with average size neonates (AHR 3.46, 95% CI 1.119-10.704). Time of initiation of BF and postnatal care were also independent predictors of neonatal mortality. Neonates initiated BF after one hour and who had no postnatal care were about 3.6 (AHR=3.57, 95% CI 1.26- 10.17)**)** and 3 (AHR= 3.07, 95% CI 1.16- 8.12) times at higher risk of dying than neonates initiated BF within one hour and had postnatal care, respectively **(Table 4)**.

Discussion

Our study showed that stillbirth rate in the study area was 24 per 1,000 births which is much lower than hospital based prospective cohort study in Uganda which reported stillbirth rate of 120 per 1,000 births [15]. This finding is also lower than EDHS 2016 report of perinatal mortality but it is higher than the study conducted in South-West Ethiopia [16]. Our result should be interpreted cautiously because it reports the stillbirth rate among term pregnancy only, which might underestimate actual burden of the stillbirth in the study area. On the other hand, there could be a misclassification of pregnancy outcome such as; severely asphyxiated neonates might be classified as stillbirth which could also overestimate the magnitude of stillbirth rate in the study setting.

The neonatal mortality rate in the study area was 4.1%, which was higher than the global neonatal mortality rate in 2016 [1] and reports from studies conducted in Ethiopia [14, 17], Sudan and Zambia [18,19] . The differences might be attributed to study designs, health service coverage and socio-economic factors. Our result is consistent with the NMR of Pakistan [1], studies conducted in Jimma,

Ethiopia and Nigeria [6, 20], but it is lower than a study done in Tigray, Ethiopia [8]. In our study, 62.5% neonatal deaths occurred in the first week of their life, which is similar with other studies [7, 8, 14].

Regarding determinants of neonatal survival, socio demographic factors contribute to neonatal in this study. Additionally, place of child birth were also contributes less to neonatal mortality, even though it was reported as one of the strongest predictors of neonatal mortality in different studies [6, 21, 22].

Our study revealed that male neonates were less likely to survive than female neonates. This is similar with studies done in different areas even though there are differences in the strength of association [7, 23-26]. In this study male neonates were about 2.7 times more likely to die than female neonates. This finding is consistent with the study conducted in Northern Shoa, Ethiopia and higher than studies conducted in Nigeria, Pakistan, Bangladesh and Indonesia [7, 23-26]. The possible explanations for the increase in mortality among males neonates, as mentioned in many studies, could be male sex appeared to have respiratory problems, intrauterine growth restriction insufficiency or prematurity and low Apgar score [31, 32].

We did not measure birth weight newborns since the study was conducted at community level; instead we used mother's perception of baby's size to estimate the size of neonates. Our result shows that neonates perceived as small in size by their mothers were 3.46 times at risk of dying than those with average in size. Similarly, a study from Indonesia revealed that newborns whose birth size according to mothers' perception was smaller than average, had 2.8 times higher risk of dying than average sized babies and neonates of low birth weight had 5.5 times higher risk of neonatal death than normal weight babies [25]. Additionally, findings from Nigeria shows that neonates perceived as small or smaller by their mothers were 2.26 times higher risk dying than average sized neonates [23]. Another study from Pakistan also reported that a hazard of neonatal mortality was higher among small sized neonates than average sized neonates [24]. The prospective follow up study in Jimma, Ethiopia also showed that small size babies at birth were found to have an increased risk of death than average size neonates [6].

Post natal care in this study was statistically significant determinant of neonatal survival. Neonates who had no post natal care during neonatal period had 3 times higher risk of neonatal mortality than neonates who had post natal care. A study from Ghana consistently reported that utilization of post natal service was inversely related with neonatal mortality [27].

Similarly, the study conducted in Northern Shoa, Ethiopia revealed that neonates born from mothers who did not receive postnatal service were 3 times more likely to experience neonatal death than neonates who born from mothers who received postnatal services [21]. This might be due to postnatal visits which could enable the HEWs to identify and screen health condition of mothers and their neonates and this could help in providing neonatal health care services. Our finding had a lower strength of association compared with a study conducted in Jimma, Ethiopia. The study reported that neonates having poor neonatal care were about ten times risk of dying during neonatal period as compared to those who received good comprehensive neonatal care [6]. A possible explanation for this difference might be due

to classification of study variables. The studies classified postnatal care as having poor comprehensive neonatal care and good c neonatal care unlike our study.

In this study neonates initiated breast feeding after one hour of delivery were at higher risk of dying during neonatal period. This agrees with the studies conducted in other parts of Ethiopia. The case control study in North Shoa Zone, Ethiopia indicated that neonatal death was in excess among neonates who were not breastfed within the first hour after delivery compared with those who were breastfed within the first hour after delivery [21]. A study from Tigray, Ethiopia also reported initiating exclusive breast feeding within one hour has a protective effect on hazards of neonatal mortality [8]. Initiation of breast feeding within the first hour can help prevent neonatal deaths caused by infections such as sepsis, pneumonia, and diarrhea and may also prevent additional hypothermia related deaths, especially in preterm and low birth weight infants in developing countries [28].

Our study showed that neonates with complication survive less likely than neonates who had no complications. The study from Tigray, Ethiopia reported consistently that neonate who had no complications after birth had 99.86% less hazard of death than who had complications [8]. Similarly, the study from Ghana revealed that infections, preterm birth and low birth weight, birth trauma, and hypothermia were causes of neonatal mortality [29]. Preterm birth complications, intra partum related events and sepsis or meningitis were reported as among the leading causes of newborn death globally in 2016 [30]. In our study, preterm pregnant mothers were not participated in the study which might underestimate the strength of association of neonatal complication and neonatal mortality.

As a limitation, in this study, baby weight were not measured but estimated from mother's perception of baby's size which was subjective and may cause information bias. However, measures were taken to minimize the bias by helping mothers correctly estimate the size of their babies. The results are also consistent with other studies used similar methods. The study did not address all determinants of neonatal mortality which might affect true association of studied variables and unmeasured factors.

Conclusions

Neonatal mortality in study area was still high and calls for immediate action towards achieving the Ethiopian Health Sector Transformation plan of reducing neonatal mortality to 10% at the end of 2020 and the targets of the Sustainable Development Goals. A significant proportion of mothers also delivered at home, which requires strategies to improve coverage of institutional delivery. Various factors such as neonatal complications, duration of EBF, sex of neonates, size of neonates at birth, and postnatal care were identified as independent predictors of neonatal survival. Tailored interventions addressing modifiable risk factors should be devised so as to improve neonatal survival in the study area.

Abbreviations

AHR: Adjusted Hazard Ratio, ANC: Antenatal Care, CBNC: Community Based Newborn Care, CHR: Crude Hazard Ratio, CI: Confidence Interval, DE: Design Effect, EBF: Exclusive Breast Feeding, EDHS: Ethiopian Demographic and Health Survey, ENMR: Early Neonatal Mortality Rate, GA: Gestational Age, HEW: Health Extension Worker, HSDP: Health Sector Developmental Program, IMNCI: Integrated Management of Newborn and Childhood Illness, IRB: Institutional Review Board, KMC: Kangaroo Mother Care, NGO: Non-Governmental Organization, NMR: Neonatal Mortality Rate

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. Supportive letter was provided from Sidama Zone Health Department and Aroresa district Health Office. The study participants were communicated about the aim of the research work and informed verbal consent for minors (below the age of 18 years was obtained from their elders/parents which was approved by the ethics committee.

Consent to publish

Not applicable.

Availability of data and materials

The data that support the findings of this study will be found from the representing author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors’ contributions

AAL, MHD and DTH participated in planning the study, monitoring data collection process and analyzing the data, writing the result and the manuscript. All authors read and approved the final manuscript.

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Tables

Table 1 sample sizes calculated for specific objectives, Aroresa district, Southern Ethiopia, 2018

Variables	Confidence level (%)	Power (%)	% in unexposed	AHR	n(sample size)
No previous birth	95	80%	11.4	2.15	448
Twin birth	95	80%	2.8	5.4	240
Preterm birth	95	80%	2.9	2.15	88

Table 2 Socio demographic characteristics of mothers and neonates in Aroresa district, Southern Ethiopia, 2018.

Variables	Categories	Frequency (n.)	Percentage (%)
Age	15-24	117	20
	25-34	418	71.6
	>34	49	8.4
Residence	Urban	61	10.4
	Rural	523	89.6
Marital status	Married	553	94.7
	Others[1]	31	5.3
Husband educational level	Cannot read and write	151	27.3
	Read and write	145	26.2
	Primary	156	28.2
	Secondary & above	101	18.3
Maternal educational level	Illiterate	231	39.6
	Read and write	147	25.2
	Elementary	105	18.0
	Secondary & above	101	17.3
Religion	Protestant	520	89.0
	Orthodox	23	3.9
	Catholic	7	1.2
	Muslim	34	5.8
Ethnicity	Sidama	513	87.8
	Amhara	39	6.7
	Oromo	12	2.1
	Guragie	20	3.4
Maternal occupation	Government employee	30	5.1
	Merchant	93	15.9
	Housewife	420	71.9
	Others*	41	7.0
Monthly income	<300	90	15.4
	301-500	201	34.4
	501-1000	186	31.8
	>1000	107	18.3

[1]single, divorced, widowed [2]wolaita, kambata * Student, daily labor

Table 3 Characteristics of mothers and neonates in Aroresa district, Southern Ethiopia, 2018

Variables	Category	Frequency (n)	Percentage
Birth order	1st and 2nd	108	18.5
	3rd and 4th	294	50.5
	5th and above	182	31.2
History of still birth	Yes	84	14.4
	No	500	85.6
History of chronic diagnosed medical illness	Yes	27	4.6
	No	557	95.4
ANC visit	Yes	405	69.3
	No	179	30.7
Number of ANC visits	None	179	30.7
	1-2	209	35.8
	3 and 4	196	33.6
Complication during labor	Yes	83	14.2
	No	501	85.8
Place of deliver	Health facility	266	45.5
	Home	318	54.5
Baby sex	Boys	284	48.6
	Girls	300	51.4
Birth type	Single	560	95.9
	Twin	24	4.1
Baby's size	Average	404	69.2
	Small	60	10.3
	Large	120	20.5
Birth interval	No previous	61	10.4
	birth	233	39.9
	<24 months	258	44.2
	24-48 months	32	5.5
	>48 months		
Initiation of BF	<60 minute	520	89.0
	≥60 minute	64	11.0
Neonatal complication	Yes	162	27.7
	No	422	72.3
Post natal care	Yes	309	52.9
	No	275	47.1

Table 4 Determinants of Neonatal Survival in Aroresa district, Southern Ethiopia, 2018

Variables		Neonatal Survival Status		CHR (95% CI)	AHR (95% CI)	p-value
		Censored	Died			
Maternal educational status	Illiterate	215(93.1%)	16(6.9%)	7.18(0.95-54.13)	2.45(0.31, 19.60)	0.399
	Read and write	142(96.6%)	5(3.4%)	3.44(0.40-29.46)	3.43 (0.39, 29.97	0.265
	Primary	98(98.0%)	2(2.0%)	1.94(0.18-21.37)	1.45(0.13, 16.35	0.77
	Secondary and above	105(99.1%)	1(0.9%)	1.00	1.00	
Neonatal complication	Yes	146(90.1%)	16(9.9%)	5.39(2.31-12.59)	3.64 (1.36, 9.77)	0.010*
	No	414(98.1%)	8(1.9%)	1.00	1.00	
History of still birth	Yes	260(97.7%)	6(2.3%)	2.55(1.01-6.42)	1.13(0.41, 3.10	0.810
	No	300(94.3%)	18(5.7%)	1.00	1.00	
Place of deliver	Health facility	260(97.7%)	6(2.3%)	1.00	1.00	
	Home	300(94.3%)	18(5.7%)	2.55(1.01-6.42)	2.00(0.67, 5.97	0.214
Baby sex	Male	267(94.0%)	17(6.0%)	2.61 (1.08-6.29)	2.71(1.04, 7.09	0.042*
	Female	293(97.7%)	7(2.3%)	1.00	1.00	
Birth type	Single	539(96.3%)	21(3.8%)	1.00	1.00	
	Twin	21(87.5%)	3(12.5%)	3.48(1.04-11.68)	3.99 (0.96, 16.63)	0.057
Baby’s size	Average	393(97.3%)	11(2.7%)	1.00	1.00	
	Small	51(85.0%)	9(15.0%)	5.89(2.44-14.22)	3.46(1.12, 10.70)	0.031*
	Large	116(96.7%)	4(3.3%)	1.24(0.40-3.90)	1.37(0.41,4.55)	0.609
Initiation of BF	<60 min.	502(96.5%)	18(3.5%)	1.00	1.00	
	≥60min.	58(90.6%)	6(9.4%)	2.81(1.12-7.09)	3.57(1.26, 10.17)	0.017*
Postnatal care	Yes	302(97.7%)	7(2.3%)	1.00	1.00	
	No	258(93.8%)	17(6.2%)	2.799(1.16-6.75)	3.07(1.16, 8.12)	0.024*

*= significant at $P < 0.05$

Figures

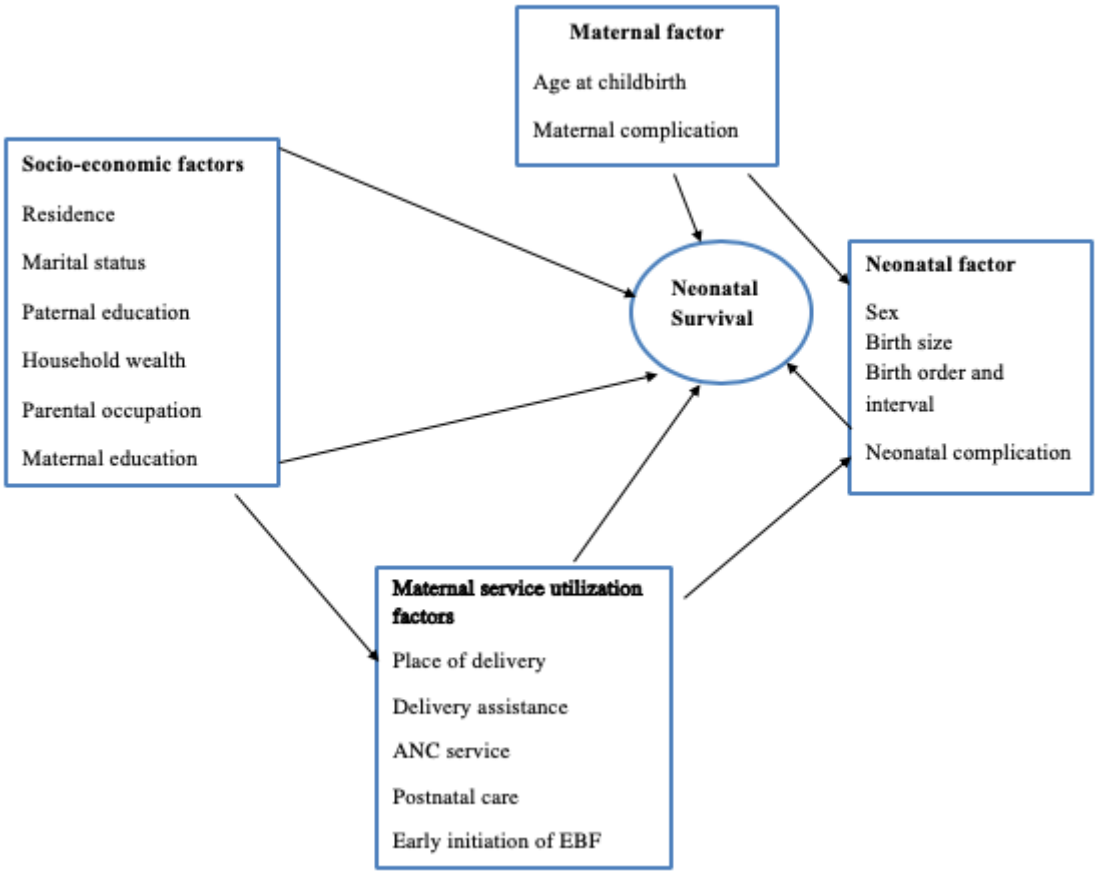

Figure 1

Source: conceptual framework proposed by Mosley and Chen with modifications.

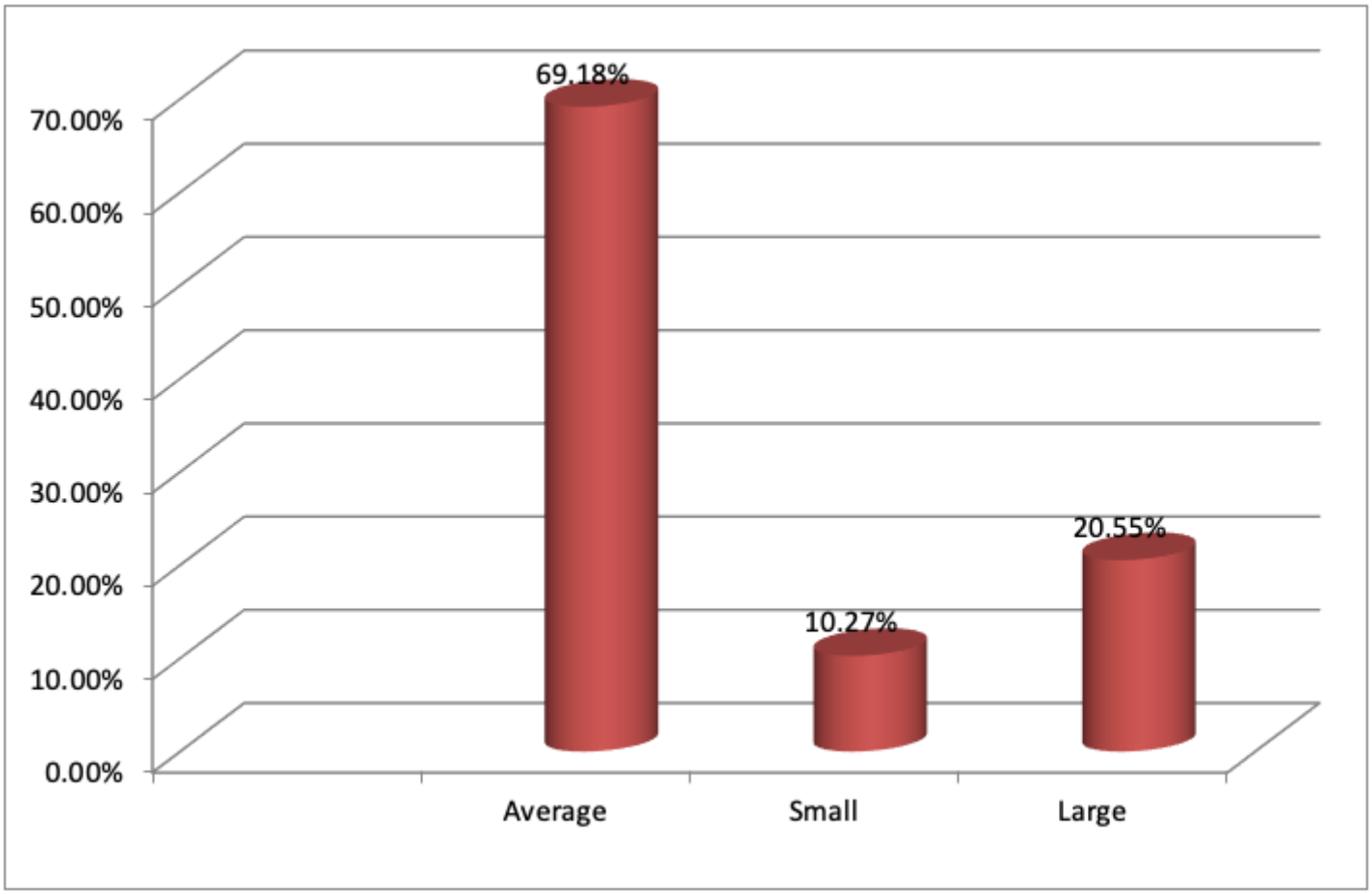

Figure 2

Baby's size according to perception of mother in Aroresa District, Southern Ethiopia, 2018.

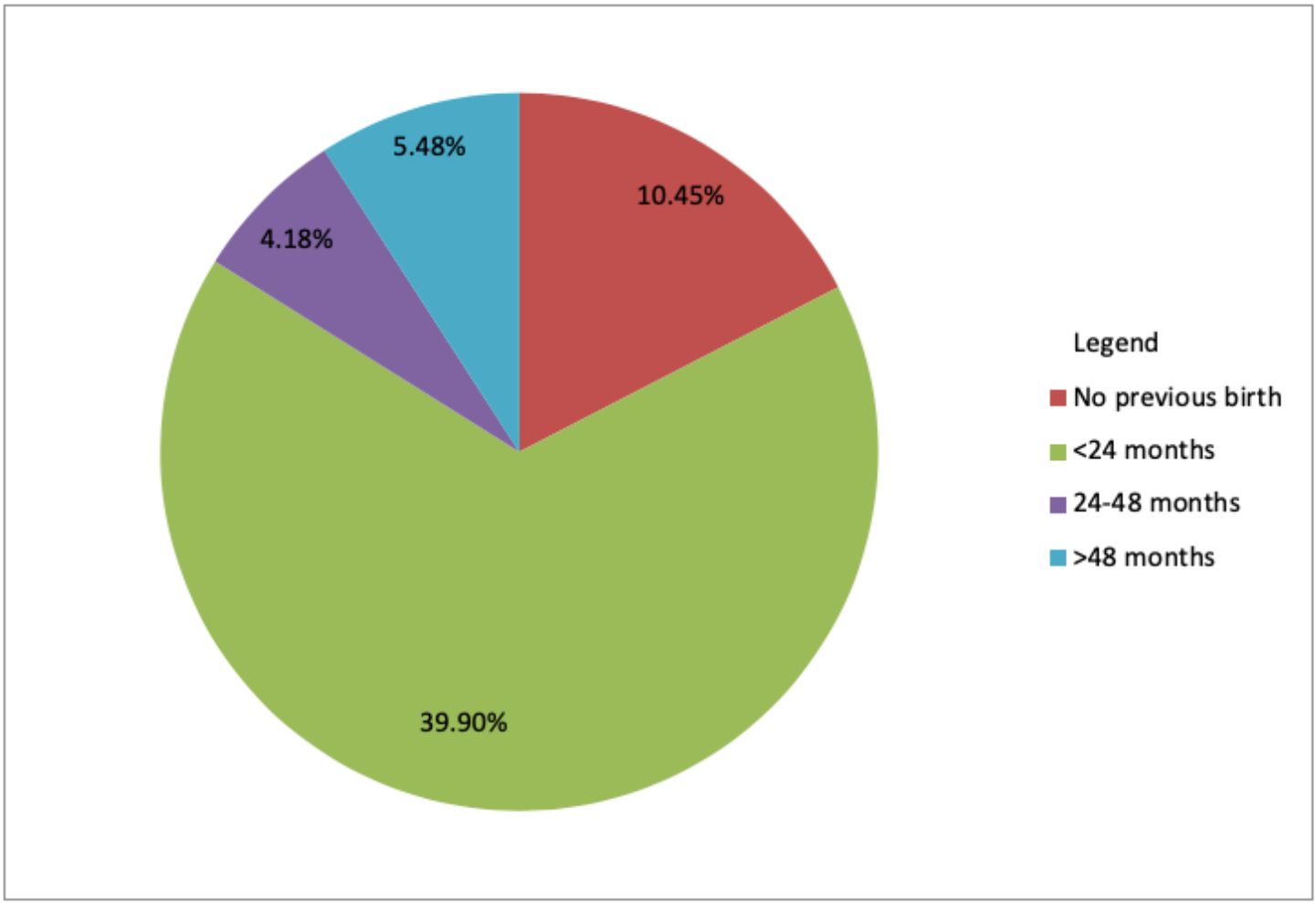

Figure 3

Birth interval of Neonates in Aroresa district, Southern Ethiopia, 2018.

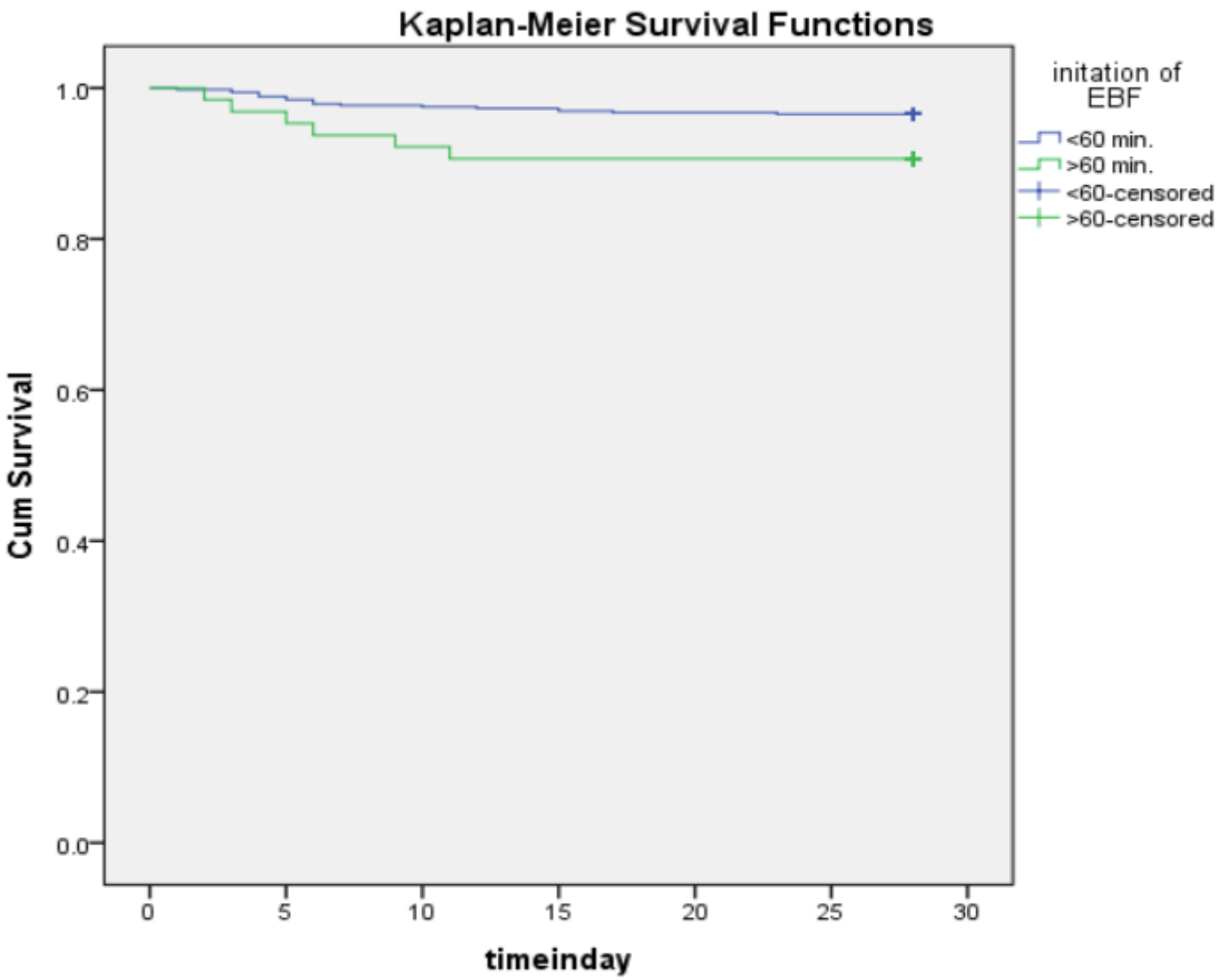

Figure 4

Kaplan-Meir survival pattern of Neonate and initiation of Exclusive Breast Feeding (EBF) Aroresa district, Southern Ethiopia, 2018