Determinants of neonatal mortality in Ethiopia: an analysis of the 2016 Ethiopia Demographic and Health Survey

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Abstract

Background: The first 28 days of life, the neonatal period, are the most vulnerable time for a child's survival. Neonatal mortality accounts for about 38% of under-five deaths in low and middle income countries. This study aimed to identify the determinants of neonatal mortality in Ethiopia.

Methods: The study used data from the nationally representative 2016 Ethiopia Demographic and Health Survey (EDHS). Once the data were extracted; editing, coding and cleaning were done by using SAS 9.4.Sampling weights was applied to ensure the representativeness of the sample in this study. Both bivariate and multivariable logistic regression statistical analysis was used to identify determinants of neonatal mortality in Ethiopia.

Results: A total of 11,023 weighted live-born neonates born within five years preceding the 2016 EDHS were included this in this study. Multiple logistic regression analysis showed that multiple birth neonates (Adjusted Odds Ratio (AOR)=6.38;95%-Confidence Interval (CI):4.42-9.21), large birth size (AOR=1.35; 95% CI: 0.28-1.62), neonates born to mothers who did not utilize ANC (AOR=1.41; 95% CI: 1.11-1.81), neonates from rural area (AOR=1.88; 95% CI: 1.15-3.05) and neonates born in Harari region (AOR=1.45; 95% CI: 0.61-3.45)had higher odds of neonatal mortality. On the other hand, female neonates (AOR=0.60; 95% CI: 0.47-0.75), neonates born within the interval of more than 36 months of the preceding birth (AOR=0.56; 95% CI: 0.43-0.75), neonates born to fathers with secondary and higher education level (AOR=0.51; 95%CI: 0.22-0.88) had lower odds of neonatal mortality in Ethiopia.

Conclusion: To reduce neonatal mortality in Ethiopia, there is a need to implement sex specific public health intervention mainly focusing on male neonate during pregnancy, child birth and postnatal period. A relatively simple and cost-effective public health intervention should be implemented to make sure that all pregnant women are screened for multiple pregnancy and if positive, extra care should be given during pregnancy, child birth and postnatal.

Keywords: Neonatal mortality; logistic regression; odds ratio; Ethiopia.

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Background

Neonatal mortality is defined as an infant in the first 28 days of life after birth, and contributes to 38% of all under-five deaths. Global estimates indicate that annually 2.6 million neonatal deaths take place among newborns in 2016. The largest number of newborn deaths occurred in low- and middle-income countries especially Southern Asia (39%), followed by sub-Saharan Africa (38%)[1-3]. Globally, the under-five mortality rate dropped to 41 deaths per 1,000 live births in 2016 from 93 in 1990. The neonatal mortality rate fell by 49% from 37% deaths per 1,000 live births in 1990 to 19% in 2016[1,4]. In 2017, neonatal mortality rate was 28.9 deaths per 1,000 live births in Ethiopia. Neonatal mortality rate of Ethiopia fell gradually from 50.6 deaths per 1,000 live births in 1998 to 28.9 deaths per 1,000 live births in 2017[5].

The global effort is put in place to alleviate poverty and improve the health status of children aiming at achieving the Millennium Development Goals (MDGs) for the past 15 years. This effort managed to decrease under-five mortality generally, but significant proportion of this reduction is attributed to post neonatal mortali-

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ty[6]. Among most of Sub-Saharan Africa countries, a decline in neonatal mortality is recorded in Ethiopia, and the nation has achieved MDG-4(reducing under-five mortality by two thirds). However, the neonatal mortality rate is still unacceptably high at 37 per 1000 live births exceeding the global estimate of 19 per 1000 live births in two folds[7-9].

The United Nations mortality estimate in 2013 revealed that the neonatal mortality rate in Ethiopia was 28 per 1000 live births. Even though there is an achievement observed in the reduction of neonatal mortality by 48%, still neonatal mortality is high[10]. At the 67th World Health Assembly in 2014, 194 member states of the WHO develop an action plan that was targeted to end preventable deaths and stillbirths[11].

According to the Ethiopian Demographic Health Survey (EDHS) 2011, mortality estimate ranges from as low as 53/1000 live births in Addis Ababa to as high as 169/1000 live births in Benishangul-Gumuz region. Infant mortality also declined from 97deaths per 1,000 live births in 2000 to 48 deaths per1,000 live births in 2016, which is about a 50% reduction in the last 16 years. Neonatal mortality declined from 49 deaths per 1,000 live births in 2000 to 29 deaths per 1,000 births in 2016, a reduction of 41% over the past 16 years[12].

The determinants of neonatal mortality are not well documented in Ethiopia mainly at national level. But few previous studies reported causes such as sepsis, birth asphyxia, birth injury, Preterm prenatal respiratory disorder, prematurity, tetanus, preterm birth, congenital malformations and unknown causes[13,14].

Likewise, Ethiopia has approved strategies to halt the burden of neonatal mortality through ANC, postnatal care (PNC), immunization during and after pregnancy, and skill birth attendance. Despite there is a reduction in neonatal mortality, still there is a need to have focused attention on newborn interventions[15]. Therefore, the aim of this study was to identify factors affecting neonatal mortality in Ethiopia.

Data and statistical analysis

Source of data

This study used data from the 2016 Ethiopia Demographic and Health Survey (EDHS) which is openly available from the measure DHS website (https://dhsprogram.com). The 2016 EDHS is the fourth Demographic and Health survey conducted in Ethiopia. The survey was implemented by the Central Statistical Agency (CSA) at the request of the Federal Ministry of Health (FMoH). The data were collected from January 18, 2016 to June 27, 2016. The primary objective of the 2016 EDHS was to provide up to date estimates of key demographic and health indicators.

Study variables

The response (outcome) variable of this study was 'neonatal mortality', which is defined as the death of a live-born infants within 28 days of life which can be recorded as binary (1= died, 0= not died). Table 1 shows a list of all the independent variables (factors) used in this study along with their definitions and categorizations. Demographic factors included in this study were maternal age (in year), sex of child, birth order, birth type, birth interval (months) and birth size. Socio-economic factors: place of residence, region of residence, maternal education level, paternal education level, religion and wealth index; maternal health care: place of delivery and Antenatal Care (ANC) usage.

Table 1 Definition and categorization of the variables used in the analysis of neonatal mortality in Ethiopia, EDHS 2016

Variables	Definitions and Categorization
Maternal age	Mother's age at childbirth (1=15-24; 2=25-34; 3=35-49)
Birth order	Birth rank of child (1=first;2=2-3; 3=4-5; 4=6 or more)
Birth interval	Preceding birth interval (in months) (1=<24; 2= 24-36; 3= > 36)
Sex of child	Sex of the neonate (1=male; 2=female)
Type of birth	Type of neonate birth (1=single; 2=multiple
Birth size	Mother's perception of birth size at birth (1=Large; 2=Average; 3= small)
ANC Usage	Antenatal care usage during pregnancy (1=Yes; 2=No)
Place of delivery	Place of delivery (1=Home; 2=Health facility)
Residence	Place of residence (1=Urban; 2=Rural)
Region	Administrative regions (1=Tigray;2=Afar;3 =Amhara; 4=Oromia 5=Somali; 6= Benishangul; 7=SNNP; 8=Gambela; 9=Harari; 10= Dire Dawa; 11=Addis Ababa)
Maternal education	Maternal education level (1=No education; 2=Primary; 3= Secondary& Higher)
Paternal education	Paternal education level (1=No education; 2=Primary;3= Secondary & Higher)
Wealth index	Household weald index (1=Poor; 2=medium; 3=Rich)
Religion	mother's religion: (1=Christian; 2=Muslim; 3=Traditional/Others)

Sampling weights

To adjust for the disproportionate sampling and lack of independence of individual units within randomly sampled clusters[17], DHS weights the data. This study applied sampling weights to ensure the actual representativeness of the survey to national level.

Statistical analysis

SAS 9.4 (SAS Institute Inc.,Cary, NC, USA) was used to analyze the data in this study. Weighted frequency was calculated for all study variables to describe the background characteristics of study participants. After reporting the frequency distribution, logistic regression analysis was conducted to investigate the association between the potential determinants and neonatal mortality. Crude odds ratios (CORs) were calculated by entering all potential factors into the baseline equation (i.e., one variable at a time) with neonatal mortality as the outcome variable. Significance factors ($p \leq 0.25$) in bivariate logistic regression analyses were included in the multiple logistic regression analysis for adjustment and adjusted odds ratios (AORs) were calculated using stepwise variable selection method. Odds ratios (ORs) were reported with 95% confidence intervals (CIs).

Results

A total of 11,023 weighted neonates born within five years preceding the 2016 Ethiopia Demographic and Health Survey (EDHS) were included in this study. The characteristics of the study variables were presented in Table 2. Out of these, 365 (3.3%) of neonates, were died within 28 days of live born. About 20.9 % of neonates born to mothers aged 15-24 were died in 28 days of life. Majority of male neonates (65%), neonates delivered at home (71.6%), neonates born to mothers with no education (70%), neonates born to mothers residing in rural area (89.3%) and neonates born to poor household (62.8%) were died in 28 days of life (Table 2).

Table 2 Background characteristics of study participants, EDHS 2016 (n=11,023)

Variables	Unweighted n (%)	Weighted n (%) *	Number of deaths n (%)	NMR
Maternal age (in year)				
15-24	2575(24.2)	2716 (24.6)	76(20.9)	29.5
25-34	5521(51.9)	5611(50.9)	200 (55.1)	36.2
35-49	2545(23.9)	2695 (24.5)	87 (24.0)	34.2
Sex of child				
Male	5483 (51.5)	5725 (51.9)	236(65.0)	43.0
Female	5158 (48.5)	5298 (48.1)	127(35.0)	24.2
Birth Order				
1	2167 (20.4)	2058 (18.7)	77(21.2)	35.5
2-3	3338 (31.4)	3359 (30.5)	104(28.7)	31.2
4-5	2475 (23.3)	2604 (23.6)	79(21.8)	31.9
6+	2661 (25.0)	3001 (27.2)	103(28.4)	38.7
Birth Type				
Single	10363 (97.4)	10730 (97.3)	320(88.2)	30.9
Multiple	278 (2.6)	292(2.7)	43(11.8)	154.7
Birth Interval (months)				
<24	3018 (28.4)	2836 (25.7)	144(39.7)	47.7
24-36	3296 (31.0)	3431 (31.1)	103(28.4)	31.3
>36	4326 (40.7)	4756 (43.1)	116(32.0)	21.8
Birth Size				
Large	3214 (30.2)	3527 (32.0)	77(22.1)	24.0
Average	4419 (41.5)	4559 (41.4)	170(48.9)	38.5
Small	2890 (27.2)	2829(25.6)	101(29.0)	34.9
Missing	118 (1.1)	109 (1.0)		
ANC Usage				
Yes	6869(64.6)	6897 (62.6)	199(54.8)	29.0
No	3771 (35.4)	4126(37.4)	164(45.2)	43.5
Place of Delivery				
Home	7155 (67.2)	7997 (72.6)	260(71.6)	36.3
Health facility	3370 (31.7)	2892 (26.2)	99(27.3)	29.4
Missing	116 (1.1)	134 (1.2)		
Place of residence				
Urban	1974 (18.6)	1216 (11.0)	39(10.7)	19.8
Rural	8667(81.4)	9807 (89.0)	324(89.3)	37.4
Region				
Tigray	1033 (9.7)	716 (6.5)	28(7.7)	27.1
Afar	1062 (10.0)	114 (1.0)	37(10.2)	34.8
Amhara	977 (9.2)	2072 (18.8)	33(9.1)	33.8
Oromia	1581 (14.9)	4851(44.0)	51(14.0)	32.3
Somali	1505 (14.1)	508 (4.6)	68(18.7)	45.2
Benishangul	879 (8.3)	122 (1.1)	36(9.9)	41.0
SNNP[a]	1277 (12.0)	2296 (20.8)	37(10.2)	29.0
Gambela	714 (6.7)	27 (0.2)	21(5.8)	29.4
Harari	605 (5.7)	26(0.2)	27(7.4)	44.6
Addis Ababa	461 (4.3)	244 (2.2)	10(2.8)	21.7
Dire Dawa	547 (5.1)	47 (0.4)	15(4.1)	27.4
Maternal education level				
No education	6838 (64.3)	7284 (66.1)	254(70.0)	37.2
Primary	2678 (25.2)	2951 (26.8)	81(22.3)	30.3
Secondary & higher	1125 (10.6)	788 (7.1)	28(7.7)	24.9
Paternal education level				
No education	4928 (46.3)	5161 (46.8)	180(49.6)	36.5
Primary	3220 (30.3)	3243 (29.4)	107(29.5)	33.2
Secondary &higher	1785 (16.7)	1899 (17.5)	60(13.5)	33.6
Missing	708 (6.7)	724 (6.6)		
Religion				
Christian	5016 (47.1)	6204 (56.3)	154(42.4)	30.7
Muslim	5442 (51.1)	4561 (41.4)	203(55.9)	37.3
Traditional/Others	183 (1.7)	257 (2.3)	6(1.7)	32.8
Wealth Index				
Poor	5775 (54.3)	5156 (46.8)	228(62.8)	39.5
Medium	1466 (13.8)	2280 (20.7)	47(12.9)	32.5
Rich	3400 (32.0)	3587 (32.5)	88(24.2)	25.9

[a] Southern Nations, Nationalities and Peoples NMR: Neonatal mortality rate

Antenatal care usage and place of delivery

A supplementary analysis at the level of mother was conducted to investigate the percentage distribution of antenatal care usage and place of delivery by some background characteristics. Table 3 shows that 63.1% of mothers aged 15-24 had utilized ANC services and 29.5% of them gave birth at health facility. Mothers who gave birth to first ordered child were more likely to utilize ANC services (74.9%) and give birth at health facility (52.2%) than the rest order births. Women residing in urban area were more likely to utilize ANC services (87.5%) and more likely to give birth at health facility (79.5%). Majority of mothers with no education gave birth at home (81.6%) and 44.6% of them did not utilize ANC services (Table 3).

Table 3 Percentage distribution of ANC usage and place of delivery by background characteristics, EDHS 2016

Variable	ANC Usage		Place of delivery	
	Yes (n=6896)	No (n=4126)	Health facility(n=2892)	Home(n=7997)
	N (%)	N (%)	N (%)	N (%)
Maternal age (in year)				
15-24	1626(63.1)	949(36.9)	749(29.5)	1793(70.5)
25-24	3578(64.8)	1942(35.2)	1805(33.0)	3657(67.0)
35-49	1665(64.8)	880(36.2)	816(32.4)	1705(67.6)
Birth Order				
1	1622(74.9)	544(25.1)	1121(52.2)	1026(47.8)
2-3	2308(69.1)	1030(30.9)	1192(36.1)	2106(63.9)
4-5	1507(60.9)	968(39.1)	552(22.5)	1902(77.5)
6+	1432(53.8)	1229(46.2)	505(19.2)	2121(80.8)
Place of residence				
Urban	1727(87.5)	247(12.5)	1562(79.5)	402(20.5)
Rural	5142(59.3)	3524(40.7)	1808(21.1)	6753(78.9)
Region				
Tigray	862(12.5)	171(4.5)	572(17.0)	437(6.1)
Afar	520(7.6)	542(14.4)	109(3.2)	952(13.3)
Amhara	633(9.2)	344(9.1)	243(7.2)	718(10.0)
Oromia	872(12.7)	709(18.8)	297(8.8)	1272(17.)
Somali	739(10.8)	766(20.3)	274(8.1)	1230(17.2)
Benishangul	598(8.7)	280(7.4)	213(6.3)	655(9.2)
SNNP	874(12.7)	403(10.7)	344(10.2)	906(12.7)
Gambela	447(6.5)	267(7.1)	248(7.4)	454(6.3)
Harari	448(6.5)	157(4.2)	313(9.3)	290(4.)
Addis Ababa	434(6.3)	27(0.7)	444(13.2)	15(.2)
DireDawa	442(6.4)	105(2.8)	313(9.3)	226(3.2)
Mothers' education				
None	3785(55.4)	3053(44.6)	1247(18.4)	5525(81.6)
Primary	2062(77.0)	615(23.0)	1201(45.6)	1432(54.4)
Secondary & Higher	1022(90.8)	103(9.2)	922(82.3)	198(17.7)
Wealth index				
Poor	3108(53.8)	2667(46.2)	894(15.7)	4817(84.3)
Medium	989(67.5)	476(32.5)	402(27.8)	1042(72.2)
Rich	2772(81.5)	628(18.5)	2074(61.5)	1296 (38.5)

Factors associated with neonatal mortality

Table 4 shows that sex of child, birth type, birth interval, birth size, antenatal care (ANC) usage, place of delivery, place of residence, region, maternal education, paternal education, religion, and wealth index were significantly associated with neonatal mortality at 25% level of significance. That is, the individual contribution of each of these factors to neonatal mortality was statistically significant. Then, these factors were included in multiple logistic regression analysis to assess their net effect on neonatal mortality in Ethiopia. Stepwise variable selection method was employed to select variables. Table 4 presents the unadjusted (Crude) and adjusted odds ratio (OR) including the 95% confidence interval (CI) for factors associated with neonatal mortality in Ethiopia.

Compared to male neonates, female neonates were 0.60 times less likely to die (AOR=0.60; 95%CI: 0.47-0.75). Multiple birth neonates were 6.71 times more likely to die (AOR= 6.71; 95% CI: 4.66-9.66) compared to single birth neonates in Ethiopia. Neonates born within the interval >36 months of the preceding birth were 0.56

times less likely to die (AOR=0.56; 95% CI: 0.43-0.75) compared to neonates born within the interval <24 months of the preceding birth. Large sized neonates at birth had higher odd of neonatal mortality than average (normal) sized neonates (AOR=1.48; 95% CI: 0.27-1.64). Neonates born to mothers who did not utilize ANC services during pregnancy were 1.41 times more likely to die (AOR=1.41; 95% CI: 1.11-1.81) compared to neonates born to mothers who utilized ANC services during pregnancy.

Neonates born to mothers living in rural area had higher odds of neonatal mortality compared neonates born to mothers living in urban area (AOR=1.88; 95% CI: 1.15-3.05). Neonates born in Harari region had higher odds of neonatal mortality than neonates born in Addis Ababa (AOR=1.45; 95% CI: 0.61-3.45). Compared to neonates born to fathers with no education, neonates born to fathers with secondary and higher education were 0.51 times less likely to die (AOR=0.51; 95% CI:0.22-0.88) (Table 4).

Table 4 Unadjusted (Crude) and adjusted odds ratio (OR) for factors associated with neonatal mortality in Ethiopia, EDHS 2016 (n=11,023)

Variables	Crude OR (95% CI)	Adjusted OR (95% CI)
Maternal age (in year)		
15-24	1.18(0.53-2.43)	
25-34	1.00	
35-49	0.85(0.49-1.23)	
Sex of child		
Male	1.00	1.00
Female	0.56(0.45-0.70) ***	0.60(0.47-0.75) ***
Birth Order		
1	1.15(0.85-1.55)	
2-3	1.00	1.00
4-5	1.03(0.76-1.38)	
6+	1.25(0.95-1.65)	
Birth Type		
Single	1.00	1.00
Multiple	5.74(4.07-8.10) ***	6.71(4.66-9.66) ***
Birth Interval (months)		
<24	1.00	1.00
24-36	0.64(0.50-0.83)	0.67(0.51-0.88)
>36	0.55(0.43-0.71) **	0.56(0.43-0.75) **
Birth Size		
Large	1.35(0.28-1.62) ***	1.48(0.27-1.64) ***
Average	1.00	1.00
Small	0.86(0.67-1.38)	1.03(0.71-1.49)
ANC Usage		
Yes	1.00	1.00
No	1.52(1.24- 1.88) ***	1.41(1.11-1.81) **
Place of Delivery		
Home	1.00	1.00
Health facility	0.80(0.63-1.02)	1.25(0.92-1.69)
Place of residence		
Urban	1.00	1.00
Rural	1.93(1.38-2.70) ***	1.88(1.15-3.05) *
Region		
Tigray	1.26(0.61-2.61)	0.62(0.26-1.48)
Afar	1.63(0.80-3.30)	0.75(0.31-1.82)
Amhara	1.58(0.77-3.23)	0.90(0.38-2.11)
Oromia	1.50(0.78-2.99)	0.78(0.34-1.80)
Somali	2.13(1.09-4.18)	1.09(0.47-2.54)
Benishangul	1.93(0.95-3.92)	0.86(0.36-2.05)
SNNP	1.35(0.66-2.73)	0.69(0.29-1.60)
Gambela	1.37(0.64-2.93)	0.69(0.29-1.66)
Harari	2.11(1.01-4.40)†	1.45(0.61-3.45) *
Addis Ababa	1.00	1.00
Dire Dawa	1.27(0.57-2.86)	1.08(0.43-2.71)
Maternal education level		
No education	1.00	1.00
Primary	0.81(0.63-1.04)	1.04(0.78-1.39)
Secondary & higher	0.66(0.45-0.98)	0.95(0.57-1.58)
Paternal education level		
No education	1.00	1.00
Primary	0.91(0.71-1.16)	0.91(0.70-1.17)
Secondary & higher	0.36(0.87-1.92) ***	0.51(0.22-0.88) ***
Religion		
Christian	1.00	1.00
Muslim	1.22(.99-1.51)	0.86(0.60-1.24)
Traditional/Others	1.07(0.47-2.45)	0.66(0.24-1.86)
Wealth Index		
Poor	1.00	1.00
Medium	0.81(0.59-1.11)	0.86(0.60-1.23)
Rich	0.65(0.50-0.83)	0.83(0.59-1.18)

*p<0.05 **p<0.01 ***p<0.001 †p<0.25

Discussion

The result of this study indicated that sex of child, birth type, birth interval, birth size, ANC usage, place of residence, region of residence and paternal education level had statistically significant influence on neonatal mortality in Ethiopia.

The result of this study showed that sex of child is an important determinant of neonatal mortality in Ethiopia. Female neonates were at decreased risk of death compared to male neonates. This may be due to biological difference between male and female neonates. That is female neonates had strong immune system than male neonates' due to genetic difference between female and male. New born girls have a biological advantage in survival over newborn boys. They have lesser vulnerability to perinatal conditions (including birth trauma, intrauterine hypoxia and birth asphyxia, prematurity, respiratory distress syndrome and neonatal tetanus), congenital anomalies, and such infectious diseases as intestinal infections and lower respiratory infections. This result is consistent with other studies that indicated male neonates were at increased risk of death compared to female neonates[3,18-20].

Multiple births contribute substantially to mortality in neonatal[19-22]. The result of the current study showed a higher risk of neonatal mortality for multiple births compared to single births. This may be due to the fact that multiple births are more likely associated with low birth weight and biological immaturity.

The risk of neonatal death decreases with increasing birth interval[26]. This is due to the fact that the mother may have time to prepare for the next birth by seeking skilled birth assistance. The study conducted in Indonesia and Ethiopia showed that neonates with shorter birth interval (<24 months) had higher odds of neonatal mortality[10,27,28]. This study showed lower odds of neonatal mortality for neonates born within the interval of 24-36 and>36 months of the preceding birth compared to neonates born within the interval of <24 months of the preceding birth. The result was consistent with the above literatures.

The current study revealed that birth size had significant influence on neonatal mortality in Ethiopia. Very large birth size had higher odds of neonatal mortality than average size neonates. This might be due to the fact that larger babies have a higher risk of birth injury, respiratory distress due to birth asphyxia and congenital anomaly which could contribute to the higher likelihood of neonatal mortality. The result was consistent with previous studies conducted elsewhere[15,21].

ANC seeking during pregnancy is another important determinant of neonatal mortality. The result of this study revealed significantly higher odds of neonatal mortality among neonates whose mothers did not seek ANC services during pregnancy that is confirmed by previous reports[15,30-32]. The antenatal period clearly presents opportunities for reaching pregnant women with a number of interventions that may be vital to health and well-being of women and their new born infants.

The current study showed that neonates born to mothers residing in rural areas had a higher risk of neonatal mortality compared to those living in urban areas. This finding is consistent with previous studies[11,35]. This might be the limited access to health facilities and maternal healthcare services, such as delivery assisted by a healthcare professional, and prenatal and postnatal care in rural area.

Region of residence had significant influence on neonatal mortality in Ethiopia. The result of this study showed that neonates born to mothers residing in Harar region had higher odds of neonatal mortality compared to neonates born to mothers residing in Addis Ababa. This might be due to the difference in the health facility among regions of the country. The result is in line with some previous studies[10,15,26].

Paternal education is another potential determinant of neonatal mortality in Ethiopia. The results of current study showed that neonates born to fathers with secondary and higher education level had lower odds of neonatal mortality compared to neonates born to fathers with no education. This might be due to the more educated father would be aware about the importance of seeking skilled birth assistance during pregnancy and encourage his wife to seek skilled birth assistance and help her to utilize antenatal care services during pregnancy. The result of this study is in line with other studies[12,15,35].

Conclusion

The results of this study showed sex of child, birth type, birth interval, birth size, ANC usage, place of residence, region of residence and paternal education level had a statistically significant influence on neonatal mortality in Ethiopia. Further, most of demographic factors had statistically significant influence on neonatal mortality in this study. To reduce neonatal mortality in Ethiopia, there is a need to implement sex specific public health intervention mainly focusing on male neonate during pregnancy, child birth and postnatal period. A relatively simple and cost-effective public health

intervention should be implemented to make sure all pregnant women are screened for multiple pregnancy and if positive receive extra care should be given during pregnancy, child birth and postnatal.

Strengths and limitations

Strengths

This study used a nationally representative 2016 Ethiopia Demographic and Health Survey (EDHS) data. Further the study applied sampling weights to ensure the representativeness of the sample. Considering the design effect of the 2016 EDHS, the current study applied complex sample analysis. Even though, under-five mortality has declined in the last four decades in Ethiopia, the reduction of neonatal mortality was slower. Therefore, this study is important to indicate the determinants of the slow decline of neonatal mortality in Ethiopia.

Limitations

The limitation of this study is that the information used in the current study was subject to recall bias as the information collected relied on the women's recall ability about her pregnancy. Some variables were not included in this study due to large number of missing values. However, these limitations are unlikely to impact on the validity of the analysis.

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Competing interests

The authors declare that they have no competing interests.

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