Original article

Risk factors of neonatal mortality in Ethiopia

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Abstract

Background: An understanding of risk factors related to neonatal mortality is important to guide the development of focused and evidence-based health interventions to reduce neonatal deaths.

Objective: This study aimed to identify risk factors of neonatal mortality in Ethiopia.

Methods: The data source for the study was the 2011 Ethiopian Demographic and Health Survey. The survival information of a total of 8,651 live-born neonates born five years before the survey was examined. Stratified Cox-proportional hazards model was employed to identify risk factors associated with neonatal deaths.

Results: About 71% of the neonatal deaths occurred within the first week after birth and, the cumulative death rate reached 79% in the second week. The estimated hazard ratios of mortality were higher for twins or multiple births (HR=3.73, 95% CI: 2.81-4.94), first order birth (HR=1.68, 95% CI: 1.25-2.24), male sex (HR=1.26, 95% CI: 1.06-1.50), birth interval shorter than 24 months (HR=1.63, 95% CI:1.31-2.03), very small and vary large size neonates born to mothers younger than 20 years of age and above 34 years (HR=1.38, 95% CI:1.05-1.82) and (HR=1.32, 95% CI 0.06-2.80), respectively, and neonates whose mothers had a history of pregnancy complications (HR=1.73, 95% CI: 1.27-2.24) compared to their respective counterparts. The risk of dying was lower for neonates whose mothers attended antenatal visits (HR=0.72, 95% CI: 0.59-0.89) and neonates put to breast immediately upon birth (HR=0.83, 95% CI: 0.59-0.99).

Conclusion: Public health interventions directed at reducing neonatal death should address the demographic factors mentioned above and maternal health services. [*Ethiop. J. Health Dev.* 2013;27(3):192-199]

Introduction

Neonatal mortality (NNM) is the probability of dying within the first month of life and is expressed as neonatal deaths per 1000 live births. In 2005, the World Health Organization reported that neonatal deaths accounted for 40% of deaths under the age of 5 worldwide; each year an estimated 8 million neonates died within the first 28 days of life (1). According to the most recent estimate of 2013, the global NNM has declined to 2.9 million (2). The vast majority of these death occurred in low-income countries (3).

The first month of life, the neonatal period, carries one of the highest risks of death of any month in the human lifespan (4). In high-income countries, neonates are now a major focus of child health for reducing both for mortality and morbidity. However, in low-income countries NNM rates, trends, and causes have attracted relatively little attention compared to maternal deaths or deaths among older children under-five. As far as international public health policy and programs are concerned neonatal deaths still do not receive attention commensurate with their burden (5). A specific focus on NNM is required as the epidemiology, cause-of-death distribution, and health interventions differ from those of older children. Child survival programs have typically focused on diseases affecting children aged over one month primarily pneumonia, malaria, diarrhea, and vaccine preventable diseases and safe motherhood programs have tended to focus on the mother and not her newborn (6).

Despite the reduction in under-five mortality over the past years, it has become evident that the Millennium Development Goal 4 (7) that targets reducing of under-five mortality by two-thirds by 2015 is unlikely to be achieved if neonatal survival chances do not improve (4). Thus, it is crucial that health policy makers and program managers pay attention to the epidemiology of neonatal deaths, mainly in low-income countries where most of NNM takes place.

Ethiopia is the second most populous country in Africa after Nigeria with a population estimated at nearly 83 million in 2010 (8). The population grows at an annual rate of 2.6% which is slightly greater than that for sub-Saharan African countries average growth of 2.5%. The age structure suggests that nearly 45% of the population is under 15 years. High mortality, high fertility and low life expectancy characterize the demography, as in most sub-Saharan African countries (9).

In Ethiopia infant mortality declined by 39 percent over the 15-year period between the 2000 EDHS and the 2011 EDHS, from 97 to 59 deaths per 1,000 live births. Under-five mortality declined by 47% over the same period (from 166 deaths per 1,000 live births to 88 deaths per 1,000 live births). Neonatal mortality has also decreased from 49 deaths per 1,000 live births according EDHS 2000 to 39 deaths per 1,000 live births in the EDHS 2005; it remained stable at 37 deaths per 1,000 as reported in EDHS 2011(10). This decline in NNM, as in other parts of the world, was slower than for infant and under-five mortality, which fell by 42% and 47%,

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respectively over the 15-year period. As mentioned above the country is experiencing a high NNM rate (37 per 1,000 live births) which is comparable to the average rate of 35.9 per 1,000 for the African region overall (11).

There is a rather limited research on NNM in Ethiopia. Most of the information for any program planning and implementation has been based on Ethiopian demographic and health surveys conducted every five years. Given this fact this study is an attempt to identify risk factors associated with NNM in the country. To be specific, the study focused on household level socio-economic, demographic and maternal health service characteristics that influence neonatal survival.

Methods

The dataset used in this study was obtained from the Ethiopian demographic and health survey conducted in 2011, which is the third comprehensive survey conducted as part of the worldwide Demographic and Health Surveys project. The data provide in-depth information on fertility, family planning, infant, child, adult and maternal mortality, maternal and child health, nutrition and knowledge of HIV/AIDS and other sexually transmitted diseases. The sample for the 2011 EDHS was designed to provide population and health indicators at national (urban and rural) and regional levels. Administratively, the regions of Ethiopia are divided into zones, and zones, into administrative units called *weredas*. Each *wereda* is subdivided into the lowest administrative units, called *kebeles* which are further sub-divided into census enumeration areas. A representative sample of 17,817 households was selected for the 2011 EDHS. Of these households 16,702 were successfully interviewed in which 17,385 eligible women were identified for individual interview; full interviews were conducted with 16,515 women. The number of children at this level was 11,654 representing the number of live-births born to the interviewed mothers in the period of five years preceding the date of the survey. After removal of missing values we obtained complete information about 8,651 neonates.

Neonatal survival time (the response variable) was measured as the duration starting from date of birth to the date of death measured in days. The predictors considered in this study were categorized as: **s**ocioeconomic (region, place of residence, wealth index, mother's level of education, marital status); demographic (mother's age, birth order, child's sex, multiple births, birth interval, birth size, when neonate was put to breast); maternal health service (antenatal care, place of delivery, delivery assistance). It is worthwhile pointing out that data about birth weight was recorded if available; if not, then a description of 'size at birth' was recorded from the mother's recall for all births in the five years preceding the survey. Since weight at birth was not recorded in about 88% of the cases, the statistical analysis of the study used five categories of size as provided in Table 1. Information about the number of deaths within 30 days after birth and right-censoring (survival beyond 30 days) as well as categories of the socio-economic, demographic and maternal health factors/characteristics that are mentioned above as given in the same table. The statistical analysis of survival was based on Cox proportional hazards regression model (12). Data analysis was performed using the software SAS 9.2 and STATA 11.

In the univariate Cox analysis the covariates place of residence, multiplicity of birth, mother's age, birth order, child's sex, birth interval, antenatal visits, pregnancy complication, birth size, region and breast feeding were identified as statistically significant at 0.25 level of significance. Next, the remaining covariates that were non-significant in the univariate stage, namely: marital status, residence, wealth index, mother's education, delivery place and delivery assistance, were included (one at a time) in the model containing the former group. The results obtained showed that these were not confounders of the main factors.

In addition to that, further analysis of the data brought to light the existence of a region-time interaction manifesting the non-proportionality of hazards. One way of accommodating non-proportional hazards in a model is to use the Stratified Cox proportional hazards model (SPH). Stratification entails fitting separate baseline hazard functions across strata. In an SPH model, a proportional hazards structure does not necessarily hold for the combined data; instead, it is assumed to hold within each stratum (in this case region). The computations validated that the assumption of proportional hazards holds after stratification. Table 3 provides estimates for the SPH model.

Results

Descriptive Results:

A total of 8,651 neonates, who were born during the five years preceding the date of the survey, were included in the study. Summary descriptions for the demographic, socio-economic, and maternal health/obstetric factors included in this study together with the NNM rate are presented in Table 1. This shows that 48.5% were females (versus 51.5% males), 3.6% were multiple births, 83.2% were born in rural Ethiopia, 14.2% were born in health facilities and only 53.3% were put to breast immediately upon birth. About 15.5% of neonates were first births, 20.2% had preceding birth intervals less than 24 months, and 23.2% were very small and 16.9 % were very large at birth. About 88% of the mothers were married, 0.6% had never been in union and 11.4% were widowed, separated or divorced; 10.7% of mothers were below 20 years of age, 73.6% of them were aged 20-34 years, and the remaining 15.7% were older than 34 years. Only 33.5% of the mothers sought antenatal visits, 25.4% of the visits were by skilled birth attendants, and 8% faced pregnancy complication during delivery. With regard to educational attainment, about 70% of the mothers had no education while 25% had primary education and the remaining 5% had attended secondary and higher education. About 49.6% of households were classified as poor while 16.4% had medium income and 34% were classified as rich. The highest numbers of births were observed in Oromiya (15.5%) and SNNP (13.4%), whereas the recorded birth rate was lowest in Addis Ababa (3.4%).

The last column in Table 1 shows NNM per 1,000 live-births. The highest rates were: 38.6 (mothers of age group 24-34 years); 51.6 (married mothers); 41.2 (mothers with no education); 51.3 (mothers in rural areas); Oromiya (8.7), both SNNP and Amhara (8.4); 42.9 (mothers who did not receive antenatal care visits), 50.1 (delivery at home), 45.8 (unskilled delivery assistance), 53.5 (mothers who did not experience pregnancy complications); 53.2 (single-births). NNM for males and females, respectively, were 34.0 and 25.8; the highest rate (24.3) was observed for the birth interval 24-47 months; the rate among neonates that had not been breastfed was 31.7. The lowest NMM 1.3 and 2.2 were recorded for Addis Ababa and Dire-Dawa, respectively.

The overall estimates of the Kaplan-Meier survivor function (Table 2) showed that most deaths occurred in the earlier days of life and declining in the later days of follow-up time. Based on figure 1, about 71% and 79% of the neonatal deaths occurred within the first and second weeks of follow-up period, respectively.

Cox Proportional Hazards Regression Results:
Interpretation of estimated hazards ratios and their corresponding 95% confidence intervals was done in the same way as in the Cox model with no stratification. These are detailed below.

The estimated hazard ratio for multiple birth neonates in relation to single births (reference category) was 3.73 (95% CI: 2.81-4.94). It means that twins or multiple births were 3.73 times more likely to die than singletons. For neonates with first birth order and higher order births compared with birth order 2-4 (reference group) the estimated hazard ratios were 1.68 (95% CI:1.25-2.24) and 1.00 (95% CI:0.80-1.29), respectively. Compared to birth order 2-4, first order birth led to a 67.5% higher risk of death while no difference in death rate seemed to prevail between higher order births and birth order 2-4. Male neonates experienced a 26% higher risk of death than female ones (reference category). The estimated hazard ratio for neonates whose mothers attended antenatal visits during pregnancy compared to those mothers who did not was 0.72 (95% CI:0.58-0.89); that is, neonates born to mothers who attended antenatal visits during pregnancy were 28% less likely to die than neonates born to mothers who did not receive any antenatal services. The risk of dying for neonates with preceding birth interval less than 24 months was higher by about 63% relative to neonates born between 24-47 months (reference category). The relative risk of death for neonates with preceding birth interval greater than 47 months, compared to the reference category, was 0.98 (95% CI: 0.77-1.25), thereby providing evidence of no significant difference in the risk of dying for birth interval 24-47 months. The estimated hazard ratios for very large-size and very small-size neonates compared with average-size neonates were 1.97 (95% CI: 1.54-2.52) and 1.83 (95% CI: 1.48-2.31), respectively, showing that the risk of death for neonates with very large- and very small-size at birth were 97 % and 83% higher, respectively, than neonates with an average-size at birth (reference category). The estimated hazard ratio for mothers under 20 years of age was 1.38, implying that neonates who were born to mothers younger than 20 years died at a rate 38% higher than those born to mothers who belonged to the age group 20-34 (the reference group). The estimated hazard ratio of 1.32 in the case of mothers older than 34 years indicates that neonatal death was 32% higher than that for neonates born to mothers in the referent category. Neonates born to mothers (who had experienced any pregnancy complications) were 73% more likely to die than those born to mother who did not experience any pregnancy complications during delivery (estimated hazard ratio of 1.73 with 95% CI (1.27-2.24)). The estimated hazard ratio for neonates put to breast was 0.83 (95% CI: 0.69-0.99) revealing a situation where neonates put to breast immediately upon birth had a 17 % lower risk of mortality than those who were not put to breast immediately after birth.

Table 1: **Distribution of demographic, socio-economic & maternal health/obstetric factors and NMR (n=8,651)**

Background characteristics	Censored	Dead	Total and %	NNM
Mother's age				
<20 years	832	832	922 (10.7)	10.4
20-34 years	6029	6029	6363 (73,6)	38.6
>34 years	1273	1273	1366 (15.7)	10.8
Marital status				
Never in union	48	48	53 *9,6)	0.6
Married	7164	7164	7610 (88.0)	51.6
Widowed/divorced/separated	922	922	988 (11.4)	7.6
Mother's level of education				
No education	5706	5706	6062 (70.1)	41.2
Primary	2024	2024	2162 (25.0)	16.0
Secondary & above	404	404	427 (4.9)	2.7
Residence				
Urban	1381	1381	1454 (16.8)	8.4
Rural	6753	6753	7197 (83.2)	51.1
Region				
Tigray	906	906	959 (11.1)	6.1
Affar	754	754	794 (9.2)	4.6
Amhara	936	936	1009 (11.7)	8.4
Oromiya	1269	1269	1344 (15.5)	8.7
Somali	694	694	735 (8.5)	4.7
Ben.-Gumuz	701	701	766 (8.9)	7.5
SNNR	1083	1083	1156 (13.4)	8.4
Gambela	604	604	644 (7.4)	4.6
Harari	423	423	450 (5.2)	3.1
Addis Ababa	286	286	297 (3.4	1.3
Dire-Dawa	478	478	497 (5.7)	2.2
Wealth index				
Poor	4022	4022	4293 (49.6)	31.3
Medium	1329	1329	1416 (16.4)	10.1
Rich	2783	2783	2942 (34.0)	18.4
Antenatal visits				
No	5385	5385	5756 (66.5)	42.9
Yes	2749	2749	2895 (33.5)	16.9
Delivery place				
Home	6989	6989	7422 *85.8)	50.1
Health facility	1145	1145	1229 (14.2)	9.7
Delivery assistance				
Unskilled	6071	6071	6467 (74.6)	45.8
Skilled	2063	2063	2184 (25.4)	14.0
Pregnancy complication				
No	7493	7493	7956 (92.0)	53.5
Yes	641	641	695 (8.0)	6.2
Birth Order				
First birth	1231	1231	1343 (15.5)	12.9
2-4	3815	3815	4025 (46.5)	24.3
>4	3088	3088	3283 (38.0)	22.5
Multiple births				
Single	7878	7878	8338 (96.4)	53.2
Multiple	256	256	313 (3.6)	6.9
Child's sex				
Female	3975	3975	4198 (48.5)	25.8
Male	4159	4159	4453 (51.5)	34.0
Birth interval (in months)				
<24	1608	1608	1749 (20.2)	16.3
24-47	3960	3960	4170 (48.2)	24.3
>47	2566	2566	2732 (31.6)	19.2
Size of child at birth				
Very small	1859	1859	2011 (23.3)	17.6
Smaller-than-average	702	702	730 (8.4)	3.2
Average	3277	3277	3428 (39.6)	17.5
Larger-than-average	948	948	1019 (11.8)	8.2
Very large	1348	1348	1463 (16.9)	13.3
Child put to breast upon birth				
No	3766	3766	4040 (46.7)	31.7
Yes	4368	4368	4611 (53.3)	28.1

Table 2: **Results of the Kaplan-Meier estimates of neonatal survival function**

Days	Total	Fail	Net Lost	Survival function	Std. error	95% confidence interval
1	8651	223	63	0.9742	0.0017	(0.9707, 0.9771)
2	8365	35	0	0.9701	0.0018	(0.9663, 0.9735)
3	8330	40	1	0.9655	0.0020	(0.9614, 0.9691)
4	8289	20	2	0.9632	0.0020	(0.9590, 0.9669)
5	8267	17	2	0.9612	0.0021	(0.9569, 0.9651)
6	8248	8	0	0.9602	0.0021	(0.9559, 0.9642)
7	8240	24	0	0.9574	0.0022	(0.9530, 0.9615)
8	8216	7	0	0.9566	0.0022	(0.9521, 0.9607)
9	8209	3	0	0.9563	0.0022	(0.9518, 0.9604)
10	8206	10	2	0.9551	0.0022	(0.9505, 0.9593)
11	8194	1	1	0.9550	0.0020	(0.9504, 0.9592)
12	8192	5	3	0.9544	0.0022	(0.9498, 0.9586)
13	8184	3	0	0.9541	0.0023	(0.9494, 0.9583)
14	8181	10	0	0.9529	0.0023	(0.9482, 0.9572)
15	8171	13	0	0.9514	0.0023	(0.9466, 0.9557)
16	8158	3	0	0.9510	0.0023	(0.9463, 0.9554)
17	8155	3	0	0.9507	0.0023	(0.9459, 0.9551)
18	8152	3	0	0.9503	0.0023	(0.9455, 0.9547)
19	8149	2	0	0.9501	0.0023	(0.9453, 0.9545)
20	8147	5	0	0.9495	0.0024	(0.9447, 0.9539)
21	8142	8	0	0.9486	0.0024	(0.9437, 0.9531)
22	8134	3	0	0.9482	0.0024	(0.9433, 0.9527)
23	8131	2	0	0.9480	0.0024	(0.9431, 0.9525)
24	8129	1	1	0.9479	0.0023	(0.9430, 0.9524)
25	8127	2	1	0.9477	0.0024	(0.9427, 0.9522)
26	8124	1	0	0.9475	0.0024	(0.9426, 0.9520)
27	8123	2	0	0.9473	0.0024	(0.9424, 0.9518)
28	8121	6	0	0.9466	0.0024	(0.9416, 0.9512)
29	8115	2	0	0.9464	0.0024	(0.9414, 0.9509)
30	8113	55	8058	0.9400	0.0026	(0.9347, 0.9448)

Table 3: **P-values, estimated hazard ratio (HR), 95% confidence intervals based on Stratified Proportional Hazards Model**

Covariate	P-values	Est. HRs	95% conf. int. for HR	
			Lower	Upper
Multiple births	<.0001	3.728	2.813	4.942
Birth order				
First birth	0.002	1.675	1.252	2.242
2-4 (reference)	0.001	1		
>4	0.971	1.004	0.802	1.258
Sex	0.010	1.260	1.057	1.501
Birth interval				
<24 months	<.0001	1.633	1.312	2.032
24-47 months (ref.)	0.000	1		
>47 months	0.870	0.980	0.770	1.245
Antenatal visits	0.002	0.716	0.577	0.889
Size at birth				
Very small	<.0001	1.833	1.457	2.305
Smaller than average	0.000	1.246	0.973	1.173
Average (ref.)	0.139	1		
Larger than average	0.478	1.128	0.808	1.575
Very large	0.000	1.966	1.535	2.519
Pregnancy complication(s)	0.001	1.732	1.266	2.239
Mother's age				
<20 years	0.004	1.382	1.051	1.818
20-34 years (ref.)	0.021	1		
>34 years	0.019	1.323	1.060	1.799
Breastfed upon birth	0.037	0.828	0.693	0.989

NOTE: A reference category in this table is selected based on guidelines by Garson (2006). The guidelines are: First, using categories such as *miscellaneous* or *other* is not recommended. Second, the reference category should not be a category with few cases. Third, theory may suggest which category we compare to a particular category.

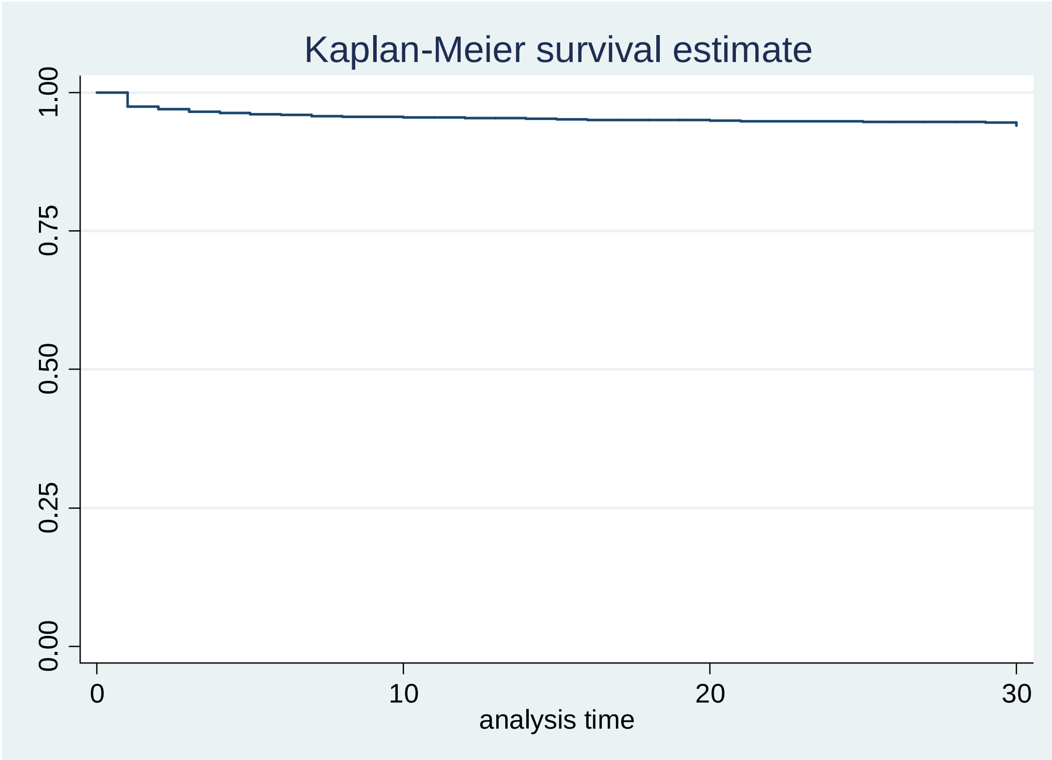

Figure 1: **Overall estimate of the Kaplan-Meier survivor function as a function of survival time (measured in days).**

Discussion

The main aim of this study was to identify risk factors of NNM in Ethiopia using the nationally representative 2011 EDHS data. Both univariate and multivariate statistical analyses were employed to examine factors affecting NNM. Our analyses revealed that demographic and some maternal health service factors, rather than socioeconomic ones, had statistically significant effect on NNM. The variables influencing NNM were multiplicity of birth, birth order, child’s sex, birth interval, antenatal visits, birth size, pregnancy complication, mother's age at birth, and whether a child was put to breast immediately at birth or not.

The findings of this study revealed that the risk of neonatal death was higher among twin or multiple births than among single births. A study (13) in southwest Ethiopia suggested that twins were much more likely to die than singletons, even after taking their birth weight into account. A study in Brazil (14) also found that multiplicity of birth was significantly associated with NNM. One possible explanation for this observed association could be (15) that multi-foetal pregnancy and multiple births including twins and higher order multiples such as triplets and quadruplets were at high-risk during both pregnancy and birth. These high-risk births were frequently accompanied by a number of associated foetal and neonatal complications that required special and expensive medical care.

In several studies birth order of a neonate brought to light controversial results about NNM. Some studies showed that first order births were at higher risk of NNM while others showed that higher order births were at higher risk. For instance, a study about risk factors of NNM in Bangladesh showed that infants of first birth had a higher risk of NNM (16). A study in the Empowered Action Group States of India (17) showed that neonates with first and higher order births experienced a high risk of death. In rural Iran, neonates with four or higher order births were at increased risk of NNM (18). A study in Kenya (19) found that increased risk of NNM was associated with first born children. The present study showed that neonates with first order birth experienced the lowest NNM (12.9) compared with 2-4 births, concurring with those research which came to the conclusion that higher birth orders were at increased risk. The arguments put forward supporting these opposing conclusions are that first birth is associated with very young mothers with little or no experience of taking care of an infant (health care, feeding, and the like). On the other hand, with higher birth order (many children) come scarcity of food, lack of attention by mothers, and so on.

The present study revealed that male neonates experienced a higher risk of dying compared with females; this finding is consistent with results of other studies elsewhere. It was found that in Indonesia (20) and in Brazil (14) the risk of neonatal death was higher for male infants. It is not apparent why more male neonates than females died on the basis of the information provided by the EDH surveys.

The results of this study suggested that the risk of neonatal death was higher for neonates with preceding birth interval less than two years. Another study in Ethiopia showed that birth intervals shorter than two years led to higher NNM rates than in higher birth intervals (21), while analysis of pooled data on birth history from 52 countries (22), to see the effect of preceding birth intervals on NNM, showed that the risk was higher for birth intervals shorter than 24 months as well as for the periods longer than 47 months, compared to the referent category (24-47 months). Similar to the findings of the present study, the three studies (17-19) provided evidence that the risk of dying was higher for neonates with birth spacing less than 24 months. This could probably be attributed to biological factors: giving a second birth within such a short span of time affects the health of both child and mother

The present study showed that neonates, whose mothers attended antenatal visits during pregnancy, had a lower risk of NNM than those who did not. A study in the Gaza Strip (the occupied Palestinian territory) found that newborns of mothers who attended fewer than four antenatal sessions during pregnancy had a risk of dying that was almost twice that of those born to mothers who attended antenatal session four or more times (23). A study in Ethiopia showed that NNM was associated with antenatal care follow-up (13); antenatal care contributes positively its share to reducing NNM.

In this study physical size at birth came out as one of the statistically significant predictors of neonatal death despite the limitation associated with it because of the way the EDH survey gathered data about weight. This has been highlighted earlier – physical size is actually not weight, but rather mothers’ perceived size of their children.

The risk of death for neonates with very large and very small physical size at birth was higher than neonates with average size at birth whereas the risk of death for neonates with smaller-than-average and larger-than-average size was statistically not significant compared to the reference category. Neonatal death was higher for very small infants in Indonesia (20).

The findings of this study showed that neonates born to mothers who were under 20 years of age and to mothers 34 years and older were at a higher risk of death compared with those born to mothers in the age bracket 21-33 years. A finding in Bangladesh (24) showed that mothers’ age at birth (age under 20 years) was the most significant predictor of NNM. The studies (17, 25, 26) provided similar evidence: the risk of dying was higher for neonates whose mothers’ age was below 20 years.

The present study revealed that neonates born to mothers who experienced complications during childbirth had a higher risk of dying compared to those born to mothers who gave birth without any complications. The finding is similar to that of a study in Indonesia which showed that neonates born to mothers with delivery complications had lower survival than those born to mothers without complications (20).

Another important predictor of NNM is the timing of putting neonates to breast upon birth. This study showed that neonates put to breast immediately upon birth had lower risk of NNM than those not put to breast immediately upon birth. Hence, the risk of death in neonates who were breastfed within the first hour of delivery was much lower than among those who were not breastfed in the first hour (23).

The authors would like to point out that this study was undertaken under these limitations: (a) **t**he estimates of NNM were based on retrospective birth histories which were subject to possible reporting errors; and (b) variables such as gestational age and birth weight were not considered The record on gestational age was not available in the 2011 EDHS data, while the weight of about 88% of neonates was not recorded during the survey.

Conclusions

Most of the deaths (71%) occurred within the first week after birth; they then declined slowly in the later days of follow-up. Results based on the stratified proportional hazards model revealed that demographic factors and taking advantage of maternal health services, rather than socio-economic factors, had significant effect on NNM. Specifically, the study demonstrated that multiplicity of birth, birth order, child’s sex, birth interval, antenatal visits, physical size at birth, mother's age at birth, and whether a child was put to breast upon birth had statistically significant impacts on the survival of neonates. Multiplicity of birth and birth order also had significant effect on survival; that is, twins or multiple births and first order birth were at a higher risk. Male neonates experienced a higher risk of death than females. Mortality in the case of neonates, whose mothers attended antenatal care was low. Neonates with preceding birth interval shorter than two years were at high risk of death. Neonates with very small- and very large- physical size at birth were more likely to die. Neonates born to mothers aged 21-33 years experienced relatively lower risks compared with neonates born to mothers under 20 and above 33 years. Neonates born to mothers who had experienced pregnancy complications were more likely to die whereas those put to breast immediately upon birth were at a relatively lower risk.

In the light of the above findings we suggest that the pertinent government organs and other stakeholders should strive to put in place intervention mechanisms that would mitigate the severe negative effects which result because of giving birth within short intervals (of less than two years), and due to early and late pregnancy. Mothers need to know (through various means) about the usefulness of putting neonates to breast immediately upon birth.

It is superfluous to emphasize the importance of providing antenatal care. As ANC alone would not make much difference in terms of survival, the importance and the necessity of skilled delivery must be emphasized.

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