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Determinants of early neonatal mortality in Nigeria: results from 2013 Nigeria DHS

Abstract

Introduction: Globally, burden of child mortality continues to decline especially in the last two decades. However, despite this global decline in child mortality, Nigeria continues to contribute disproportionate amount of child deaths contributing around 13% of the global child deaths in 2013. Of the total child deaths, around 44% occur in the first six days of life (early neonatal period). Preventing early neonatal death is critical in reducing child mortality. In Nigeria, early neonatal mortality rate is one of the highest estimated at 32 per 1000live births.

Materials and methods: This analysis utilized data from the 2013 Nigeria DHS. The 2013 survey consists of nationally representative sample of 38,948 women aged 15-49 years and 17,359 men aged 15-59 years living in 38,904 households. The statistical model for investigating the factors influencing early neonatal mortality is the Cox proportional hazards regression model. The analysis was conducted using State v13.0.

Results: In the five years preceding the survey, there were 119, 024 live births and 3772 early neonatal deaths translating to early neonatal mortality rate (ENNMR) of 32 per 1000 live births. Based on the adjusted hazard ratio, utilization of focused ANC (aHR=0.60, 95% CI: 0.52-0.70), utilization of postnatal care within two days of delivery (aHR=0.87, 95% CI: 0.80-0.96); while factors that significantly increased the risk of early neonatal death include residing in rural area (aHR=1.31, 95% CI: 1.18-1.46), being a large baby (aHR=1.17, 95% CI: 1.05-1.30) and a mother experiencing pregnancy complication (aHR=1.28, 95% CI: 1.14-1.44).

Conclusion: Early neonatal mortality rate in Nigeria is high. Several factors have been found to significantly reduce the risk of early neonatal mortality such as utilization of antenatal and postnatal care. Factors that increased risk of early neonatal mortality are rural residence, being a large baby and having had pregnancy complications. Therefore, it is recommended that utilization of ANC and postnatal care should be expanded to allow increased access and utilization

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Abbreviations: MDGs, millennium development goals; SGA, small gestational age; EAs, enumeration areas

Introduction

Child mortality remains a significant public health challenge particularly in developing countries of sub-Saharan Africa where around 50% of the global 6.3 million children die before their fifth birth day. Additionally, all the 16 countries with under-5 mortality rate of more than 100 per 1000 live births are located in sub-Saharan Africa and the region experienced one of the slowest annual rates of reduction in child mortality of 2.7% between 1990 and 2012.[1] Of the 6.3 million child death estimated to have occurred worldwide in 2032, around 44% of these deaths took place during the neonatal period (i.e. within the first 28 days of life) and a further 75% of these neonatal deaths occurred during the first week of life (i.e. the early neonatal period).[2,3] It follows that around 33% (or 2.1 million) of the global child death took place during the early neonatal period while the remaining 67% takes place in the remaining 1818 days. These deaths are substantial and targeting their determinants in the form of programmatic interventions will lead to significant reduction in child mortality overall. Therefore, strategies that promote better survival during the early neonatal period will have the greatest impact to reduce the overall child mortality as well as sustaining the progress made in reducing child mortality thus far. In Nigeria, child mortality continues to be a public health challenge despite adopting the various international health agendas aimed at reducing child mortality such as millennium development goals (MDGs), partnerships for maternal, neonatal and child health (PMNCH) and the Countdown Strategy. Despite keying into these programs, neonatal, infant, child and under-5 mortality rates remain high at 37, 69, 64 and 128 per 1000 live births respectively and Nigeria's contribution to the global burden of child mortality is immensely huge at around 13% (or 804,000 child deaths) in 2013.[4,5] Nigeria's contribution to global pool of child mortality has marginally decreased from 849,000 in 1990 to 827,000 in 2012 while there is a reversal in the expected decline as neonatal deaths increasing from 207, 000 to 267,000 during the same period.[4] Past literature on the subject matter have continued to give more emphasis on either under-five mortality[6–11] or on neonatal mortality[12,13] ignoring the significant proportion of early neonatal deaths as an important component of both neonatal and under five mortalities. Exploring the determinants responsible for early neonatal morality might hold the key to overall reduction in under five mortality. Therefore, this study aim at examining the factors responsible for early neonatal mortality in Nigeria using the recent 2014 Nigeria DHS data. It is anticipated that the result of this analysis will provide information for policy change and programme planning as we plan towards sustainable development beyond the 2015 agenda.

Materials and methods

The data for this study comes from the 2013 Nigeria DHS. The 2013

survey consists of nationally representative sample of 38,948 women aged 15-49 years and 17,359 men aged 15-59 years living in 38,904 households. The purpose of the survey is to provide policy makers and researchers with "updated estimates of basic demographic and health indicators" for planning, policy-making and programming. Therefore, it collected information on various demographic and health issues and indicators such fertility levels, trends and preferences; nuptiality, sexual activity, awareness and use of contraception, child nutrition and feeding practices including nutritional statuses, child morbidity and mortality, health seeking behaviors among mothers. The explicit goal of the Nigeria DHS is to provide "reliable information about maternal and child health and family planning services"; maternal and child health is the direct focus of this investigation. The study will narrow on recent births within the 5-year period prior to the survey in 2013 as well as all early neonatal deaths (deaths within 6 days of birth) within the 5-year period prior the survey in 2013. The survey is based on a stratified three-stage cluster sampling design consisting of 904 clusters (primary sampling units) that are derived from 2006 census enumeration areas (EAs) [NPC 2014].

The instruments used to collect the data for the 2014 NDHS consisted of six questionnaires; for the purpose of this research the women's questionnaire remains the most important. From this questionnaire the birth recode file (NGBR6AFL) was utilized for the analysis. The variables of interest in this study are broadly divided into dependent (or outcome) and independent (or explanatory) variable. The primary outcome variable is early neonatal death while the independent variables are the demographic factors related to early neonatal death such as the utilization of antenatal care, health facility delivery and postnatal care.

Bivariate analyses were conducted to establish any statistical association between the outcome variable, early neonatal death and the explanatory variables as listed in Table 1. The bivariate analyses are the unadjusted regression models; they provided the crude hazard ratios. Multivariate analysis was also conducted using stepwise backward elimination method to identify those factors that were significantly associated with early neonatal mortality. The statistical model for investigating the factors influencing early neonatal mortality is the Cox proportional hazards regression model.[14] The Cox was chosen for this analysis since it represents the typical "time-to-event" pattern or "failure data" or "time-to-failure" data we are dealing with. Early neonatal death is a form of failure data in which we are trying to estimate the risk or probability of an early neonatal death from birth. Thus, Cox provides the most appropriate analytical model as it provides an estimate of the treatment effect on survival after adjustment for other explanatory variables. In addition, it allows us to estimate the hazard (or risk) of death for an individual, given their prognostic variables. In this model, it is proposed that the hazard or risk or probability for a subject j in the data experiencing the event is given by the semi-parametric relationship:

$$h\left(t \mid x_j\right) = h_0\left(t\right).\exp\left(x_i \beta_x\right)$$

the h_0 component represents the survival or the hazard function while the β component stand for the multivariate component or the regressions coefficients to be estimated from the data and the x's multiplied by β are the explanatory variables i=1, 2, 3, …….n; n denotes the number of the explanatory variables in the model. The h_0 represents that baseline hazard function when all the explanatory variables are zero. A model with one explanatory (independent) variable looks like this:

$$h_j\left(t \mid x\right) = h_0\left(t\right).\exp\left(x_1 \beta_{ij}\right)$$

and if the individual (live birth in this case) is exposed to any of the factors under investigation, the model is of the form: (i.e. x=1)

$$h_j\left(t \mid x_j = 1\right) = h_0\left(t\right).\exp\left(\beta_1 * 1\right) = h_0\left(t\right).\exp\left(\beta_1\right)$$

However if the individual is not exposed, then the model takes the form of: (i.e. x=0)

$$h_j\left(t \mid x_j = 0\right) = h_0\left(t\right).\exp\left(\beta_1 * 0\right) = h_0\left(t\right)$$

Table 1 Definitions and categorization of variables used in the determinants of ANC and institutional delivery in Nigeria DHS 2013

Variable	Definition/Categorization
Maternal age	Maternal age at interview coded as 15-24=1; 25-34=2; 35 and above=3
Maternal education	Highest educational level coded as none=0; primary=1; secondary and more=3
Place of residence	Place of residence coded as rural=2, urban=1
Geopolitical zone	Geopolitical zone of residence coded as North=1; South=2
Household wealth index	Household wealth index coded poor=1; middle=2; rich=3
Religion	Religious affiliation of mother coded as Christian/Catholic=1; Islam=2; Traditional/other=3
Parity	Number of children given birth coded as one=1; 2-4=2; 5 and more=3
Working status of mother	Whether the mother was working or not at the time of survey coded as yes=1; no=0
ANC utilization	Attended at least four ANC visits during last pregnancy coded as yes=1; no=0
Sex of child	Sex of the child coded as male=1; female=2
Mode of delivery of child	Whether the child was delivered via caesarean section or not coded as yes=1; no=0
Birth weight of child	Weight at birth of child in Kg coded as small=1; normal=2; large=3
ANC Index	If a woman received all six elements of care at ANC; all=1, none=0
Place of delivery	Delivered in health facility or not coded as HF=1; Home=0
Skilled postnatal care	*Postnatal care provided by skilled health personnel coded as yes=1; no=0
Timing of postnatal care	Postnatal care received within 2days or after coded as yes=1; no=0
Type of marriage	Monogamy=1; Polygyny=2
Place of postnatal care	Place where postnatal care was received coded as health facility=1; home=0
Complications	Mother had complications during pregnancy coded as yes=1; no=0
Birth rank order	Rank order of position of child coded as first=1; second=2; third=3; four and more=4

*Skilled personnel included medical doctor, nurse, and midwife/auxiliary nurse.

In this model the risk or probability of either early neonatal death was measured in terms hazard ratio; representing increased (or decreased) risk of early neonatal death. Hazard ratio of more than one indicates increased risk of early neonatal death while hazard ratio of less than one indicates reduced risk of early neonatal death; hazard ratio of one means the exposure/characteristic/factor has no effect on early neonatal death. The Cox model is implemented in Stata v13[15] using the Stata's *stcox* command that fits the Cox proportional hazard models. However, the data was first *stset* that is 'telling' the Stata to treat the data as a form of 'time-to-event' or survival analysis. Further, because the data for the analysis was collected using complex three-stage cluster sampling design, the analyses were conducted incorporating this sampling design and also applying the sampling weight (wt) generated by dividing v005 by 1,000,000. The Stata survey command *svy* was utilized to 'inform' Stata about the nature of the data in terms sampling design and by so doing, Stata handles the data appropriately. The sampling weight was also *stset*, as usual to 'tell' Stata to handle this weight as survival data.

The multivariate analysis was conducted after running the stepwise forward elimination procedure that identified the potential factors associated independently of our study outcome. Only factors with a p value <0.20 were entered in the unadjusted model. However, sex of child, place of residence and birth weight were added without recourse to our forward elimination process. Sex of child and place residence were reported to be significant predictors of neonatal mortality[12] while birth weight was added in preference to perceived size of baby by mother since the latter is less subjective in assessing weight of child at birth than the latter.

Results

Table 2 provides estimates of live birth, early neonatal death and early neonatal mortality rates for Nigeria using the 2014 Nigeria DHS. There were 119, 024 live births and 3772 early neonatal deaths; the early neonatal mortality rate is on average 32 per 1000 live births recorded within the five-year period before the survey. Factors associated with high (at least above the national average) rate of early neonatal mortality include: rural residence, Caesarean mode of delivery, large babies, birth order of first and the fourth, being a male child, inadequate ANC care, mother not working, being in the age bracket of 15-24 years, lack of formal education, living in poor household, a woman being in polygynous marriage, belonging to Islamic and traditional religion and being multiparous of five or more. Those factors associate with lower than average early neonatal mortality rates also include: those who had at least four ANC visits, babies with normal birth weights, women who had adequate ANC services and women who wanted their pregnancies later. However, these estimates are simple frequencies that needed to be tested using appropriate statistical technique.

Table 2 Live births, early neonatal mortality and early neonatal mortality rates, Nigeria DHS 2013

Covariate	Live Births	Early Neonatal Mortality	Early Neonatal Mortality Rate
Age of Mother			
15-24	9398	367	37.6
25-34	38879	1202	30
35+	66976	2202	31.7
Geopolitical Zone			
North	78775	2631	32.3
South	36478	1141	30.3
Place of Residence			
Urban	39940	1145	27.9
Rural	75312	2627	31.7
Mother's level of Education			
No formal education	61536	2119	33.3
Primary	25285	824	31.6
Secondary and above	28431	828	28.3
Mother Working			
Yes	28026	951	32.8
No	86849	2814	31.4
Wealth Index			
Poor	55022	1983	34.8
Middle	22363	699	30.3
Rich	37867	1089	28
Religion			
Christianity	42425	1306	29.9
Islam	70737	2378	32.5
Traditional/other	1530	67	41.8
Parity			
1	4250	138	31.3
02-Apr	33976	894	25.6
5+	77027	2740	34.4
Type of Marriage			
Monogamy	65276	2057	30.5
Polygyny	42259	1481	33.9
Sex of Child			
Male	58793	2258	37
Female	56460	1514	26.1
ANC Index			
Not adequate	101563	3481	33.1
Adequate	13690	291	20.8
ANC Visits			
<4	9196	222	23.6
4+	10577	215	19.9
Place of Delivery			
Home	19355	543	27.3
Facility	11011	335	29.5
Mode of Delivery (CS)			
Yes	602	44	68.3
No	29728	865	28.3
Birth Weight (in Kg)			
Small	681	16	22.5
Normal	4209	37	8.8
Large	25758	870	32.7
Postnatal Care			
Within 2 days	2659	4	1.6
After 2 days	2947	35	11.9
Postnatal Care			
Skilled	4930	32	6.5
Non-skilled	790	10	13.5
Place of Postnatal Care			
Home	757	10	12.7
Facility	4910	32	6.6
Total	115253	3772	31.7

Citation: Dahiru T. Determinants of early neonatal mortality in Nigeria: results from 2013 Nigeria DHS. *J Pediatr Neonatal Care*. 2015;2(5):11–12. DOI: 10.15406/jpnc.2015.02.00089

Table 3 presents the results of both unadjusted and adjusted hazard ratios indicating the hazard ratios and 95% confidence interval. In the unadjusted model, factors that are significantly associated with increased hazard of early neonatal mortality include women who are 35 years or more (HR=1.06, 95% CI: 1.02-1.09), rural location (HR=1.30, 95% CI: 1.28-1.33), high parity of five and more (HR=1.09, 95% CI: 1.04-1.15), polygynous marriages (HR=1.17, 95% CI: 1.15-1.19), women working (HR=1.03, 95% CI: 1.02-1.05), large babies (HR=1.20, 95% CI: 1.13-1.27), belonging to traditional religion (HR=1.13, 95% CI: 1.02-1.24) and birth order of four and more (HR=1.03, 95% CI: 1.06-1.11); however, experiencing complication during pregnancy is marginally significant in increasing the hazard of early neonatal death. Those factors associated with decreased hazard of early neonatal mortality include: residence in southern part of Nigeria (HR=0.97, 95% CI: 0.95-0.99), having at least primary education and above, being in both the middle or rich wealth index and delivery in health facility (HR=0.89, 95% CI: 0.86-0.92) are associated with decreased hazard of early neonatal death. Equally significant are having skilled ANC as well as receiving all the six elemental services of ANC (HR=0.95, 95% CI: 0.92-0.98) and (HR=0.95; 95% CI: 0.92-098) respectively. Having postnatal care within two days of delivery (HR=0.70, 95% CI: 0.64-078), and in a health facility (HR=0.88, 95% CI: 0.79-0.98) and within two days (HR=0.84, 95% CI: 0.77-0.92) are significant protectors of early neonatal death.

Table 3 Unadjusted and adjusted hazard ratios (95% confidence interval [CI]) for variables associated with early neonatal mortality, 2013 Nigeria DHS

Covariate	Unadjusted			Adjusted		
	HR	(95% CI)	p values	HR	(95% CI)	P values
Maternal Age						
15-24	1			1		
25-34	1.01	(0.98-1.05)	0.466	0.97	(0.89-1.11)	0.953
35+	1.06	(1.02-1.09)	<0.001	1.07	(0.95-1.22)	0.265
Geopolitical Region						
North	1			1		
South	0.97	(0.95-0.99)	0.001	0.91	(0.81-1.01)	0.083
Place of Residence						
Urban	1			1		
Rural	1.3	(1.28-1.33)	<0.001	1.31	(1.18-1.46)	<0.001
Educational Attainment						
None	1			1		
Primary	0.96	(0.93-0.98)	<0.001	0.97	(0.84-1.13)	0.724
Secondary+	0.88	(0.86-0.90)	<0.001	0.92	(0.80-1.07)	0.295
Religion						
Christianity	1			1		
Islam	0.98	(0.96-1.00)	0.017	0.99	(0.89-1.10)	0.824
Traditional/other	1.13	(1.02-1.24)	0.006	0.45	(0.21-0.95)	0.036
Parity						
One	1					
02-Apr	0.95	(0.90-0.99)	0.068			
5+	1.09	(1.04-1.15)	0.015			
Type of Marriage						
Monogamy	1					
Polygyny	1.17	(1.15-1.19)	<0.001			
Wealth index						
Rich	1			1		
Poor	0.89	(0.87-0.92)	<0.001	1.05	(0.89-1.24)	0.534
Middle	0.8	(0.78-0.81)	<0.001	0.96	(0.81-1.12)	0.65
Mother working						
No	1			1		
Yes	1.03	(1.02-1.05)	<0.001	0.96	(0.87-1.06)	0.372
Place of delivery						
Home	1			1		
Health facility	0.89	(0.86-0.92)	<0.001	1.01	(0.91-1.11)	0.892
Birth weight (in Kg)						
Normal	1			1		
Small	0.94	(0.84-1.07)	0.353	0.81	(0.68-0.95)	0.012
Large	1.2	(1.13-1.27)	<0.001	1.17	(1.05-1.30)	0.004
Birth size§						
Large	1.05	(1.01-1.09)	0.013			
Average	1					
Small	1.01	(0.96-1.06)	0.756			
Sex of Child						

Citation: Dahiru T. Determinants of early neonatal mortality in Nigeria: results from 2013 Nigeria DHS. *J Pediatr Neonatal Care*. 2015;2(5):11–12. DOI: 10.15406/jpnc.2015.02.00089

Table Continued...

Covariate	Unadjusted			Adjusted		
Female	1			1		
Male	1	(0.98-1.01)	0.631	1.02	(0.93-1.10)	0.715
Mode of Delivery						
Non-caesarean	1			1		
Caesarean section	0.93	(0.81-1.07)	0.33	1.16	(0.96-1.39)	0.118
Birth Order						
First child	1	(0.97-1.03)	0.896			
Second child	1					
Third child	1	(0.99-1.05)	0.305			
Fourth and above	1.03	(1.06-1.11)	<0.001			
Had Complications						
No	1			1		
Yes	1.07	(1.01-1.13)	0.06	1.28	(1.14-1.44)	<0.001
Had Skilled ANC						
No	1			1		
Yes	0.88	(0.85-0.92)	<0.001	0.6	(0.52-0.70)	<0.001
ANC Adequacy						
No	1					
Yes	0.95	(0.92-0.98)	<0.001			
Had Postnatal Care ψ						
No	1			1		
Yes	0.84	(0.77-0.92)	<0.001	0.87	(0.80-0.96)	0.003
Skilled Postnatal Care						
No	1					
Yes	0.7	(0.64-0.78)	<0.001			
Place of Postnatal Care						
Home	1					
Health facility	0.88	(0.77-0.92)	<0.001			

Ψ within 2 months of delivery

The adjusted hazard ratios are also shown in the last three columns of Table 3. Only six factors show significant relationship with hazard of early neonatal mortality. Newborns born to mothers in rural areas are at increased hazard of early neonatal death (HR=1.31, 95% CI: 1.18-1.46). So also babies who were large at birth had increased risk of early neonatal mortality (HR=1.17, 95% CI: 1.05-1.30) compared to those with normal birth weight and small (HR=0.81, 95% CI: 0.68-0.95). Having experienced complication (HR=1.28, 95% CI: 1.14-1.44) remained significant predictor of early neonatal mortality in the adjusted model as well as utilization of skilled ANC (HR=0.60, 95% CI: 0.52-0.70) and having postnatal care within two days of delivery (HR=0.87, 95% CI: 0.80-0.96).

Discussion

We conducted an analysis of the determinants of early neonatal mortality in Nigeria using the most recent Nigeria DHS, the 2014 Nigeria DHS. Globally, in 2013 an estimated 6.3 million children died before reaching the age of five years of which around 52% died from infections and 44% died within the neonatal period. Further to these, 73% of all neonatal deaths happened during the first week of life with a staggering one million (or 36%) occurring on the day of birth.[16–18] In the Nigeria context, there was an estimated 804,000 deaths among children less than five years in 2012 making her as one of the largest contributor of child mortality in the world.[4] Despite efforts from MDG resources, Nigeria doesn't seemed to be making significant progress to achieve the target by 2015 possibly due to ignoring child death within the first week of life. From this analysis, several factors have been identified to determine early neonatal mortality. The bivariate logistic regression models indicates that residing anywhere in Northern geopolitical zone as well as rural residence increased the likelihood of early neonatal mortality. Other factors that significantly increases the hazard of early neonatal mortality include high parity, being in polygynous marriage, low household wealth index, being a working mother, high birth order and experiencing pregnancy complications.

Firstly, the survival advantage of newborns in the Southern part over that in the Northern part of Nigeria as well as urban-rural differentials in child mortality has been well documented by previous investigators. Adebowale et al.[19] and Adedini et al.[6] both reported that child mortality risks are higher in Northern than in Southern part of Nigeria as well as increased risk associated with rural residence compared to urban residence. This study has reconfirmed this regional and rural-urban differentials that could be attributed to a couple of factors. In the first instance, the urban areas are characterized by ease of access to health care facilities due to their abundance. At the individual level, presence of health facilities is not enough to guarantee utilization, and therefore individual factors such as wealth index as a proxy of overall socio-economic level, educational level and knowledge of the benefits of health facility utilization especially maternal and child health care are also important in explaining this North-South and rural-urban divide in child mortality risk. Furthermore, women in Northern Nigeria have lower educational achievements than their Southern counterparts and since education plays a significant role in utilization of maternal and child health services it is to be expected that women in the Southern Nigeria will perform better than those in Northern Nigeria. The positive role of maternal education in child survival has been reported for quite some time now.[20–22] Furthermore, Adetunji et al.[23] reported that education leads to adoption of modern medication and abandonment of traditional medicalization as well as erosion of traditional beliefs related to illness and health seeking

behavior. Therefore, the differentials in child mortality seen in this study is explained based on the educational differentials between the North and South and between the rural and urban Nigeria.

Secondly, the adjusted model show that attending focused ANC has a significant and positive influence on reducing the risk of early neonatal mortality. One of the benefits of ANC is that of detecting ill health which can be treated early to prevent further complications in both the mother and child. Women who receive adequate and quality ANC services are more likely to remain healthy by complying with healthy habits being advised during ANC sessions and more likely that a precarious condition to be detected early and remedial actions taken promptly. It is therefore expected that women who had adequate ANC should have lower risk of experiencing early neonatal death. Our result presented here is a confirmation of this effect as has been demonstrated by several previous researchers;[24–27] and that women who had ANC are more likely to have also utilized skilled attendance at delivery further reducing risk of early neonatal death.[28] Further on this argument is that women who had ANC are more likely to deliver in health facility and receive postnatal care. Utilization of these services (facility delivery and postnatal care) are expected to further reduce the risk early neonatal mortality.[29,30] The effect of ANC on early neonatal death was further assessed using a composite index of ANC, which is those who received all the six elements of ANC against who received none. Expectedly, those who had adequate ANC were at reduced risk of experiencing early neonatal mortality compared to those who did not. However, the protective effect of ANC as a composite index disappeared in the adjusted model. Our adjusted model did not show significant contribution of utilization of health facility delivery and reduced risk of early neonatal mortality, however the unadjusted model did demonstrate this relationship. The lack of positive influence of health facility delivery and early neonatal death has been reported by other researchers such as the study by Ezeh et al.[31] even though their outcome refers to neonatal mortality and not early neonatal mortality but again Oti et al.[32] reported that place of delivery as well skilled attendance at delivery did not influence positive perinatal outcome. This lack of influence of place of delivery on early neonatal outcome could be due to poor quality of services at the health facilities and possibly due to inability of the survey to control for unmeasured confounding variables in the study. It could also be due to selection bias where births that occur in health facilities are those that are experiencing difficult delivery or experienced complications during pregnancy and therefore decided to deliver in health facility for medical intervention. Lack of timely and adequate receipt of care at the time of labor and child birth could possibly explain this absence of impact of place of delivery on early neonatal death; moribund woman in labor will arrive at health facility too late for any form of medical intervention to save her life and that of her baby.[33]

In the unadjusted model, a statistically significant relationship is seen between birth weight and early neonatal morality; that is large babies have increased hazard of dyeing within the early neonatal period. In the adjusted model, however, small babies are less likely to die during the early neonatal period while large babies are likely to die within six days of birth. This in contrast to results available from previous investigations and it could be due to several weakness associated different nomenclatures of small babies such as small-for-gestational age (SGA), preterm small babies or a combination of both, that is preterm and small-for-gestational age as well as accurate measurement of birth weights of babies at birth bearing in mind that facility deliveries occur in only 36% of all births.[4] The problem of nomenclature has well been documented by Marlow[34] and this nomenclature bias could explain why small babies are less likely to die within the first week of life while large babies are more likely to die.[35–38] In 2012 an estimated 10 million SGA babies were delivered and about 80% of all neonatal deaths in 2012 in sub-Saharan Africa and south Asia are small babies.[34] The finding that large babies have increased hazard of early neonatal death could be explained that large babies are also associated with other maternal co-morbidity such as gestational diabetes that jeopardizes the survival of both mother and baby. The results further show a rich-poor gap in risk of death in the first week of life. Postnatal care is one of the components of continuum of care that received less attention as a strategy towards reducing child and maternal death.[39] Promoting universal access to postnatal care has been recommended for years and studies evaluating the impact of postnatal care of neonatal care has demonstrated significant reduction in neonatal mortality.[40–43] Our model indicates that having postnatal care within 2days of delivery decreases the risk of early neonatal death. This is an expected result since the postnatal care affords the health care worker and the mother-baby pair to interact to detect and treat any potential risk to the survival of the newborn baby. However, our findings is at variance to that reported by Singh et al where no significant association was found between postnatal care within 24 hours and early neonatal mortality.[44]

With regard to religion, extant literature has indicated that Muslim-dominated communities are characterized by high fertility, infant and child mortality.[45–49] In the Nigeria situation similar indications abound.[1,50,51] Researchers have attempted to explain the Muslims disadvantage when it comes to health care utilization and outcomes: that Muslim women are restricted in terms of seeking western education, decision-making regarding household spending on food and health care utilization and their complete reliance of livelihood on their partners. Because of these religious constraints, they exhibit poor health performance regarding maternal and child health indicators. The results of this study indicates that as far as early neonatal death is concerned, new born babies born to Muslim women are less likely die within the first six days of life compared to newborn babies born to Christian mothers. In the adjusted model, this relationship disappears and that babies of Traditionalist have decreased hazard of early neonatal death compared to babies of Christian mothers. Our finding is not an isolated one; Bhalotra et al.[52] in India reported that Indian Muslims have some child survival advantage over their colleagues the Hindus, which they attributed to a variety a reasons such as lower son preference, indulgence in healthy habits and behaviors such as low or total abstinence to tobacco smoking and alcohol intake and a strong kinship. They are of the opinion that access and utilization of health services play less of significance in this survival advantage. In Nigeria, similar analogy could be drawn but to conclude on this relationship requires further research.

Conclusion

This analysis of factors associated with early neonatal mortality in Nigeria show that four factors are significantly responsible: living in rural areas of Nigeria, having had complications during pregnancy, having skilled antenatal care and utilizing postnatal care within two days of delivery. While it is not practical to relocate people to urban areas, it can be recommended that to address early neonatal mortality in Nigeria maternal health services particularly antenatal and postnatal care be expanded into the rural areas of Nigeria. This will reduce physical barrier; but also alongside the quality of service must be maintained. Beyond provision of such services, demand must be created through public information system and behavior and communication strategies to encourage and boost utilization of ANC and postnatal care services.

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Strengths and weaknesses of the study

The study design and its conduct have some strength. It uses data from a nationally representative sample of women and therefore the estimates generated could be extrapolated to the entire population of Nigeria. This is important for programming and monitoring and evaluation as these estimates can provide benchmarks for these purposes. Secondly, its large sample allows estimates to be reliable and accurate as well as estimation of standard errors.

However, there are several limitations imposed by the design or the conduct of the study. Selection bias is important confounder reducing the strengths of the study. Its effect appears in the case of place of delivery and hazard of early neonatal mortality, for example. One would expect that those babies born in health facility would have reduced risk of early neonatal mortality but in the adjusted model we see the reverse (even it is not statistically significant). It possible that facility deliveries occur only when the home delivery has failed and the woman had to be taken to a facility to rescue her life. Also, those who had facility delivery we are not sure of the level of quality service they received; level of staffing, their competencies and equipment are not available to us (or at least not collected during the survey). Finally and importantly is the fact that cross-sectional studies can only be utilized to generate associations or hypotheses, causal inference are not possible and require randomized control trial. Thus, we are constrained to conclude in the affirmative that early neonatal mortality seen in this analysis is the direct effect of these four factors.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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