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First-day and Early Neonatal Mortality in Nigeria: A Pooled Cross-sectional Analysis of Nigeria DHS Data

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Background: Deaths within the early neonatal period is constituting large proportions of child deaths. While risk factors associated with child death has been extensively studied, there appears scanty research on the risk factors associated with early neonatal period.

Methods: We conducted analysis of pooled data sets of 2003, 2008 and 2013 Nigeria Demographic and Health Survey (NDHS). Information was collected from a combined number of 79,953 women aged 15-49 years old. Multiple pregnancies were included and live birth was restricted to the most recent within the five year-period before each survey. Main outcome variables are death within the first day of life (FDM) and death within the first seven days of life (ENND). Risk of death was examined using Cox regression models.

Results: Descriptive statistics indicates that both the first-day mortality rate and early neonatal death rate are highest for newborn delivered to women less than 18 years, unwanted pregnancy, very small babies (<1500 g), born outside of home and hospital, Caesarean delivery and twin babies. Multivariate analyses indicated that twin babies, babies born to via Caesarean section and during the five year period before 2013 survey are the uniform and significant risk factors for both first-day and early neonatal mortality; while receiving less than four antenatal clinic visits, being a

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male baby and residing in North West are the additional significant risk factors for early neonatal death.

Conclusions: Three factors are the significant predictors of both first-day and early neonatal mortality; Caesarean section, multiple births and year of birth. Reducing first-day deaths and early neonatal deaths will requires improved ANC attendances, quality services during labour and delivery, immediate newborn care and postpartum care; maternal and child health program implementation should also be intensified.

Keywords: First day death; early neonatal; maternal; child health; demographic; health; survey; Nigeria.

1. INTRODUCTION

Globally, substantial progress has been in reducing child mortality, at least between 1990 and 2015. Number of child deaths declined by more than half (at about 54%) from 12.7 million in 1990 to 5.9 million in 2015 or a daily average of 16,000 child deaths. Correspondingly, the under-five mortality rate declined by similar of 53% from 91 per 1000 live births to 43 per 1000 live births [1]. Similar reductions in neonatal mortality has been recoded within the period 1990-2015. Worldwide, neonatal mortality fell by 47% from 5.1 million in 1990 to 2.7 million in 2015; proportionally, the neonatal mortality rate fell by 36% from 36 deaths per 1000 live births to 19 deaths per 1000 live births [1].

Interestingly, a new pattern of distribution of child mortality by age has appeared over the period 1990-2015. That is, increasing proportion of child deaths occurring around labour and immediate postpartum period [2]. Over this period, proportions of child death occurring with the neonatal period, early neonatal period and within the first day of life have constituted large percentages of child deaths. Globally, around 44% of all deaths in children less than 5 years occur in the neonatal period (between birth and first 28 days of life) and this proportion is increasing as the numbers of post-neonatal deaths fall more rapidly [3,4]. Similarly, early neonatal death (death within the first seven days of life) contributes approximately 16% of under-five deaths and 36% of neonatal deaths respectively. Furthermore, in 2015, there were approximately 2 million early neonatal deaths or 32% of all under-five deaths or 73% of all neonatal deaths. Therefore, both early neonatal death and first-day mortality constitute large chunk of child mortality to the extent that any meaningful progress in reducing child mortality needs to take cognizance of these deaths occurring within these critical periods of life.

First day has been described as the most critical and dangerous day in the life of a newborn [5]. In 2015, 36 countries have first-day mortality rate of 10 or more per 1000 live birth of which only 4 are outside of sub-Saharan Africa: India, Lao’s People Democratic Republic, Afghanistan and Pakistan. All six countries with first-day mortality rate (FDMR) of less than 1 are in Europe except one: Cyprus, Estonia, Sweden, Iceland, Singapore and Luxemburg [1]. Sub-Saharan Africa (SSA) caries as much as 21% of first-day mortality [1] for reasons such as high rates of preterm birth, maternal under-nutrition where as much as 10-20 percent of women are underweight [6], poor prenatal, intranatal and postnatal care coupled with manpower shortage and poor state of health infrastructure [5].

In 2015, Nigeria alone contributed approximately 13% of under-five deaths, 9% of neonatal deaths and 9.4% of first-day mortality [1]. While worldwide, neonatal mortality rate declined by 47% during the millennium era, the amount of reduction in Nigeria was only 16%; little is known about rates of declines with regard to early neonatal and First-day mortality in Nigeria. In addition to paucity of data on first-day mortality and early neonatal death, risk factors associated with these components of child death is virtually non-existent. This study aims to provide information on risk determinates of first-day mortality and early neonatal deaths since they are critical in achieving the desired reduction in child mortality.

2. METHODS

This study utilized the data sets of 2003, 2008 and 2013 surveys conducted in Nigeria by ICF International in collaboration with the National Population Commission, which is the government’s agency responsible for such surveys. The three surveys were pooled (merged) into one a single data set to optimize deaths in the first day and within the first seven days of life (deaths within these windows of life are usually small and pooling of surveys becomes necessary). Information was collected from a combined number of 79,953 women aged 15-49 years old: 7,620 in 2003; 33,385 in 2008 and 38, 948 in 2013. Similarly, the combined number of live births for the three surveys is 244,836. In the 2013 survey there were 119,282 live births; in 2008 survey there were 101,977 live births and in 2003 there were 23,578 live births respectively. In this analysis, multiple pregnancies were included and live birth was restricted to the most recent within the five year-period before each survey. The organization, conduct, and other technical details in terms of sampling, questionnaire administration are described in the final reports of the each survey. Also, the ethical clearance for the conduct of these surveys were issued by the National Health Research Ethics Committee of the Federal Ministry of Health of Nigeria.

2.1 Study Outcome Variables

The two main study outcomes are: first day mortality and early neonatal mortality (death within the first six days of life). In the DHS data, age at death (b6) was utilized; and all deaths coded as 100 and 101 were treated as first-day mortality to avoid calendar bias [5]. For the early neonatal death, the same variable (b6) was utilized; and all deaths coded from 100 to 106 were treated as early neonatal deaths (ENND).

2.2 Study Factors

The study variables are broadly divided into four: individual-level variable, variable more related to the baby, contextual and community-level or household-level factors. This broad classification is based on review of relevant literature on the subject matter [3,7]. The individual-level factors examined here include maternal age (coded as <18, 18-34 and 35 and above years); maternal educational attainment (coded as none, primary and secondary and more); spousal educational attainment (similarly coded as none, primary and secondary and more); marital status (never married, currently married and formerly married); type of marriage (polygyny, monogamy); parity (1, 2-3, 4-5, 6+); occupational status of woman (has/no occupation); occupational status of husband/spouse (has/no occupation); religious affiliation of mother (Christianity, Islam, traditional/other); ethnicity (Hausa, Yoruba, Igbo, Fulani and Others); body mass index (underweight [BMI<18.50], normal [BMI=18.51-30.00] and obese [BMI>30.00]); pregnancy desire (wanted, mistimed and unwanted); antenatal care utilization (none, 1-3 visits and 4+ visits).

At the level of the baby, factors examined included baby's birth weight [for those that had their birth weight recorded] (very small [<1499 g], normal [1500-2499 g] and big [≥2500 g]); sex of baby (male, female); place of delivery (home, public hospital, private hospital, other places); skilled attendance at delivery [delivery attended by either a qualified medical doctor, nurse, midwife or auxiliary nurse] (yes, no); mode of delivery (vaginal, Caesarean section); birth interval (< 24 months, ≥ 24 months); birth order (1^{st}, 2^{nd} – 3^{rd}, 4^{th} -5^{th}, 6^{th} or more); child is twin (yes, no); high risk birth (woman younger than 18 years or older than 34 years; short birth interval of less than 24 months or multiple birth) (yes, no). Household wealth level (poor, middle and rich); place of residence (urban, rural); zone of location (North Central, North East, North West, South East, South South, South West) are better described as community-level factors while the year of survey (2003, 2008 and 2013) is better described as contextual factor. These variables are selected in the model based on review of relevant literature.

2.3 Statistical Analysis

First, descriptive statistics were generated to produce a table of total births, first-day deaths, early neonatal deaths, first-day and early neonatal mortality rates by some selected socio-demographic characteristics. Secondly, a multivariable hazard regression model was fitted for each of the study outcome. For this purpose, Cox proportional hazard regression model was fitted after setting the data to fit the 'time-to-event' pattern [8]. This was done using *stset* command in both cases for first-day mortality and early neonatal mortality. In this model, it is assumed that the risk or probability of first-day mortality and early neonatal mortality approximate to 'time-to-event' distribution and Cox proportional hazard model can be used to model the distribution of both first-day and early neonatal death. In each case, 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:

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

Where h_0 represents baseline survival or the hazard function while the β component stand for the multivariate regression 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. For a case of either first-day mortality or early neonatal death, the equation is now of this form if the live birth is exposed to any of factors under investigation (i.e. x=1):

$$h(t \mid x_j) = h_0(t).\exp(\beta_1 * 1)$$
$$= h_0(t).\exp(\beta_1 * 1) = h_0(t).\exp(\beta_1)$$

However, if the live birth is not exposed, the equation becomes:

$$h(t \mid x_j) = h_0(t).\exp(\beta_1 * 1)$$
$$= h_0(t).\exp(\beta_1 * 0) = h_0(t)$$

The probability of first-day or early neonatal death was measured using the hazard ratio (with the associated 95% confidence interval). The hazard ratio (HR) assessed the effect of the predictor variables on first-day mortality and early neonatal mortality. All analysis was conducted incorporating weighting factor; Stata v13SE was used in the analysis.

3. RESULTS

Table 1 shows total number of live births, first-day deaths, early neonatal deaths, first-day mortality and early neonatal mortality rates by some socio-demographic characteristics. The combined total weighted number of births from the three is 244,836 distributed as follows: 23,578 (10.9%) during 2003; 101,977 (43.0%) during 2008 and 119,282 (46.2%) during 2013 survey respectively. Similarly, the pooled weighted deaths for the three surveys is 8,176 of which 4,876 (59.6%) occurred within the first-day of life. Furthermore, the first-day mortality rates show striking differential against certain socio-demographic characteristics. For instance, first-day mortality rate (FDMR) is much higher among those younger than 18 years and those above 34 years. FDMR among the Igbos is the highest, with 25 deaths per 1000 live births; this is also consistent with the rate in South East (26 per 1000 live births) where it is home to the Igbos. Unwanted pregnancy, male baby, very small baby, birth interval less than 24 months, Caesarean delivery, first and sixth birth orders, twin birth and high risk pregnancy all carry are associated with much elevated first-day mortality rates. Use and non-use of antenatal care are all associated with reduced FDMR. Interestingly, home delivery has a low FDMR compared to hospital delivery while delivery elsewhere has a very high FDMR of 97 per 1000 live births; delivery without skilled attendance had higher FDMR than those who had it. All other sociodemographic characteristics do not show wide variations in terms of FDMR.

As for the early neonatal death rate, factors associated with increased early neonatal death rate (ENNDR) include young maternal age (less than 18 years), living in North East, having an unwanted pregnancy, a male baby, delivery outside of home or health facility, birth interval of less than 24 months, Caesarean delivery, first and sixth birth orders, twin birth and high risk pregnancy. Generally, both FDMR and ENNDR share similar sociodemographic characteristics. Again, in both situations, there are declines in these rates between the three surveys; however, the rates of declines are not of similar magnitudes (Fig. 1).

3.1 Risk Factors for First-day and Early Neonatal Mortality

Tables 1 and 2 show the result of Cox proportional hazard models of factors associated with first-day and early neonatal mortality. For the first-day mortality, only four factors are significantly associated with increased hazard of first-day mortality: having no formal education (HR=0.71; 95% CI: 0.54-0.93); Caesarean delivery (HR=1.94; 95% CI: 1.42-2.66); twin baby (HR=1.74; 95% CI: 1.30-2.33) and being born in the five-year period before the 2013 survey (HR=1.57; 95% CI: 1.14-2.16). For the early neonatal death the risks are: lower than optimal ANC visits (1-3 visits) (HR=1.25; 95% CI: 1.00-1.56); Caesarean delivery (HR=2.09; 95% CI: (1.59-2.74); twin delivery (HR=1.82; 95% CI: 1.43-2.31); male baby (HR=1.25; 95% CI: 1.10-1.43) and the survey period 2008-2013 (HR=1.48; 95% CI:1.17-1.88).

4. DISCUSSION

While it is generally acclaimed that substantial progress was made in reducing child and maternal mortality during the Millennium era, reducing newborn deaths has been generally slow despite the fact that they constitute significant proportions of child mortality. By the finish line of MDG, that is 2015, newborn deaths constitutes approximately 45% of all of the 5.945 million child deaths. Of these newborn deaths, approximately 2.02 million (or 75.3%) occurred within the first week of life (0-6 days) and a further 1.00 million (or 37%) occurred on the day of their birth [7,9,10]. Borrowing from the language of Lawn et al. [7], first day is only one out of approximately 1800 days but carries 17% of all deaths occurring in this period; similarly, 34% of all child deaths is concentrated in only seven days out of the approximately 1800 days. It therefore becomes imperative that any meaningful strategy aimed at preventing child mortality will disproportionately depends on how deaths in these early periods in life are targeted with effective interventions. Effective low-cost interventions focusing on prenatal period, labour and child birth and postnatal period do exist and together could save the lives of around 2 million newborn each year. Evidence-based interventions capable of preventing such newborn deaths include tetanus toxoid injection, antibiotics for maternal and neonatal infections, steroid injections for women in preterm labour, resuscitation for babies with difficulty in breathing, immediate initiation of breastfeeding, kangaroo mother care (KMC), clean cord care to prevent neonatal infection [5,11,12].

While direct causes of FDM and ENND are generally same across the globe (such as complications of premature birth, birth complications especially birth asphyxia, severe infection (pneumonia and meningitis), congenital anomalies, diarrhoea and tetanus [7], individual and contextual factors as well as health services coverage show great disparities between developed and developing countries. Individual factors associated with increased risk of FDM and ENND include maternal age, maternal education and maternal nutrition. Contextual factors such as household wealth level, place of residence (rural versus urban), region/state of residence are also important. Both the individual and contextual factors interact to determine the level of utilization of health services such as utilization of skilled ANC and delivery, postnatal care, contraception that will allow adequate birth interval that has an impact on baby's birth weight and well-being. Globally, mothers and babies in sub-Saharan Africa face the greatest risk of dying [7]. In this study, we reported the first-day mortality rate of 20 per 1000 live births and early neonatal death rate of 33 per 1000 live births in the ten year period between 2003 and 2013. According to Oza and colleagues, the FDMR and ENNDR for Nigeria in 2013 is 14 and 27 per 1000 live births respectively [13]. The significant risk factors associated with FDM are mode of delivery, twin baby and year of survey. Caesarean delivery (CS) carries high risk of FDM for the fact that it is regarded as the last intervention to save the life of both the mother and the newborn following a complicated pregnancy or labour. In this regard, pregnant mothers or their relations do not accept CS as an elective procedure/intervention that can be instituted early in labour or even before labour begins to avoid perinatal death or maternal death [14]. The FDMR and ENNDR among CS delivered babies are more than twice among normally delivered babies respectively; and the rate of CS in this pooled data analysis is around 5.1% which is far from the recommended 15% by the WHO indicating underuse which could possibly explain why FDMR and ENNDR are excessively higher among CS delivered babies [15]. When CS as an intervention to save life of mother and fetus is withheld for any reasons, it jeopardizes the survival chances of the fetus and the mother. In hospital-based studies reported from Nigeria, higher CS rates have been reported in the ranges of 12.5% in Ibadan and 16.3% in Kaduna [16,17]. An inherent characteristic of hospital-based studies that is capable of distorting the figure is the issue of selection bias in which severe, moribund and incapacitated patients requiring CS are treated thereby inflating the rate.

Our study corroborates the findings of previous researchers on the association between multiple births and poor perinatal outcome. In this study, the risk of FDM is almost 75% more for a multiple birth while the risk for ENND is more than 80%. Similarly, the FDMR and ENNDR are around four times that of a singleton birth. Olusanya has reported increased hazard of perinatal death among multiple births in an inner-city hospital in Lagos, though this was a case-control study [18]. Increased hazard of perinatal death among multiple births has been attributed to increased complications from prematurity, low birthweight, and IUGR [19-22]. Other associated increased risk to survival include birth asphyxia/low five-minute Apgar scores, neonatal sepsis, and admission to the special care baby unit (SCBU) [23].

Table 1. Total births, first-day mortality rates and early neonatal mortality rate, Nigeria 2013 DHS

Background characteristics	Total births	FDM	FDMR per 1000 live births	ENND	ENNDR per 1000 live births
Age at last birth					
<18	32598	858	26.3	1553	47.6
18-34	190805	3480	18.2	5767	30.2
35+	21433	538	25.1	856	39.9
Educational attainment, woman					
None	130794	2422	18.5	4534	34.7
Primary	56804	1239	21.8	1919	33.8
Secondary +	57239	1214	21.2	1723	30.1
Educational attainment, man					
None	111207	2063	18.6	3875	34.8
Primary	52428	1175	22.4	1817	34.7
Secondary +	79334	1597	20.1	2412	30.4
Wealth					
Poor	116468	2310	19.8	4184	35.9
Middle	48423	1008	20.8	1633	33.7
Rich	79946	1558	19.5	2359	29.5
Marital status					
Never married	1771	38	21.5	68	38.6
Married	228499	4543	19.9	7655	33.5
Formerly	14566	294	20.2	452	31.0
Type of marriage					
Monogamy	155987	3029	19.4	5015	32.1
Polygyny	88850	1847	20.8	3161	35.6
Parity					
1	9031	168	18.6	288	31.9
2-3	40824	691	16.9	1112	27.2
4-5	61714	1021	16.5	1694	27.4
6+	133268	2995	22.5	5081	38.1
Occupation, woman					
No occupation	59146	1121	19.0	1974	33.4
Has occupation	185690	3755	20.2	6201	33.4
Occupation, husband					
No occupation	3289	63	19.1	97	29.4
Has occupation	241547	4813	19.9	8079	33.4
Religion					
Christianity	96188	2185	22.7	3169	33.0
Islam	143324	2591	18.1	4795	33.5
Traditional/other	4677	93	19.9	196	41.8
Ethnicity					
Hausa	81409	1525	18.7	2812	34.5
Yoruba	27952	499	17.8	807	28.9
Igbo	27844	706	25.4	997	35.8
Fulani	19956	372	18.7	745	37.3
Others	87675	1774	20.2	2814	32.1
Place of residence					
Urban	77118	1384	17.9	2213	28.7
Rural	167719	3492	20.8	5963	35.6
Zone					
North Central	32639	615	18.8	957	29.3
North East	42430	890	21.0	1618	38.1
North West	86386	1524	17.6	2863	33.1
South East	22564	580	25.7	830	36.8
South South	28175	659	23.4	922	32.7

Background characteristics	Total births	FDM	FDMR per 1000 live births	ENND	ENNDR per 1000 live births
South West	32643	608	18.6	987	30.2
Body Mass Index					
Underweight	22548	410	18.2	745	33.0
Normal	197038	3883	19.7	6536	33.2
Obese	24654	568	23.0	869	35.3
Pregnancy desire					
Wanted	58923	1071	18.2	1715	29.1
Mistimed	4362	75	17.3	111	25.4
Unwanted	1997	49	24.3	78	39.2
Antenatal care					
None	17562	210	12.0	398	22.6
1-3 visits	4705	64	13.5	95	20.2
4 or mote visits	19458	274	14.1	406	20.9
Birth weight of baby					
Very small	64	3	42.6	4	58.7
Normal	829	18	22.2	26	31.4
Big	65195	1235	18.9	1971	30.2
Sex of child					
Female	119282	1992	16.7	3347	28.1
Male	125554	2883	23.0	4829	38.5
Place of delivery					
Home	41644	644	15.5	1146	27.5
Public hospitals	13935	320	22.9	444	31.9
Private hospitals	9914	233	23.5	321	32.4
Other places	612	60	97.9	90	147.4
Skilled attendance at delivery					
Yes	219571	4301	19.6	7365	33.5
No	25266	575	22.8	811	32.1
Mode of delivery					
Normal/vaginal	64800	1198	18.5	1917	29.6
CS	1266	64	50.7	91	71.6
Birth interval					
More than 24 months	185298	3216	17.4	5389	29.1
Less than 24 months	59538	1660	27.9	2787	46.8
Birth order					
1^{st}	56276	1364	24.2	2294	40.8
$2^{nd} – 3^{rd}$	86102	1321	15.3	2283	26.5
$4^{th} – 5^{th}$	54230	977	18.0	1594	29.4
6^{th} and more	48229	1213	25.2	2005	41.6
Fourth order child					
Yes	142378	2685	18.9	4577	32.1
No	102459	2191	21.4	3599	35.1
Twin birth					
No	236376	4100	17.3	6987	29.6
Yes	8460	776	91.7	1189	140.5
High risk pregnancy					
No	84090	1114	13.2	1922	22.9
Yes	160746	3762	23.4	6254	38.9
Year of survey					
2003	23578	518	22.0	889	37.7
2008	101977	2143	21.0	3513	34.4
2013	119282	2215	18.6	3774	31.6
Total	244, 836	4876	19.9	8176	33.4

Table 2. Adjusted HR (95% CI) for variables associated with first-day and early neonatal mortality, 2013 Nigeria DHS

Variable	First-day mortality	Early neonatal mortality
	HR (95% CI)	HR (95% CI)
Age at last birth		
18-34	1.00	1.00
<18	1.11 (0.69-1.78)	1.05 (0.73-1.51)
35+	1.11 (0.88-1.42)	1.21 (1.00-1.46)
Maternal education		
Secondary	1.00	1.00
None	0.71 (0.54-0.93)**	0.82 (0.66-1.02)
Primary	0.80 (0.63-1.01)	0.83 (0.69-1.01)+
Body mass index		
Normal	1.00	1.00
Underweight	0.98 (0.71-1.34)	0.92 (0.80-1.18)
Obese	1.08 (0.83-1.41)	1.07 (0.86-1.33)
Pregnancy desire		
Wanted	1.00	1.00
Mistimed	0.97 (0.70-1.34)	0.91 (0.70-1.18)
Unwanted	1.01 (0.70-1.47)	0.91 (0.66-1.25)
Antenatal care		
4 or more visits	1.00	1.00
None	0.86 (0.66-1.13)	0.94 (0.76-1.16)
1-3 visits	1.16 (0.86-1.53)	1.25 (1.00-1.56)*
Skilled ANC		
Yes	1.00	1.00
No	0.99 (0.74-1.33)	0.81 (0.64-1.02)
Place of residence		
Hospital	1.00	1.00
Home	0.78 (0.54-1.13)	0.77 (0.57-1.03)
Skilled attendance at delivery		
Yes	1.00	1.00
No	0.79 (0.54-1.15)	0.84 (0.62-1.14)
Mode of delivery		
Vaginal	1.00	1.00
CS	1.94 (1.42-2.66)***	2.09 (1.59-2.74)***
Birth interval		
≥24 months	1.00	1.00
<24 months	1.02 (0.81-1.28)	1.04 (0.87-1.35)
Birth order		
$2^{nd} – 3^{rd}$	1.00	1.00
1^{st}	1.20 (0.90-1.60)	1.39 (1.12-1.73)*
4^{th} -5^{th}	0.94 (0.68-1.31)	0.89 (0.69-1.16)
6^{th} or more	1.00 (0.72-1.40)	0.84 (0.65-1.10)
Baby is a twin		
No	1.00	1.00
Yes	1.74 (1.30-2.33)***	1.82 (1.43-2.31)***
Pregnancy is high risk		
No	1.00	1.00
Yes	1.14 (0.79-1.64)	1.16 (0.82-1.55)
Sex of baby		
Female	1.00	1.00
Male	1.09 (0.92-1.30)	1.25 (1.10-1.43)**
Locality		
Urban	1.00	1.00
Rural	0.96 (0.77-1.19)	1.07 (0.90-1.28)

Variable	First-day mortality	Early neonatal mortality
	HR (95% CI)	**HR (95% CI)**
Zone of residence		
South West	1.00	1.00
North Central	0.98 (0.71-1.36)	0.83 (0.71-1.22)
North East	1.03 (0.73-1.46)	0.96 (0.73-1.26)
North West	0.78 (0.55-1.12)	0.70 (0.53-0.93)*
South East	1.00 (0.72-1.40)	0.96 (0.72-1.26)
South South	1.05 (0.75-1.48)	1.07 (0.81-1.41)
Household wealth		
Rich	1.00	1.00
Poor	1.05 (0.80-1.37)	0.91 (0.73-1.12)
Middle	0.94 (0.73-1.22)	0.87 (0.71-1.07)
Year of survey		
2003	1.00	1.00
2008	1.30 (0.94-1.80)	1.17 (0.92-1.49)
2013	1.57 (1.14-2.16)**	1.48 (1.17-1.88)**

****p<0.0001, **p<0.001, *p<0.05 +P=0.058*

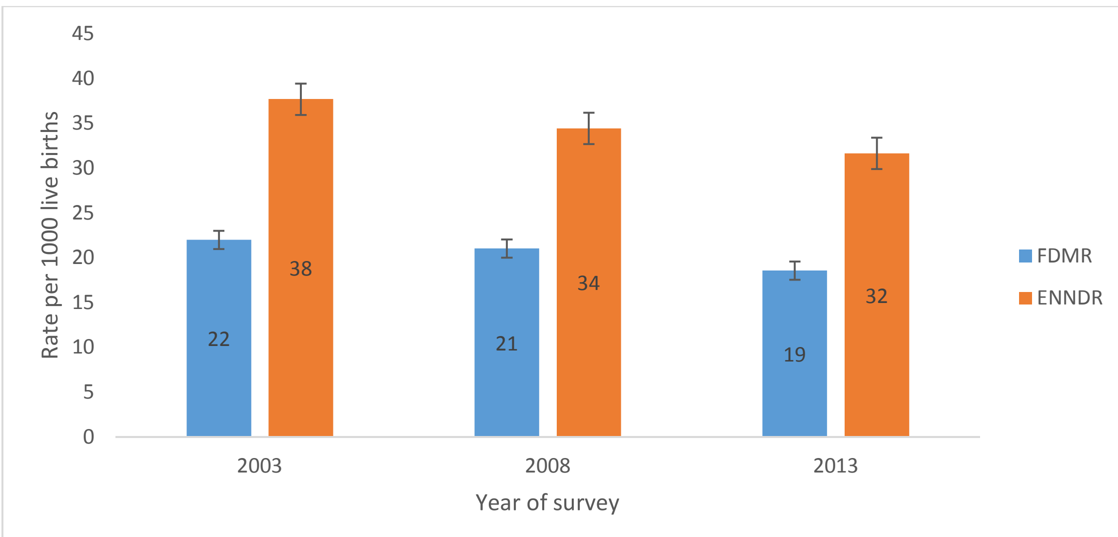

Fig. 1. First-day and early neonatal deaths per 1000 live births, (with 95% CI) by year of Nigeria Demographic and Health Surveys (NDHS), 2003–2013

Year of the survey has been found to be a significant determinant of both first-day mortality and early neonatal mortality across the two mortality spectrum. Using the 2003 survey as the reference, hazard of both FDM and ENND increased in both 2008 and 2013 (though not significant for 2008 survey). This temporal reversal in these rates is an unexpected finding considering the resources and interventions implemented during the 2003-2013 that fall fully within the MDG era. It is expected that the risk should demonstrate a downward trend from 2003 to 2013. Between 2001 and 2014, there were eleven programmes and policies focusing on improving the survival chances during the neonatal period in Nigeria. These include the Integrated Maternal, Newborn and Child Health (IMNCH) Strategy in launched 2007; the Roadmap for Accelerating the Achievement of MDG related to Maternal and Newborn Health in 2006; Kangaroo Mother Care (KMC) training guidelines for low-birth babies in 2010; Saving One Million Lives (SOML) in 2011 and Nigeria's Call to Action to Save Newborn Lives in 2014 [24]. These programmatic interventions are nationwide in addition to other programmes implemented at sub-national levels restricted to States based on bilateral agreements between these States and the foreign Agencies/ Governments including such as PATHS, PRRINN-MNCH, UKAID, EU-Prime, Norwegian Government; as well as programmes implemented differentially at State-level with multilateral agencies (WHO, UNICEF, UNFPA, The World Bank) because of the peculiar health problems in such States. Probably, however, because of phased implementation of programmes starting from the national level down to States and Local Government Areas (the smallest political and administrative unit), there has been unequal implementation and performances at sub national levels [25]. Their provided an excellent description of factors, levels and progress associated with 20 key MCH interventions and how variations in the implementations of these programmes at national and sub-national level impacted on the differentials in the coverage and expected outcome/impact in the country. Nigeria's health system is organized in such a structure that programme implementation from the national level to sub-national levels (States and Local Governments) permits differences in the intensity and coverage of interventions with results that some States may perform (and actually do performed) better than other states. According to this work, overall intervention coverage in these 20 key MCH interventions increased from 33% in 2000 to 47% in 2013, with a wide range from 21% in Sokoto State to 66% in Ekiti State. Finally, because the present analysis is based on overall national data, we believe that if the analyses were conducted at sub-national level (that at State level) the results would have shown some downward trend in the risk of FDM and ENND most particularly at zonal levels as reported by Wollum (2015). Overall, our results are similar with that reported by Jaramillo-Mejía MC when they reported that multiple pregnancies and CS delivery increased risk of first-day mortality [26].

5. CONCLUSION AND RECOMMENDATION

5.1 Policy Implications

The policy implications would be related to the three significant factors identified as the risks for FDM and ENND which appear to be wholly health system factors. Firstly, there is urgent need to improve antenatal care coverage since it provides the suitable environment for any subsequent medical intervention for the mother and baby in the case of need. Currently, less than two-thirds (61%) of pregnant women has ANC while just over half (51%) had at least four ANC visits. The multiplier effect of ANC attendance is to retain pregnant women for risk evaluation and intervention. For example, those that require medical intervention such as CS delivery would be clearly identified and receive the intervention to reduce the risk of adverse pregnancy outcome. Currently, only about 2% of pregnancies are delivered via CS which is grossly inadequate to overcome unnecessary adverse outcomes. Addressing multiple pregnancy and CS are part of the model of responding to maternal danger signs which could be strengthened during ANC through education on birth preparedness, recognition of danger signs, cord care etc. Based on the temporal increase in risk of FDM and ENND that is highest in the 2013 survey, its indicates that risks associated with FDM and ENND has been deteriorating over time lending support that the MCH interventions implemented over these years has not been effective.

6. STRENGTHS

To our knowledge, this is the first time this type of analysis of risk factors for first-day and early neonatal mortality is being conducted using a large population data for Nigeria, though there are fragmentary and hospital-based studies on the subject matter. Furthermore, it is the first time in which data from three surveys are pooled to analyse factors are associated with FDM and ENND cognizance of their contribution to overall child mortality. We used one the powerful model for the analysis: Cox proportional hazard model.

7. LIMITATIONS

As a cross-sectional study, the DHS data can only provide associated risk and not causality. It is for this reason that we are unable to demonstrated significant association between sex of newborn and first-day mortality despite knowing this from previous studies.

CONSENT

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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