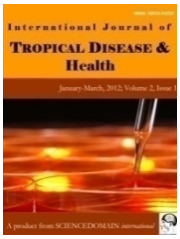

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Differentials and Correlates of Infants Mortality in Nigeria: A Comparative Survival Analysis between North East and South West Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors FAF and AO conceived and designed the study and wrote the methodologies. Author FAF analysed the data, wrote the result and the discussion. Both authors contributed to the introduction, proof read and agreed on the final manuscript.

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ABSTRACT

Aims: Infant mortality rate (IMR) is not only used as a demographic measure, but also as an important health indicator of a society as well as a measure of its living standard worldwide. The Nigeria Demographic and Household Survey (NDHS) declared a wide difference in the IMR among geographical zones in Nigeria with widest gap between the North East (NE) and South West (SW). This study assessed the differences in IMR viz-a-viz socio-demographic, sexual and reproductive factors and also determined factors affecting the IMR in the two zones.
Place of Study: Rural and Urbanlocations across the NE and SW Nigeria
Study Design: We used a nationally representative cross sectional data from the NDHS 2008 survey.Our analysis was based on the 23,995 and 11,546 births during five years preceding data collection from women aged 15-49 years in NE and SW Nigeria respectively.
Methods: We censored the children who have not had their first birthday as of the day of interview and estimated the IMR with Life tables using West Models. Other analysis were carried out with descriptive statistics, bivariate and multivariate cox regression models at 5% significance level.

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Results: About 3 of every four NE children are from rural areas compared with 47.4% in SW, while nearly 78% of NE children are from mothers without formal education the rate was 20.9% in the SW. The IMR among children from teenager mothers was 121 and 82 per 1000 live births in NE and SW respectively, 87 for urban NE, 52 for urban SW, 115 for rural NE, and 66 for rural SW. In the NE, children from rural areas were about 30% times more likely than children from urban areas to die before their first birthday (HR=1.3 95% CI:1.1-1.6)while in the SW they were 40% times more likely to die (HR=1.6 95% CI:1.1-2.4). Children from wealthiest homes in the NE had lower IMR than children from wealthiest homes in the SW (37 vs 55) but wealth quintiles were not significant to IMR in the SW.

Conclusion: The prevailing trend of early marriage, non-education, delayed initiation of breastfeeding, unsafe drinking water, unemployment and poverty among others should be averted so as to improve child survival in the Nigeria especially in the North East.

Keywords: Infant mortality rate; NDHS; wealth index; early marriage; Nigeria.

1. INTRODUCTION

The infant mortality rate (IMR) is the number of infants among 1000 who die before their first birthday. Worldwide, infant and child mortality is used not only as a demographic measure, but also as an important health indicator of a society as well as a measure of its living standard. IMR and child mortality rate reflect a country's level of socioeconomic development and quality of life and are also used for monitoring and evaluating population and health programme and policies. Everyday about 29,000 under–five children die worldwide; the majority of these deaths occurs in developing world and is largely due to preventable causes (UNICEF, 2008). UNICEF has been able to identify those regions of the world as having inadequate or no progress towards reaching the Millennium Development Goal (MDGs) for a reduction by two-third in under-five mortality rate between 1990 and 2015. The NDHS (2008) has shown that about 75 infants in every 1000 live births in Nigeria died before their first birthday (i.e. 1 in 13 live births) [1]. The report further stated that under-five mortality rate is 157 per 1,000 live births for the five-year period immediately preceding the survey and also that the neonatal mortality rate is 40 per 1,000 births. Thus, almost half of childhood deaths occurred during infancy, with one-quarter of the deaths taking place during the first month of life.

Nigeria is Africa's most populous nation with an estimated population of 170 million by mid-2012 [2,3]. While the IMR for the entire world is 41 per 1000 live births, it is 5 for more developed countries, 67 for Africa, 72 for sub-Sahara Africa, 76 for West Africa and 77 for Nigeria [3]. The estimatefor Nigeria is very close to the estimated 75 IMR in the NDHS 2008 [1]. Although the rate in Nigeria is neck to neck with that of its neighboring countries, for instance Ghana is placed at 70, Cote D'ivoire at 73, Togo at 78, Benin 81, Mali 97 and Cameroun 62 [3], the IMR in Nigeria remains undoubtedly high. Just as the fertility rate in Nigeria is above the worlds' average,the IMR too is above the world's average [4,5].

An in-depth analysis of IMR in the 6 geo-political zones of Nigeria according to the NDHS (2008) is as follows: North central (77), North east (109), Northwest (91), Southeast (95), South-south (84), Southwest (59) per 1000 live births, while the national IMR stands at 75/1000. The levels of infant mortality in all 3 Northern geo-political zones are higher than the national figure of 75 infant deaths per 1000 live birth [1]. This finding suggested differences in IMR across the zones, with the widest difference between the Northeast and Southwest Nigeria.

IMR and maternal mortality are not disconnected. Till date, Maternal and child health (MCH) outcomes in Nigeria are among the worst in the world [6,7]. Several studies have ascribed inadequate health facilities, lack of transportation to institutional care, inability to pay for services and resistance among some populations to modern health care as key factors behind the country's high rate of maternal, newborn and child morbidity and mortality [8,9].

Attention to clean and hygiene delivery practices and the provision of essential care for the newborn are important interventions which can improve health outcomes of all infants whether born at home or in a health facility [6,7,10–13]. Practicing exclusive breastfeeding may be insufficient; an early initiation to breast feeding and exclusive breastfeeding practice will reduce infant deaths. A 2006 study in rural Ghana showed that early initiation to breastfeeding within the first hours of birth could reduce 22% of neonatal deaths, and initiation within the first day would prevent 16% of deaths [14]. Similar findings were documented in a 2008 study in Nepal [15].

A recent study carried out in North East part of Nigeria associated most of the diseases among infants and children in the Northern part of the country with poverty [16]. Also, an earlier South West Nigeria study reported that low educational status of the mother and poor environmental sanitation may put children at risk of childhood diseases [17] which could soar the IMR.

Socio-demographic and economic factors play important roles in determining child survival all over the world [18] just as mothers' education has an implicit effect on the health of children [19]. Early marriage was also identified in several studies to have affected both the socioeconomic condition and infant mortality [20–22]. An India study in 2010 showed that children born to mothers who were married before attaining the age of 18 were at a higher risk of stunting and underweight compared to children of women who had married at age 18 or older [23]. Several other factors have been ascribed to IMR [24–28].

Some studies have reported regional disparities in health service delivery and resource availability. Although, Southern states in Nigeria enjoy more health services than the northern states [6], but of much concern is the fact that most of the public health interventions by government and non-governmental agencies are majorly directed to the northern region of the country with minimal results been achieved in terms of IMR [1]. Therefore, there is need to identify possible factors responsible for non-significant decline in IMR so as to improve the understanding of the precise determinants of mortality of infant in the Northeast as compared to Southwest Nigeria thus enabling policy makers and donor agencies to direct resources towards mitigating the risk factors. The study will bring about an understanding and improvement on the infant mortality indicators in Northern Nigeria and the country in general thus enabling Nigeria to achieve the Millennium Development Goal 4 (reduction in child mortality). This will definitely have a multiplier effects on the other MDGs thereby creating overall development of the society.

Despite huge research focus given infant and early childhood mortality in developing countries in recent past, there is paucity of information on comparison of IMR across zones in Nigeria and only very few studies have some of the correlates of infant and child mortality. Most of these studies have focused on indirect estimation of infant and child mortality levels [6,19,29].

In this study, we estimated IMR and assessed pattern of infant mortality in the NE and SW geo-political zones of Nigeria viz-a-viz socio-demographic, health and reproductive factors.

We also identified and compared the Socio-demographic, health and reproductive factors influencing infant mortality in the two zones.

2. METHODOLOGY

We used the Nigeria Demographic and Household Survey [1] data to carry out a retrospective analysis of the recoded children data collected during a cross-sectional survey. Our analysis was based on the recoded children data which consist of 23,995 and 11,546 births from NE and SW Nigeria respectively. The women supplied information of all the children they had within five years preceding the survey, whether the child was dead or alive. The NE consist of Taraba, Adamawa, Yobe, Borno, Gombe and Bauchi states while the SW states are Lagos, Ogun, Oyo, Ondo, Osun and Ekiti Fig. 1. Details of the survey methodology has been reported [1].

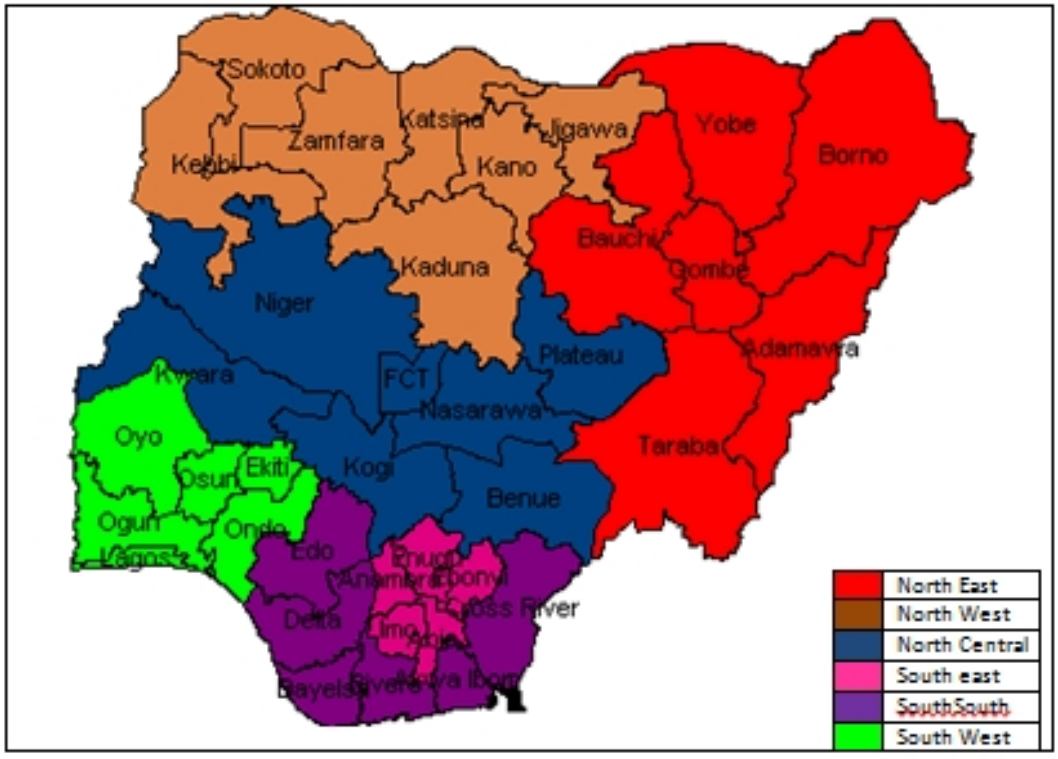

Fig. 1. Map of Nigeria showing its 36 states, the federal capital territory and the geographical zones

2.1 Variables

The outcome measure is mortality in infants whose mothers (15-49yrs) are from NE and SW region of the country. The explanatory variables we examined in this study include: Educational attainment of both parents, age of the mother, age of mother at first birth and at first marriage, sexual debut, wealth index, number of births within five years, type of place of residence and the source of drinking water, occupation, place of delivery, duration of breastfeeding, other intake apart from breast-milk and post natal care.

2.2 Statistical Analysis

Descriptive statistics and Chi square test were used to analyze the data.We used the date of birth of children, whether the child was dead or alive, age at death for those who have died. We censored the children who have not had their first birthday as of the day of interview. We specified both the failure time (the age when the child died) and the censoring time (the age of the child as at the time of the survey). We then computed the IMR with life table using the west model.

Life tables describe death rates in a given population over time. It also allows the examination of the empirical hazard function through aggregation. Let T_i be the individual failure or censoring times. The data are aggregated into intervals given by t_j , j = 1; : : : ; k, and $t_{j+1}=\infty$ with each interval containing counts for $t_j<\tau<t_{j+1}$. Let d_j and m_j be the number of failures and censored observations during an interval and let $N_j$be the number alive at the start of the interval.

Thenthe adjusted number at risk at the start of the interval is.

$$n_j = N_j - \frac{m_j}{2} \qquad \text{.....(1)}$$

The product-limit estimate of the survivor function as given by [30]is

$$\hat{S}(t) = \begin{cases} 1 & \text{if } t < t_1 \\ \prod_{t_i \le t} [1 - \frac{d_i}{n_i}] & \text{if } t \ge t_1 \end{cases} \qquad \text{.....(2)}$$

With asymptotic variance

$$\hat{V}[\hat{S}(t)] = \hat{S}(t)^2 \sum_{t_i \le t} \frac{d_i}{Y_i(Y_i - d_i)} \qquad \text{.....(3)}$$

The Cox proportional hazards regression assumes the relationshipfor one covariate where ho(t) is the baseline hazard function, xi are the covariates and βi are the coefficients.

$$h(t; x) = h_0(t)\exp(x\beta) \qquad \text{.....(4)}$$

We also stratified Cox regression estimates. In the stratified estimator, the hazard at time *t* for a subject in group is assumed to be

$$h_i(t) = h_{i0}(t)\exp(\beta_1 x_{i1} + ... + \beta_k x_{ik}) \qquad \text{.....(5)}$$

That is, the coefficients are assumed to be the same, regardless of group, but the baseline hazard can be group specific. In our stratified Cox analysis, we tested whether the proportional-hazards assumption was violated using the significance of the hazard ratios and the Wald chi square statistics.

Variables significant in the bivariate cox regression were used in the multiple cox regression to assess association with outcome variable while controlling for confounders. Variables significant in the binary cox regression were compared across the two regions. Sampling

weights were applied in our analysis. The weighting was based on the sampling fractions derived from the sample size and the total population of each state constituting Nigeria. Statistical significance was determined at p-value=0.05. We used the STATA (version 12) statistical analysis software for all the analysis.

2.3 Ethical Considerations

Ethical approval for data collection obtained for the survey was already documented [1].

3. RESULTS

Within five years before the survey, 23,995 and 11,546 children were born to the respondents from NE and SW respectively. About 22.0% of mothers in SW are aged 35-39year. Almost 3 of every four children from NE are from rural areas while the rural-urban ratio in SW was about 1 to 1. Nearly 78.0% of NE mothers had no formal education compared to 21.0% in the SW. All the socio-demographic variables of mothers we examined were found to be statistically different across the two zones Table 1.

Over 75.0% of mothers from NE had had over four children compared with 49.0% from SW. About one tenth of NE children were underweight at birth compared with 3.0% in the SW. About 45.0% NE children usually drink well water compared to 25.0% in the SW, also 87.0% of NE children were delivered at the homes of respondents or that of their relatives compared with 24.0% in the SW. All the sexual, reproductive and healthy living variables of mothers we examined were found to be statistically different across the two zones Table 2.

The overall IMR in the NE was 108 per 1000 live births compared to 59 in the SW (Table 3, Table 4 and Fig. 2). Fig. 2 shows the survival curves of children in their first years of life in the two zones. The probability of a child from NE and SW surviving 1styear was estimated as 0.890 vs 0.940respectively.

The IMR among children from teenager mothers was 121 and 82 per 1000 live births from NE and SW respectively, 115 and 57 for children whose mother was aged 20-24 years in NE and SW respectively. While the Urban IMR in NE is 87 per 1000 live births, SW Urban areas had 52. The IMR among children from NE poorest homes was 117 compared to 67 from the SW. The hazard ratio of a child in rural locations dying before their first birthday is higher than those in urban settlements in both NE (1.3) and SW (1.6). In both zones, education status of parents was significant independent predictors of infant mortality. In the NE children from mothers with higher education were about 60% less likely to die before attaining one year and about 90% less likely in the SW. Children from richer and richest homes in the NE were about 50% and 70% times less likely to die before first birthday respectively than those from poorest homes, but this wasn't significant in the SW. Ages of mothers, religions, ethnicity in both zones were not significant independent predictors of infant deaths Table 3. The IMR among children whose mothers had sexual intercourse before age 13 was 115, compared to 107 among children of mothers who had it within 20 to 29 years of age in the NE. Also in the SW, the IMR of children from mothers with sexual debut at age lower than 13years is 121 compared to 49 in the 20-29 years age bracket. The IMR among children born at respondents homes in the NE is 104 compared with 87 in public facilities and 97 in private facilities. In NE, children born in public hospitals were less likely to die before age one while in SW, only children born in private hospitals were less likely to have died before attaining age one year. Sources of drinking water was not a significant predictor of infant

deaths in the NE but in the SW, children who were given water from wells and flowing rivers were more likely to die before age 1 than those drinking water from pipes, taps and boreholes Table 4.

Table 1. Socio demographic characteristics of respondents from North East and South West Nigeria

Variable		NE: N=23995 ()() East %	SW: N=11546	p-value
		%	%	
Age of mothers	Mean	34.7±8.3	37.1±7.6	
	15-19 years	2.2	0.7	<0.001*
	20-24 years	8.7	4.9	
	25-29 years	17.0	15.1	
	30-34 years	17.7	18.9	
	35-39 years	20.1	22.0	
	40-44 years	16.9	18.7	
	45-49 years	17.4	19.8	
Locality	Urban	24.8	52.6	<0.001*
	Rural	75.2	47.4	
Ethnicity	Yoruba	0.3	75.8	<0.001*
	Hausa/fulani	44.0	3.6	
	Igbo/Ibiobio	0.2	7.9	
	Others	55.6	12.7	
Religion	Catholic	1.3	4.8	<0.001*
	Other Christian	14.6	55.9	
	Islam	82.0	37.7	
	Traditionalist	1.3	1.2	
	Others	0.8	0.4	
Highest level of education	No education	77.8	20.9	<0.001*
	Primary	14.8	31.6	
	Secondary	6.2	37.1	
	Higher	1.2	10.4	
Father's highest education level	No education	69.1	16.7	<0.001*
	Primary	13.5	28.3	
	Secondary	10.1	39.1	
	Higher	5.6	14.8	
	Don't know	1.4	1.1	
Wealth index	Poorest	48.8	5.0	<0.001*
	Poorer	24.7	13.2	
	Middle	15.5	16.0	
	Richer	8.5	23.4	
	Richest	2.5	42.4	
Marital status	Never married	0.3	0.9	<0.001*
	Currently married	96.3	94.5	
	Formerly married	3.4	4.6	
Currently working	No	36.3	9.6	<0.001*
	Yes	63.7	90.4	
	Total	52.1	47.9	

Table 2. Sexual, reproductive & health characteristics of mothers in North East & South West Nigeria

Variable	Categories	North east (%) N=23995	South west (%) N=11546	Significance
Age of Mothers at 1st	<13 years	10.5	2.0	<0.001*
	13-19 years	83.3	67.2	
Median:	20-29 years	6.2	30.4	
NE: 15 SW: 18	30 years &	0.0	0.3	
Age of Mother at first birth	<13 years	3.4	0.9	
	13-19 years	73.8	42.0	<0.001*
Median:	20-29 years	22.0	53.7	
NE:17 SW: 20	30 years &	0.8	3.4	
Age of Mother at 1st marriage	Unmarried	0.3	0.9	
	<15	47.9	10.0	<0.001*
	15-19	41.8	41.6	
Median:	20-23	7.1	29.3	
NE: 15 SW: 19	Over 23 years	3.0	18.3	
Total Children Ever Born	1 or 2 children	8.2	15.6	<0.001*
	3 or 4 children	17.1	35.8	
	Over 4 children	74.7	48.6	
Births in last 5 years	0	22.8	36.2	<0.001*
	1	29.3	33.1	
	2	39.0	26.0	
	3	8.3	4.1	
	4	0.6	0.6	
Size of Child at Birth	Very large	15.5	16.8	<0.001*
	Above average	22.4	35.7	
	Average	40.2	34.8	
	Below average	9.7	8.0	
	Very small	10.7	2.8	
Given milk other than breast in 1st 3	No	78.6	97.8	<0.001*
	Yes	21.4	2.2	
When child was put to breast	Immediately	24.8	35.0	<0.001*
	Within 24 hours	24.4	41.7	
	2-3 days	20.4	7.8	
	After 3 days	30.4	15.5	
Completed Vaccination	No	98.4	87.3	<0.001*
	Yes	1.6	12.7	

Child sleeps under net	No	86.1	88.9	<0.001*
	Yes	13.9	11.1	
Drinking water source	Pipe/tap/borehol	24.8	41.8	<0.001*
	Well	45.3	24.9	
	Surface/flowing	26.8	24.7	
	Rain	0.1	2.2	
	Others	3.1	6.5	
Had postnatal	No	87.2	72.7	<0.001*
	Yes	12.8	27.3	
Place of child's delivery	Homes	86.5	23.7	<0.001*
	Public	11.8	39.1	
	Private	1.0	30.4	
	Others	0.7	6.8	
	Total	52.1	47.9	

CEB Children Ever Born, ^Number of Children, All frequencies were weighted

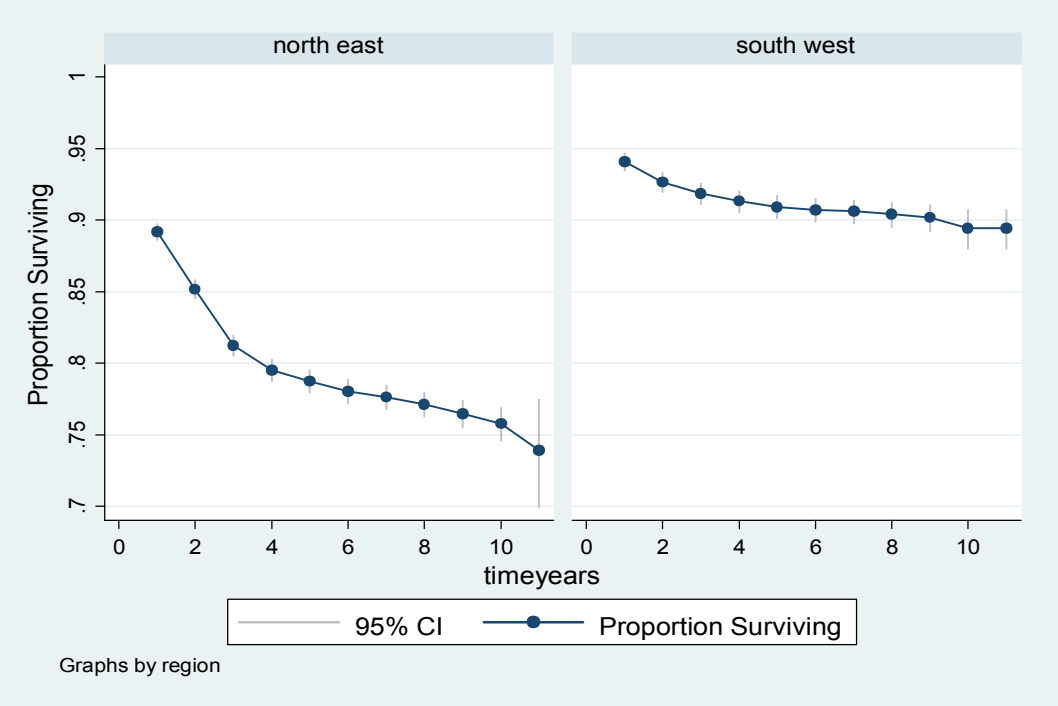

Fig. 2. Survival curves of children for the first ten years of birth in North East and South West Nigeria

Table 3. Estimated IMR across socio demographic characteristics of mothers from North East and South West Nigeria

Variable	Estimated Infant mortality rates per 1000 live births		Bivariate hazard ratios of the strata of the variables			
			HR (95%CI)	p-value	HR (95%CI)	p-value
	N East	S West	North East		South West	
Age of mothers						
15-19 years	121	82	Ref	1.000	Ref	1.000
20-24 years	115	57	1.1(0.7-1.6)	0.716	0.6(0.2-1.9)	0.397
25-29 years	89	54	0.7(0.5-0.9)	0.050	0.5(0.2-1.4)	0.163
30-34 years	103	53	0.8(0.5-1.2)	0.246	0.4(0.1-1.2)	0.122
35-39 years	115	58	1.1(0.7-1.6)	0.802	0.6(0.2-1.7)	0.301
40-44 years	133	66	0.9(0.6-1.5)	0.723	0.3(0.1-1.2)	0.094
45-49 years	132	83	1.1(0.6-1.8)	0.809	0.3(0.1-1.8)	0.193
Locality						
Urban	87	52	Ref	1.000	Ref	1.000
Rural	115	66	1.3(1.1-1.6)	0.023	1.6(1.1-2.4)	0.016
Ethnicity						
Yoruba	32	57	Ref*	1.000	Ref*	1.000
Hausa/Fulani	98	63	1.5(0.2-10.7)	0.679	1.4(0.5-3.7)	0.549
Igbo/Ibiobio	48	56	xxx		0.5(0.3-1.2)	0.129
Others	116	73	1.7(0.2-12.1)	0.591	1.6(0.9-2.5)	0.049
Religion						
Catholic	137	53	Ref*	1.000	Ref	1.000
Other Christian	101	54	1.4(0.6-3.5)	0.448	1.3(0.5-3.1)	0.558
Islam	108	68	1.2(0.5-3.0)	0.625	1.5(0.6-3.6)	0.386
Traditionalist	151	63	1.6(0.6-4.8)	0.361	1.0(0.1-8.7)	0.980
Others	250	xxx	2.1(0.6-6.9)	0.222	Xxx	
Highest education						
No Education	114	73	Ref	1.000	Ref	1.000
Primary	104	66	0.9(0.8-1.2)	0.801	0.9(0.6-1.6)	0.803
Secondary	76	55	0.6(0.4-0.8)	0.008	0.6(0.4-1.1)	0.084
Higher	29	32	0.4(0.2-0.9)	0.045	0.1(0.0-0.5)	0.004
Father's education						
No Education	115	67	Ref	1.000	Ref	1.000
Primary	109	69	0.9(0.8-1.2)	0.744	1.2(0.7-2.2)	0.521
Secondary	103	56	0.8(0.7-1.1)	0.272	0.8(0.4-1.4)	0.356
Higher	63	45	0.4(0.2-0.6)	0.000	0.4(0.2-0.9)	0.024
Wealth index						
Poorest	117	67	Ref	1.000	Ref	1.000
Poorer	119	74	1.0(0.8-1.2)	0.958	1.9(0.7-5.2)	0.229
Middle	95	63	0.9(0.7-1.2)	0.564	2.3(0.9-6.4)	0.095
Richer	84	53	0.5(0.3-0.8)	0.001	1.5(0.5-4.0)	0.438
Richest	37	55	0.3(0.2-0.8)	0.013	0.9(0.3-2.4)	0.830
Marital status						
Never Married	25	53	Ref	1.000	Ref*	1.000
Currently Married	109	59	2.5(0.6-10.5)	0.205	0.4(0.2-1.0)	0.055
Formerly Married	102	69	4.4(1.1-19.6)	0.049	0.5(0.1-2.3)	0.402
Currently working						
No	98	53	Ref*	1.000	Ref*	1.000
Yes	116	60	1.1(0.9-1.3)	0.406	1.0(0.6-1.8)	0.892
Total	108	59				

Hr Hazard Ratio, xxx No convergence due to insufficient sample size

Table 4. Pattern of infant mortality vizaviz across sexual and reproductive characteristics of mothers from North East and South West Nigeria

Variables	Estimated infant mortality rate per 1000 live births		Bivariate association between mortality and variables			
			HR(95%CI)	P-value	HR(95%CI)	p-value
	N East	S West	North East		South West	
Age of mothers at 1st intercourse						
<13 years	115	121	Ref	1.000	Ref	1.000
13-19 years	107	57	0.9(0.7-1.2)	0.459	1.8(0.4-7.3)	0.437
20-29 years	107	49	1.0(0.7-1.5)	0.836	1.0(0.2-4.4)	0.981
30 years & above	xxx	Xxx	xxx		xxx	
Age of mother at first birth						
<13 years	102	217	Ref *	1.000	Ref	1.000
13-19 years	110	67	0.8(0.5-1.4)	0.457	0.4(0.1-1.7)	0.219
20-29 years	103	52	0.9(0.5-1.4)	0.551	0.2(0.1-1.1)	0.066
30 years & above	133	61	1.2(0.5-2.9)	0.611	0.2(0.0-0.9)	0.049
Age of mother at 1st marriage						
Unmarried	25	53	Ref	1.000	Ref	1.000
<15	120	84	2.8(0.7-11.8)	0.153	0.5(0.2-1.6)	0.231
15-19	100	64	2.2(0.5-9.01)	0.293	0.6(0.2-1.6)	0.293
20-23	103	55	3.1(0.7-13.3)	0.122	0.3(0.1-0.8)	0.013
Over 23 years	89	48	3.2(0.7-14.0)	0.130	0.2(0.1-0.7)	0.008
Total children Ever Born						
1 or 2 children	87	34	Ref *	1.000	Ref	1.000
3 or 4 children	83	45	0.1(0.7-1.3)	0.800	1.9(1.1-3.2)	0.023
Over 4 children	102	94	1.2(1.0-1.5)	0.126	3.3(2.0-5.6)	0.000
Births in 5 years before survey						
0	160	72	Ref	1.000	Ref	1.000
1	91	39	0.6(0.1-2.6)	0.453	0.5(0.1-3.8)	0.496
2	93	56	0.8(0.2-3.5)	0.754	0.8(0.1-6.2)	0.859
3	182	152	1.7(0.4-7.6)	0.508	2.1(0.3-15.8)	0.479
4	179	206	1.7(0.3-8.1)	0.534	3.4(0.4-29.9)	0.269
Size of child at birth						
Very large	90	30	Ref	1.000	Ref	1.000
Above average	65	44	0.8(0.6-1.0)	0.087	1.4(0.7-2.7)	0.286
Average	83	61	0.8(0.6-1.1)	0.115	1.7(0.9-3.3)	0.088
Below average	92	84	1.2(0.9-1.7)	0.243	0.9(0.3-2.4)	0.840

Very small	118	104	1.0(0.7-1.5)	0.822	1.7(0.5-5.4)	0.363
Given milk other than breast in 1st 3 days						
No	48	27	Ref *	1.000	Ref	1.000
Yes	53	0	1.1(0.8-1.5)	0.632	xxx	xxx
Period child was put to breast						
Immediately	89	52	Ref*	1.000	Ref	1.000
Within 24 hours	93	53	0.9(0.7-1.1)	0.315	0.8(0.5-1.2)	0.272
2-3 days	101	34	0.9(0.7-1.2)	0.497	0.9(0.4-2.1)	0.911
After 3 days	102	46	0.8(0.6-1.0)	0.064	0.5(0.2-1.2)	0.129
Child sleeps under net						
No	99	46	Ref *	1.000	Ref*	1.000
Yes	93	48	0.9(0.7-1.2)	0.424	1.4(0.7-2.7)	0.355
Drinking water source						
Pipe/tap/borehole	97	57	Ref	1.000	Ref	1.000
Well	107	41	1.0(0.8-1.3)	0.683	1.8(1.1-2.9)	0.021
Surface/flowing	124	81	1.1(0.8-1.4)	0.616	2.1(1.3-3.4)	0.002
Rain	120	63	xxx	xxxx	0.8(0.2-3.2)	0.711
Others/Water tanker	75	57	1.1(0.7-1.7)	0.746	1.1(0.5-2.5)	0.760
Had postnatal care						
No	65	63	Ref	1.000	Ref	1.000
Yes	42	7	0.9(0.6-1.5)	0.977	0.1(0.0-1.1)	0.057
Place of child's delivery						
Delivery homes	104	71	Ref	1.000	Ref	1.000
Public hospitals	87	59	0.6(0.5-0.9)	0.009	1.1(0.7-1.8)	0.634
Private hospital	97	47	0.5(0.1-1.5)	0.200	0.5(0.3-0.9)	0.033
Others	191	80	3.1(1.8-5.3)	0.000	1.4(0.7-2.9)	0.345

HR Hazard Ratio, xxx No convergence due to insufficient sample size

Table 5. Factors affecting Infant Mortality in North East and South West Nigeria

Variable	Categories	North East		South West	
		AOR(95% CI)	p-value	AOR(95% CI)	p-value
Location	Urban	Ref	1.000	Ref	1.000
	Rural	1.0(0.6-1.7)	0.882	1.4(0.3-7.6)	0.689
Highest level of Education	No education	Ref	1.000	Ref	1.000
	Primary	0.9(0.5-1.4)	0.531	0.8(0.1-5.2)	0.859
	Secondary	0.9(0.4-2.1)	0.859	0.9(0.1-6.6)	0.943
	Higher	2.7(0.3-24.9)	0.386	xxx	
Father's highest Education level	No education	Ref	1.000	Ref	1.000
	Primary	1.2(0.7-1.9)	0.524	1.7(0.2-13.5)	0.602
	Secondary	1.3(0.7-2.3)	0.374	1.8(0.2-15.5)	0.607
	Higher	0.3(0.1-1.1)	0.064	1.9(0-100.1)	0.740
Wealth index	Poorest	Ref	1.000	Ref	1.000
	Poorer	0.7(0.5-1.1)	0.151	0.3(0.0-5.5)	0.427
	Middle	0.8(0.5-1.4)	0.475	4.6(0.3-81.3)	0.294
	Richer	0.4(0.1-1.1)	0.078	1.4(0.1-23.6)	0.833
	Richest	0.7(0.1-6.1)	0.765	1.9(0.1-36.7)	0.670
Marital status	Never married	Ref	1.000	Ref	1.000
	Currently married	1.5(0.6-3.4)	0.378	xxx	
	Formerly married	1.5(0.6-3.4)	0.378	xxx	
Currently working	No	Ref	1.000	Ref	1.000
	Yes	1.2(0.5-1.0)	0.434	0.1(0.0-0.3)	0.000
Age of mother at first birth	<13 years	Ref	1.000	Ref	1.000
	13-19 years	0.7(0.5-0.9)	0.046	xxx	
	20-29 years	0.8(0.4-1.5)	0.497	xxx	
	30 years & Above	1.3(0.6-2.8)	0.532	xxx	
Total children ever born	1 or 2 children	Ref	1.000	Ref	1.000
	3 or 4 children	0.7(0.4-1.1)	0.109	2.3(0.5-11.3)	0.299
	Over 4 children	0.9(0.6-1.4)	0.704	6.8(1.6-29.6)	0.011
Size of child at birth	Very large	Ref	1.000	Ref	1.000
	Above average	0.9(0.5-1.6)	0.774	1.6(0.2-14.2)	0.663
	Average	1.0(0.6-1.7)	0.934	4.7(0.4-60.2)	0.239
	Below average	1.7(0.9-3.2)	0.090	5.9(0.4-78.9)	0.179
	Very Small	0.9(0.4-1.7)	0.667	2.1(0.1-36.3)	0.609
Drinking water source	Pipe/tap/borehole	Ref	1.000	Ref	1.000
	Well	1.5(1.4-1.8)	0.003	3.6(0.4-34.1)	0.264
	Surface/flowing	0.6(0.4-1.0)	0.078	6.1(1.1-42.2)	0.046
	Rain	xxx	.	xxx	
	Others/water tanker	0.8(0.3-2.5)	0.725	2(0.1-27.6)	0.606
Had postnatal care	No	Ref	1.000	Ref	1.000
	Yes	1(0.6-1.7)	0.942	0.2(0-1.5)	0.109

Hr Hazard Ratio, xxx No convergence due to insufficient sample size

Children from mothers aged 13-19years at first birth in the NE were less likely to die before first birthday than children from younger mothers just as underweight (below average) children had higher hazard ratio of dying before age one than those with very large weights. Children given water from the well had higher chances of dying (HR=1.5) than those drinking cleaner water from taps, pipes and boreholes in the NE. SW children given water from the

flowing streams had higher chances (HR=6.1) of dying than those drinking cleaner water from taps, pipes and boreholes. Children from mothers with over four children were about seven times more likely not to attain age one than those with one or two children as shown in Table 5 above.

4. DISCUSSION

We found the two zones to be significantly different on the basis of the socio-demographical characteristics as well as reproductive and environmental indicators investigated. While rural-urban location, mothers' and fathers' education, parents' marital status, wealth index,source of drinking water, child's weight at birth and place of child's delivery significantly influence infant mortality in the NE zone, rural-urban location, ethnicity, mothers' and fathers' education, parents' marital status, mothers age at first birth and first marriage, children ever born, source of drinking water and place of child's delivery are factors that significantly influence IMR in the SW zone. The estimated IMR of 108 and 59 for every 1000 live births in the NE and SW respectively is about the same with the reported 109 and 59 in NDHS (2008). Our IMR estimates across the variables in each zone are therefore reliable. The IMR in the NE zone is about twice and significantly higher than the IMR in the SW this means that infant deaths in NE would have doubled infant deaths in SW by their first birthday.

The socio-demographic, sexual and reproductive factors as well as healthy living practices among mothers in the NE are significantly different from their counterparts in the SW. This is in agreement with those reported in previous studies [6,7]. The wide difference in the IMR between the two zones could be ascribed to the differentials in the mothers' characteristics. This is in consonance with findings of previous researches which reported high percentage of early teenage marriages in Northern Nigeria and that most of these young mothers were illiterate housewives [31].

Children whose mothers and fathers had no education or had primary education were found to have higher chances of dying before their first birthday in the two zones studied and this chance is much higher in the NE. This is in consonance with reports in earlier researches that education has an implicit effect on the health of children, where health is interpreted in its broadest sense as complete physical, psychological, social, emotional, developmental and environmental well-being [32]. These educated women may also tend to live in more economically developed areas that are rich enough to have schools and access to good medical facilities [6,19,33]. This assertion is not unconnected with our findings that children in rural areas in both zones have higher likelihood of infant deaths compared with those from urban areas. Considering the wealth quintiles children belong, generally children from poor homes tend to have higher IMR than those from poorer homes. Though the NE IMR was almost double of SW rates, children from wealthiest homes in the NE had lower IMR than children from wealthiest homes in the SW. This is a clear demonstration of high disparity among the rich and poor in the NE. Wealth quintiles were not significant to IMR in SW.

Although, source of drinking water is not significant to IMR in the NE, the situation is however in the contrary in the SW where IMR is lower among children drinking water from well, stationary or flowing sources compared to those drinking water either from piped or borehole sources. Although not statistically significant children who had postnatal care were less likely in the two zones to live beyond their first birthday. This finding is in agreement with the argument by a previous research that both provisions of good prenatal and postnatal cares are essential for child's health even if the mother are teenagers [34]. We found that

young maternal age of mothers affect children survival as IMR reduced considerably as maternal age increased in both NE and SW thou IMR among NE children whose mothers had first birth at age 30 years or more were significantly higher than those who had it before age 13 years. This finding disagreed with a report that young maternal age was not an independent risk factor for adverse birth outcomes where they attributed increased risky child health to other factors that were related to teenage pregnancy such as: unmarried status, low socioeconomic status, inadequate prenatal care, low education level etc [35]. This could be attributed to the fact that most (>75%) mothers in the NE had either married or had child before attaining age 19years compared with less than half in the SW. This is closely related to the finding that IMR was higher among teenage mothers who constituted most of the mothers. However, earlier studies which examined the effect of age at first birth on child survival emphasized that adolescent women are less likely to provide adequate care for their infants and children, because they often lack the maturity, education and resources to do so [36,37].

We found that IMR was distinctly high among NE and SW children delivered at either mothers' or relatives' homes compared with those delivered at public and health care facilities. This was in agreement with findings that delivery at a health care facility was associated with subsequent reductions in neonatal, infant and under-five mortality, they submitted that places of delivery have clear beneficial effects on reducing infant and under-five mortality [6,7]. The strong cultural beliefs and practices on child birth and characteristics in Northern Nigeria could have influenced the high infant mortality rate compared to Southern Nigeria.

5. CONCLUSION

This study found that in the North East Nigeria, place of residence, mothers' and fathers' education, wealth index, and place of child's delivery significantly influence infant mortality while rural-urban location, ethnicity, mothers' and fathers' education, parents' marital status, mothers age at first birth and first marriage, children ever born, source of drinking water and place of child's delivery are factors that significantly influence IMR in the South West. While the gaps in IMR across these factors were relative close in the South West, we found high disparity in the North East. Measures should be directed at improving the socioeconomic circumstance of the entire population. The measures should include gainful employment, provision of safe drinking water, sound education as well as adequate health education and promotion to reduce infant mortality rates. Proper and timely effort should be made at improving the health indicators in Nigeria, especially in the North East so that MDG 4 (reduction in child mortality) can be achieved. These efforts should also be extended to strategies of attaining MDG 1 (poverty) and MDG 3 (gender inequality). Until the trend of socio–economic and health indicator in Northern Nigeria is adequately controlled, infant mortality rate will continue to soar.

6. LIMITATIONS

We have used data from a retrospective survey which might have been affected by memory recall and willingness to recount some experience. The information we used include events that may be difficult and painful for the mothers to recount such as death of their children. In this part of the world, mothers don't always list all their dead children and this may lead to underreporting of such events.

CONSENT

This is not applicable because we used a secondary data. Issues relating to the consent of the participants was already documented [1]

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. NDHS. Nigeria Demographic and Household Survey. DHS Measure Macro, New York and Nigeria Population Commission, Abuja; 2008.
2. NPC. Nigeria Over 167 Million [Internet]. 2013 [cited 2013 May 3]. Available from: http://www.population.gov.ng/index.php/84-news/latest/106-nigeria-over-167-million-population-implications-and-challenges.
3. PRB. The World's Women and Girls 2012 Datasheet [Internet]. Population Reference Bureau; 2012 [cited 2013 Sep 2]. Available from: www.prb.org/pdf11/world-women-girls-320770-data-sheet.pdf.
4. Cohen B. The emerging fertility transition in Sub-saharan Africa. World Dev. 1998;26:1431–61.
5. Cleland J, Onuoha N, Timaeus I. Fertility change in Sub-saharan Africa: A review of evidence. In: Locoh T, Hertrich V (eds) The onset of fertility transition in Sub-Saharan Africa. Ordinal Ed Liège. 1994;1–20.
6. Doctor H V, Bairagi R, Findley SE, Helleringer S. Northern Nigeria Maternal , Newborn and Child Health Programme : Selected Analyses from Population-Based Baseline Survey. Open Demogr J. 2011;4:11–21.
7. Ashir GM, Doctor HV, Afenyadu GY. Performance based financing and uptake of maternal and child health services in Yobe Sate, Northern Nigeria. Glob J Heal Sci. 2013;5(3):34–41.
8. Babalola S, Fatusi A. Determinants of use of maternal health serv- ices in Nigeria – looking beyond individual and household factors. BMC Pregnancy Childbirth. 2009;9(43):1–15.
9. UNICEF. The state of the world's children [Internet]. 2008 [cited 2013 Jan 25]. Available from: www.Unicef.org/sowc08/docs.
10. Anya S, Hydara A, Jaiteh L. Antenatal care in the Gambia: Missed opportunity for information, education and communication. BMC Pregnancy Childbirth. 2008;8(9).
11. Pembe AB, Urassa DP, Carlstedt A, Lindmark G, Nyström L, Darj E. Rural Tanzanian women's awareness of danger signs of obstetric complications. 2009;9:12. BMC Pregnancy Childbirth. 2009;2(9).
12. WHO. World Health Organization antenatal care randomized trial: manual for the implementation of the new model. Geneva: WHO Programme to Map Best Reproductive Health Practices; 2002.
13. Villar JEA. e.a. WHO antenatal care randomized trial for the evaluation of a new model of routine antenatal care. Lancet. 2001;357:1565–70.

14. Edmond K, Zandoh C, Quigley M, Amenga-Etego S, Owusu-Agyei S, Kirkwood B. Delayed breastfeeding initiation increases risk of neonatal mortality. Pediatrics. 2006;117:380–6.
15. Mullany LC, Katz J, Li YM, K SK, LeClerq SC, Darmstadt GL, et al. Breast-feeding patterns, time to initiation and mortality risk among newborns in Southern Nepal. Jouranal Nutr [Internet]. 2008;138(3):599–603. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2366167/.
16. Buowari YD. Paediatric care at general hospital Aliero, Kebbi State, Nigeria. Internet J Fam Pract [Internet]. 2010;9(1). Available from: http://archive.ispub.com/journal/the-internet-journal-of-family-practice/volume-9-number-1/paediatric-care-at-general-hospital-aliero-kebbi-state-nigeria.html#sthash.CpS47st9.dpuf.
17. Omokhodion F, Oyemale A, Sridhar M. Morbidity pattern among under-five children of market women in Ibadan. Nig J Paed. 2003;30(4):135–9.
18. Shawky S, Milaat WM, Abalkhail BA, Soliman NK. Effect of maternal education on the rate of. Saudi Med J. 2001;22(1):39–43.
19. Abuqamar M, Coomans D, Louckx F. Correlation between socioeconomic differences and infant mortality in the Arab World (1990-2009). Int J Sociol Anthropol. 2011;3(1):15–21.
20. Bildirici M, Ersin O KM. Genetic structure, consanguineous marriages and economic Development. Soc Sci Res Netw. 2009;1–15.
21. Othman H, Saadat M. Prevalence of consanguineous marriages in Syria. J Biosoc Sci. 2009;41(5):685–92.
22. Weinreb A. Characteristics of women in consanguineous marriages in Egypt, 1988–2000. Eur J Popul. 2008;24(2):185–210.
23. Raj A, Saggurti N, Winter M, Labonte A, Decker MR, Balaiah D, et al. The effect of maternal child marriage on morbidity and. BMJ [Internet]. 2010;340(b4258):1–9. Availablefrom:http://www.bmj.com/highwire/filestream/338927/field_highwire_article_pdf/0/bmj.b4258.
24. Awoyemi TT, Obayelu OA, Opaluwa HI. Effect of distance on utilization of health care services in rural Kogi State , Nigeria. Jouranal Hum Ecol. 2011;35(1):1–9.
25. Ajala O, Sanni L, Adeyinka S. Accessibility to health care facilities: A panacea for sustainable rural development in Osun State south-western Nigeria. J Hum Ecol. 2005;18(2):121–8.
26. Manzoor I, Hashmi N, Mukhtar F. Determinants and pattern of health care services utilisation in post graduate students. J Ayub Med Coll Abbottabad. 2009;21(3):100–5.
27. Onah H, Ikeako L, Iloabachie G. Factors associated with the use of maternity services in Enugu, southeastern Nigeria. Soc Sci Med. 2009;63(7):1870–8.
28. Chakraborty N, Islam M, Chowdhury R, Bari WW, Akhter H. Determinants of the use of maternal health services in rural Bangladesh. Health Promot Int. 2003;18(4):327–36.
29. Shettima KA. Ways to Fight Maternal Mortality [Internet]. MacArthur's Foundation: Population & Reproductive health. 2008 [cited 2013 Sep 5]. Available from: http://www.macfound.org/press/commentary/north-must-walk-fast-opinion-editorial-kole-ahmed-shettima-nigerian-guardian/.
30. Kalbfleisch JD, Prentice RL. The statistical analysis of failure time data. 2nd ed. New York: Wiley; 2002.
31. Hussain R. Community perceptions of reasons for preference for consanguineous marriages in Pakistan. J Biosoc Sci. 1999;31:449–61.
32. Arab. World. Congress. Education for all national plans in the Arab States. Main Working Document, Arab Regional Conference on EFA National Plans: What's next?, Beirut; 2004.

33. Palloni A. A review of infant mortality trends in selected underdeveloped countries: Some New Estimates. Popul Stud (NY). 1981;35(1):100–19.
34. Mahfouz AA, Elsaid MM, Al-Erian RA, Hamid AM. Teenage pregnancy: Are teenagers a high risk group? Eur J Obs Gynecol Reprod Biol. 1995;59:17–20.
35. Rogers MM, Peoples-Sheps, MD Suchindran C. Impact of a social support programme on teenage prenatal care use and pregnancy outcomes. J Adolesc Heal. 1996;19:132–40.
36. Hobcraft J. Fertility patterns and child survival: A comparative analysis. Popul Bull UN. 1992;33:1–31.
37. Govindasamy P, Stewart MK, Rutstein SO, Boerma JT, Sommerfelt AE. High-risk births and maternity care. Coloumbia, MD: Macro International; 1993.

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