

A Statistical Analysis of Child Mortality: Evidence from Nigeria

By

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Abstract

Despite the global decline in under-five mortality rate from 90 deaths per 1,000 live births in 1990 to 48 in 2012, Nigeria has failed to record any substantial improvement. Under-five mortality in Nigeria increased from 138 per 1,000 live births in 2007 to 158 per 1,000 live births in 2011 against the Millennium development Goal target of 71 per 1,000 live births. The study used data from the Nigeria Demographic and Health Survey (NDHS) 2008 to investigate the predictors of child (aged 0-4 years) mortality in Nigeria. Only data for the currently married women were extracted and filtered by the experience of child mortality ($n = 6,256$) and those who do not have such experience ($n = 9,809$). Overall, 16,065 women were covered. Cross-tabulation and binary logistic regression techniques were employed in the statistical analysis. The cross-tabulation analysis shows that that mortality rate was highest (49.14%) for children of illiterate mothers and lowest (13.29%) among mothers with higher education. In the logistic regression analysis, education of both parents and occupation of mothers were found statistically significant to reduction in child mortality rate. The result also revealed that mothers' wealth index, age at first birth and usual of place of residence have substantial impact on child mortality in Nigeria. The authors suggested that increase in women education could increase age at first birth and mitigate the risk of poor child health outcomes.

Key words: Child mortality, predictors, wealth index, logistic regression

Introduction

The main tenets of the fourth and fifth Millennium Development Goal (MDG 4 and 5) are to reduce under-five mortality rate and improvement in maternal health which by implication increases the chance of child survival. Child mortality is a fundamental measurement of a country's level of socio-economic development as well as the quality of life especially of the mothers. Under-five mortality rate ($5q_0$) represents the probability of a child who survives to age one, dying between age one and age five (Adlakha & Suchindra, 1984; National Population Commission and ICF Macro, 2009; World Health Organisation (WHO), 2011). Almost half of the child mortality (42%) in the world occurs in Africa and about 25,000 under-five children that die each day are concentrated in sub-Saharan Africa and South Asia (WHO, 2011). Under-five mortality rate (U5MR) is generally 29 times higher in developing nations compared to developed countries (Black & Liu, 2012; Gambrah & Adzadu, 2013; Marx, Coles, Prysones-Jones, Johnson, Augustin, Mackay, Bery, Hammond, Nigmann, Sommerfelt *et al*, 2005). Globally, under-five mortality has dropped significantly by almost 45 percent between 2009 and 2011 but this progress is not the reality for all countries. Despite much progress in advanced countries, Nigeria has failed to make significant progress in checking the rising mortality rate among the under-five. Currently, about half of the world's under-five deaths occur in Nigeria, India, Congo, Pakistan and China (National Bureau of Statistics (NBS), 2011; World Bank, 2013).

Statistics revealed that up to 20 per cent of child deaths in sub-Saharan Africa still occur in Nigeria. Also, the Multiple Indicator Cluster Survey (MICS4) report indicated that under-five mortality in Nigeria increased from 138 per 1,000 live births in 2007 to 158 per 1,000 live births in 2011 (National Bureau of Statistics (NBS), 2011; World Bank, 2013).

Under-five mortality rates within Africa also vary. In some countries, one-quarter to one-third of children die before reaching the age of five. Also, within the under-five age group, there are specific periods of increased vulnerability. For instance, 60 percent of under-five mortality can be attributed to deaths that occur during the first year of life, of which the first 24 hours of life is the most vulnerable period, followed by the first week and then the first month (Marx *et al*, 2005). Among the suspected factors that have contributed to drastic reduction of under-5 mortality in advanced economies include but not limited to improvement in socio-economic and environmental conditions and strategic implementation of child survival interventions (Finlay, Özaltın & Canning, 2011; Kyei, 2011; United Nations Children's Fund, 2010, 2011, 2012). Child mortality can be associated with two categories of acquired ailments: one is a heavy load of infectious diseases and the other, those diseases that are caused by inadequate nutrition (Cooper, Hickson, Mitchel, Edwards, Thapa & Ray, 1999; Katona & Katona-Apte, 2008). Socio-economic factors including immunizations, exclusive breastfeeding and the adoption and usage of insecticide-treated nets have been revealed by several studies have strong predictors of child mortality especially in the developing countries. Included among these proximate determinants are the risk of morbidity and mortality, education of mother, sanitation facilities, access to safe drinking water and maternal and child health care services (Uddin, Hossain & Ullah, 2008). However, despite these known factors, under-5 mortality rate in sub-Saharan Africa is abysmally far above the prevalent rate in other countries of the world. The study therefore attempt to consider Nigeria case in isolation and bring to fore the various predictors of under-5 mortality as evidenced by Nigerian Demographic Health Survey (NDHS) data (National Population Commission and ICF Macro, 2009).

Objective of the Study

This study examined the predictors of child mortality in Nigeria using NDHS 2008 dataset. The specific objective of this study was to identify the factors affecting child mortality and to address the policy implications in order to reduce child mortality in Nigeria.

Literature Review

Under-five mortality rate (U5MR) is the probability of a child born in a specified year dying before reaching the age of five if subject to current age-specific mortality rates and expressed as a rate per 1,000 live births (United Nations Children's Fund, 2012; UN Inter-agency Group for Child Mortality Estimation, 2013). It also refers to as the death of infants and children under the age of five. Child mortality has remained a national and global concern and its import in socio-economic rating of country's development cannot be overemphasised. Sub-Saharan Africa and Southern Asia face the greatest challenges in child survival, and currently accounted for more than 80 per cent of global under-five deaths (United Nations Children's Fund, 2012). Several factors had been identified as contributors to the increasing levels of child mortality in most developing countries. Studies have shown that there is a close relationship between educational attainment and lower mortality rates (Antai, 2011; Fayehun & Omolulu, 2009; National Population Commission and ICF Macro, 2009). This was further established through the results

in the Nigeria Demographic and Health Survey (NDHS) Report (2009), that children born to mothers with no education have the highest under-five mortality rates (209 deaths per 1,000 live births), while mothers with secondary education have 68 per 1,000 live births.

Although, there are vagaries of statistics and estimations for child mortality for different countries and the world by different sources, the patterns and trends are specifically similar. Among the general patterns is that the global under-five mortality rate has declined by almost 47 percent between 1990 and 2012 (measuring 90 deaths per 1,000 live births in 1990 and 48 in 2012) while the trend in sub-Saharan Africa is apt to increase (United Nations Inter-agency Group for Child Mortality Estimation (2013)). Globally, several causes of under-five mortality were noted among which are: pneumonia which contribute up to 17 percent of the entire death, preterm birth complications that cause about 15 percent of child death, intrapartum-related complications (10 percent), diarrhoea (9 percent) and up to seven percent due to malaria (United Nations Inter-agency Group for Child Mortality Estimation, 2013). Also, a survey carried out in Bangladesh shows that child mortality rate was highest (1.64%) for the children of illiterate mothers and lowest (0.54%) for the children whose mother's educational level is secondary and above (Uddin, Hossain & Ullah, 2009). Educated mothers are more likely than non-literate mothers to ensure a healthy environment, nutritious food, and have better knowledge about reproductive health at conception and health care facilities for their children. Literate mothers will give birth to healthier babies because they themselves tend to be healthier and are likely to experience lower mortality among their children at all ages (Pandey, 2009).

Several of diseases causing child mortality have connections with hygiene condition and unclean environment these are not limited to dirty feeding bottles, utensils, inadequate disposal of household refuse, poor storage water, to mention but few (Jinadu, Olusi, Agun & Fabiyi, 1991; NBS, 2011). Other reports have shown that maternal education is a significant factor influencing child survival (Caldwell, 2009; Osonwa, Iyam, & Osonwa, 2012). Children from poorer or rural households are reported to be more vulnerable than their counterparts from other regions (United Nations Children's Fund, 2010). A child born to a financially deprived and less educated family is at risk of perinatal death or within the first month of life. The reasons for these are obvious since the mother may be poorly nourished during pregnancy, had little or no antenatal care and likely to deliver in ill-equipped health facility. Besides, the level of competition over resources when the family is large could enhance poor care among the family members including the very young ones. All these factors are further aggravated by limited access to health services due to poor income and low levels of maternal education, often leading to the non-immunization of the child (Policy Project/Nigeria, 2002).

Data and Methods

The data for this study was extracted from the 2008 Nigeria Demographic and Health Survey (NDHS). The dataset is a nationally representative cross-sectional data collated through face-to-face interviews among 33,385 women age 15-49 in 2008. The sampling technique followed a stratified two-stage cluster procedures. The 2008 NDHS is the fourth comprehensive survey conducted in Nigeria as part of the Demographic and Health Survey (DHS) programmes. The data provide information on levels and trends in fertility; nuptiality; sexual activity; fertility preferences; awareness and use of family planning methods; infants and young children feeding

practices; nutritional status of mothers and young children; early childhood mortality and maternal mortality; maternal and child health; and awareness and behaviour regarding HIV/AIDS and other sexually transmitted infections. The targeted respondents in this study were currently married women who had experienced child mortality (6,256) and those who have not (9,809). Overall, 16,065 women were extracted. The associations between child mortality and socio-economic, demographic and maternal health care variables were tested by cross-tabulation analysis. Also, binary logistic regression approach was used to estimate the effects of each variable while controlling for others. The outcome variable is the occurrence of under-five mortality, derived from the difference between total children ever born (CEB) in the last five year and number of living children aged 0-4 years. The analysis controlled for births within the last five years before the survey. The proportions who have never lost any child are coded as zero (0) while those who have experienced under-five mortality are coded as 1. The dummy codes thus made the data suitable for binary logistics estimation. One model was formulated and it only considered all the covariates that were found significant in cross-tabulation analysis and is denoted as:

$$\text{Ln} \left\{ \frac{Y_2}{(1-Y_2)} \right\} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \dots \beta_k X_k \dots \dots \dots (1)$$

Where,

$\beta_0, \beta_1 \dots \beta_k$ are the unknown parameters of the model estimated by likelihood techniques in SPSS and $\text{Ln} \left\{ \frac{Y_2}{(1-Y_2)} \right\}$ is the outcome variable. It represents the log-odds of under-5 mortality. A change in the value of any X will indicate the likelihood of change in $\text{Ln} \left\{ \frac{Y_2}{(1-Y_2)} \right\}$ given that other Xs are constant. The X's are the covariates from the cross tabulation that range from respondent education and occupation to age at first birth.

Results and Discussions

The distributions of child mortality by socio economic and demographic variables are presented in Table 1. Among the socio-economic variables, maternal education has a strong relationship ($\chi^2 = 0.000$) with child mortality and child survival. Several studies have supported direct causal relationship between mother's education and child mortality (Osonwa *et al*, 2012; Caldwell, 2009). The result indicated that child mortality rate was highest (49.14%) among the illiterate mothers and lowest (13.29%) among mothers with tertiary education. Thus, child mortality rate decreases as mother's education increases. Similar patterns were observed among the fathers. Father's education plays significant role on child mortality, highest among the illiterate fathers and the converse holds for literate fathers as shown in Table 1. Father's level of education most times can be regarded as a valid proxy of income and wealth status of households in Nigeria. It is likely that higher educated people belong to higher economic class.

Table 1 also reflects that the highest number of deaths (38.1%) was observed for the illiterate fathers and the lowest number of deaths (11.6%) was observed for fathers who have higher education. This result shows that child mortality sharply decreases as father's educational level increases. Therefore, it could be assumed that the risk of child mortality is low for children whose parents are educated. The highest child mortality rate (44.21%) was found among the

children whose mothers were in agricultural employment (Table 1). While manual work accounts for 43.50%, the lowest (17.46%) was observed for mothers who were professionals. Father's occupation is also one of the important socio-economic characteristics influencing child mortality as observed from the result of the analysis. The child mortality rate (45.35%) was found highest for the children whose father's occupation was in agricultural sector and the rate was found low (29.02%) for children whose fathers are engaged in professional, technical or managerial related occupations (see Table 1).

Table 1: Selected socio-economic and demographic characteristics of respondents by number of living and non-living children

Selected Variables	Number of Children		Total	Percent of Death	Chi-square
	Alive	Dead			
Respondent Education					
No Education	3811 (38.9)	3681 (58.8)	7491 (46.6)	49.14	976.2**
Primary	2134 (21.8)	1469 (23.5)	3602 (22.4)	40.78	
Secondary	3022 (30.8)	978 (15.6)	4000 (24.9)	24.45	
Higher	843 (8.6)	129 (2.1)	971 (6.1)	13.29	
Spouse Education					
No Education	3052 (31.1)	3060 (48.9)	6113 (38.1)	50.06	757.3**
Primary	2020 (20.6)	1446 (23.1)	3466 (21.6)	41.72	
Secondary	3285 (33.5)	1328 (21.2)	4613 (28.7)	28.79	
Higher	1451 (14.8)	422 (6.7)	1873 (11.6)	22.53	
Respondent Occupation					
Not working	3089 (31.5)	1705 (27.3)	4794 (29.8)	35.57	220.3**
Professionals	449 (4.6)	95 (1.5)	544 (3.4)	17.46	
Clerical/Sales	3310 (33.8)	2302 (36.8)	5612 (34.9)	41.02	
Service	421 (4.3)	164 (2.6)	585 (3.6)	28.03	
Agric Employment	1532 (15.6)	1214 (19.4)	2746 (17.1)	44.21	
Manual	1007 (10.3)	776 (12.4)	1784 (11.1)	43.50	
Spouse Occupation					
Professionals	1047 (10.7)	428 (6.8)	1475 (9.2)	29.02	237.8**
Clerical/Sales	2018 (20.6)	1235 (19.7)	3253 (20.3)	37.97	
Service	1399 (14.3)	677 (10.8)	2076 (12.9)	32.61	
Agric Employment	3617 (36.9)	3002 (48.0)	6619 (41.2)	45.35	
Manual	1727 (17.6)	914 (14.6)	2641 (16.4)	34.61	
Religion					
Catholic	968 (9.9)	480 (7.7)	1447 (9.0)	33.17	313.7**
Other Christian	3729 (38.0)	1646 (26.3)	5375 (33.5)	30.62	
Islam	4968 (50.5)	4031 (64.4)	8999 (56.0)	44.79	
Traditional	144 (1.5)	100 (1.6)	244 (1.5)	40.98	
Family Size					
Small 2-4	4575 (46.6)	1717 (27.5)	6292 (39.2)	27.29	820.8**
Medium 5-7	4160 (42.4)	3029 (48.4)	7189 (44.8)	42.13	
Big 8+	1074 (11.0)	1510 (24.1)	2584 (16.1)	58.44	
Wealth Index					
Poorest	1926 (19.6)	1828 (29.2)	3753 (23.4)	48.71	790.3**
Poorer	1862 (19.0)	1715 (27.4)	3577 (22.3)	47.95	
Middle	1766 (18.0)	1232 (19.7)	2997 (18.7)	41.11	
Richer	1955 (19.9)	905 (14.5)	2860 (17.8)	31.64	
Richest	2300 (23.5)	577 (9.2)	2877 (17.9)	20.06	
Age of Mother					
15-24	3072 (31.3)	906 (14.5)	3978 (24.8)	22.78	1191.6**
25-34	4914 (50.1)	2784 (44.5)	7698 (47.9)	36.17	
35+	1823 (18.6)	2566 (41.0)	4389 (27.3)	58.46	
Age at first birth					
18 years or less	4011 (40.9)	3752 (60.0)	7762 (48.3)	48.34	569.1**
19 years or more	5798 (59.1)	2504 (40.0)	8302 (51.7)	30.16	
Place of Residence					

Urban	3464 (35.3)	1380 (22.1)	4843 (30.2)	28.50	325.8**
Rural	6345 (64.7)	4876 (78.0)	11221 (69.9)	43.45	
Birth Order					
1-2	4575 (46.6)	632 (10.1)	5207 (32.4)	12.14	3946.6**
3-4	3259 (33.2)	1456 (23.3)	4714 (29.4)	30.89	
5 or more	1975 (20.1)	4169 (66.6)	6144 (38.2)	67.86	
TOTAL	9809 (100)	6256 (100)	16065 (100)		

Source: Authors' Computation, 2013

** Significant at 0.05

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Wealth index is another important differential factor of child mortality. Children born in households with low standard of living index (i.e. the poorest and poorer) experienced highest mortality with 48.71% and 47.95% respectively, compared to those who were born in households with very high standard of living index (20.06%). It can be conjectured that the relationship between mother's wealth index and child mortality is negative. From the total deaths estimation, 10.1% deaths were found for birth cohorts between first and second order, while 23.3% and 66.6% deaths were found for the birth order 3-4 and 5+ respectively. Child mortality rate is thus confirmed to be increasing steadily with birth order as shown in Table 1. The increase in the child mortality rate with birth order may reflect a more intense competition faced by higher birth order children in terms of care givers time, medical resources, and nutritious food which are required by children. All the variables in Table 1 were significantly related to incidence of child mortality.

Table 2, present the odd ratios, standard errors and the p-values for child mortality in the study country. The significant variables found in cross-tabulation analysis were considered as the covariates of the logistic regression analysis. Mother's education is one of the most important characteristics for child mortality, the result show that mothers who have primary, secondary and higher education are 0.86, 0.65 and 0.36 respectively are less likely to experience child mortality compared to their counterparts with no education. This result established previous findings, that children born to educated mothers are healthier and well nourished which reduces the risk of mortality among them (Antai, 2011; Fayehun & Omolulu, 2009). The risk of child mortality was found to be 14 percent and 26 percent lower for children whose fathers' have secondary and higher education respectively as compared to the children of fathers' who had no education (Table 2). Cursory observation shows that the risk of child mortality is decreasing as father's education increases. Hence, father's education is adjudged to have a significant effect on child mortality. In the cross tabulation analysis, father's occupation was found to have significant effect on child mortality, but in the logistic regression it was insignificant.

The risk of child mortality is 15%, 28% and 49% lower for children from households which can be classified as middle, richer and richest (respectively) compared to those from poor households. The result shows that children born in middle, richer and richest households are 0.85 times, 0.72 times and 0.51 times less likely to die, unlike those from very poor homes (Table 2). It can therefore, be conjectured that wealth index is a significant determinant of child mortality. This result is in tandem with findings in previous studies (Antai, 2011; Uddin *et al*, 2009).

Age at first birth of mother is another significant factor affecting child mortality indicated in this study. Mothers who had their first child at age 19 and above are 0.37 times less likely to experience child mortality compared with their counterparts who deliver at age 18 years or below. The result revealed that the risk of child mortality was 63% lower for mothers who started childbearing at a later age compared to those who started early (Table 2). Similar patterns were observed for age of mothers. Children born to mothers either at the very early or late reproductive age are more likely to experience high risk of death. Women in these two categories are more prone to ill-pregnancy outcome and poor child health outcome. Reason being that, at those age groups the risk of birth complications are higher (Finlay, Özaltin,

Canning, 2011; Katona & Katona-Apte, 2008; Kyei, 2011; National Population Commission (NPC), Nigeria and ICF Macro, 2009).

Table 2. Binary Logistic Regression Analysis of Under-five Mortality

Variables	Odds Ratio	S.E.	P-value	95% Confidence Interval	
				Lower Limit	Upper Limit
Respondent Education					
No Education	RC				
Primary	0.86	0.048	0.008	0.7741	0.9620
Secondary	0.65	0.045	0.000	0.5700	0.7462
Higher	0.36	0.050	0.000	0.2762	0.4763
Spouse Education					
No Education	RC				
Primary	1.01	0.055	0.914	0.9030	1.1207
Secondary	0.86	0.052	0.014	0.7659	0.9704
Higher	0.74	0.065	0.001	0.6209	0.6771
Respondent Occupation					
Not working	RC				
Professionals	1.09	0.158	0.565	0.8177	1.4457
Clerical/Sales	1.23	0.057	0.000	1.1198	1.3442
Service	1.07	0.116	0.561	0.8608	1.3186
Agric Employment	1.22	0.073	0.001	1.0852	1.3718
Manual	1.37	0.087	0.000	1.2076	1.5474
Spouse Occupation					
Professionals	RC				
Clerical/Sales	1.08	0.089	0.318	0.9245	1.2730
Service	0.92	0.082	0.371	0.7752	1.0997
Agric Employment	0.87	0.072	0.086	0.7381	1.0203
Manual	1.07	0.091	0.458	0.9013	1.2595
Religion					
Catholic	RC				
Other Christian	0.93	0.065	0.279	0.8081	1.0633
Islam	1.06	0.080	0.427	0.9157	1.2310
Traditional	0.78	0.122	0.113	0.574	1.0604
Wealth Index					
Poorest	RC				
Poorer	1.00	0.052	0.983	0.9026	1.1055
Middle	0.85	0.050	0.006	0.7580	0.9557
Richer	0.72	0.051	0.000	0.6251	0.8270
Richest	0.51	0.045	0.000	0.4307	0.6090
Age of Mother					
15-24	RC				
25-34	3.72	0.213	0.000	3.3236	4.1599
35+	11.79	0.894	0.000	10.1643	13.6797
Age at first birth					
18 years or less	RC				
19 years or more	0.37	0.016	0.000	0.3367	0.3988
Place of Residence					
Urban	RC				
Rural	1.14	0.058	0.009	1.0339	1.2595
Constant	0.43	0.056	0.000	0.3301	0.5518

Source: Authors' Computation, 2013

Significant at 0.05

Lastly, the result shows that children born to mothers who reside in rural areas are 1.14 times more likely to die compared to those who were born to mothers who live in urban centers. This observation could be considered a reality because mothers in urban area of the country of study may likely have access to good health facilities, pipe borne water, exposure to information, and other amenities of good living.

Conclusion and Recommendations

This study utilized the nationally representative data from the Nigeria Demographic and Health Survey, 2008 to investigate the predictors of child mortality in Nigeria. The body of evidence accumulated during the period shows the existence of a relationship between several characteristics of mothers and under-five mortality in Nigeria. Both cross-tabulation and binary logistic regression techniques have been applied to identify the important predictors of child mortality. Close observation that the logical or theoretical hypothesis raised in the study are supported by the crude result of cross-tabulation and reconfirmed as valid when subjected to analysis on refined technique of binary logistic regression. However, where there are variances, it is assumed to be due to interpretation and interrelationships between covariates.

The findings suggested that parents' education has been identified as the most important predictor of child mortality. The study indicates that occupation of fathers has no significant impact on child mortality but mothers' occupation played significant role in reducing the risk of child mortality. The association between child mortality and mothers' wealth index was found to have a significant effect on child mortality ($p\text{-value} = 0.000$). The age at first birth and age of mother were also observed to be statistically significant in determining the risk of under-five mortality in Nigeria. The child mortality was found lower for children whose mothers started childbearing at age 19 year and above and higher among those who were exposed to childbirth at ages below 18 years. To reduce the risk of child mortality in the country, there should be more investments on women empowerment programmes in terms of education and employment opportunities which could increase age at first birth and reduce poor health outcomes of the child.

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